HARWARD STREET PUMP STATION AND SEWER INTERCEPTOR UPGRADE

CITY OF BATH

BATH, MAINE

BIDDING/CONTRACT DOCUMENTS AND TECHNICAL SPECIFICATIONS

MAY 2025

21119

WRIGHT-PIERCE
Engineering a Better Environment

CITY OF BATH

BATH, MAINE

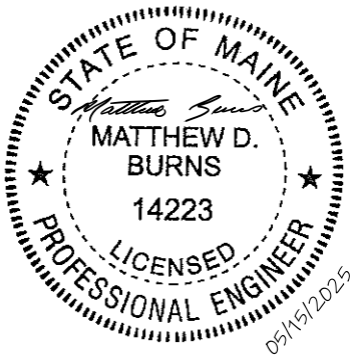
BIDDING/CONTRACT DOCUMENTS
AND TECHNICAL SPECIFICATIONS

FOR

HARWARD STREET PUMP STATION AND SEWER INTERCEPTOR UPGRADE

MAY 2025





Prepared By:

Wright-Pierce
11 Bowdoin Mill Island, Suite 140
Topsham, ME 04086
207-725-8721

TABLE OF CONTENTS

SECTION	TITLE
DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS	
00100	Advertisement for Bids
00200	Instructions to Bidders for Construction Contract
00410	Bid Form for Construction Contract
00430	Bid Bond Penal Sum Form (C-430 2018)
00450	Qualifications Statement (C-451 2018)
00510	Notice of Award (C-510 2018)
00520	Agreement Between Owner and Contractor for Construction Contract Stipulated Price (C-520 2018)
00550	Notice to Proceed (C-550 2018)
00610	Performance Bond (C-610 2018)
00615	Payment Bond (C-615 2018)
00800 SC 1 to 18	Supplementary Conditions (C-800 2018)
00800 SC-20	American Rescue Plan 2021 Requirements
00800 SC-20	Maine DEP (Rev Oct 2018)
00920	Certificate of Substantial Completion (C-625 2018)
00935	Notice of Acceptability of Work (C-626 2018)
00936	Consent of Surety to Final Payment
00937	Contractor's Affidavit
00938	Contractor's Release
00939	Waiver of Lien - Materials and Labor
00940	Work Change Directive (C-940 2018)
00941	Change Order (C-941 2018)
DIVISION 01 - GENERAL REQUIREMENTS	
01010	Summary of Work
01045	Cutting, Coring and Patching
01050	Coordination
01070	Abbreviations and Symbols
01100	Alternates
01150A	Measurement and Payment - Treatment Facility
01200	Project Meetings
01310	Construction Schedules
01320	Safety and Health Plan
01340	Submittals
01370	Schedule of Values
01380	Construction Photographs
01400	Quality Control
01500	Temporary Facilities and Controls
01515	Temporary Bypass Pumping
01520	Site Security
01562	Dust Control

SECTION	TITLE
01570	Traffic Regulations
01572	ME Construction General Permit for Stormwater (MCGP)
01600	Delivery, Storage and Handling
01710	Project Cleaning
01720	Project Record Documents
01800	Equipment Startup, Certification and Operator Training

DIVISION 02 - SITE CONSTRUCTION

02050A	Demolition
02076	AC Pipe Removal and Disposal
02080A	Contaminated Soil Waste Mgmt Outline
02110	Clearing and Grubbing
02115	Stripping and Stockpiling Topsoil
02140	Temporary Construction Dewatering System
02156	Temporary Excavation Support System
02170	Use of Explosives
02200	Earthwork
02225	Flowable Fill
02260	Filter Fabric
02270	Temporary Erosion Control
02485	Loaming & Seeding
02513A	Bituminous Concrete Paving (Maine)
02525	Granite Curbs
02527	Bituminous Concrete Curbs
02577	Pavement Markings (ME)
02601	Manholes, Covers and Frames
02610	Rigid Board Insulation for Pipe in Trenches
02615	Ductile Iron Pipe & Fittings (Buried Applications)
02622	Polyvinyl Chloride (PVC) Non Pressure Pipe
02623	Underdrain Pipe
02650	Buried Utility Markings
02654	Pipe Installation Under Railroad Tracks
02655	Couplings & Connectors (Buried Applications)
02656	Air Release Valves
02751	Sewer Flow Control
02752	Sewer Line Cleaning
02753	Television Inspection of Sewers
02755	Final Sewer Testing
02760	Cleaning and Pigging Force Main

DIVISION 03 - CONCRETE

03010	Concrete Modifications and Repairs
03100	Concrete Forming
03150	Concrete Accessories
03155	Concrete Post-Installed Anchors and Reinforcement
03200	Concrete Reinforcement

TABLE OF CONTENTS (CONT.)

SECTION	TITLE
03300	Cast-In-Place Concrete
03305	Concrete Testing
03320	Concrete Placement
03340	Cold Weather Concreting
03341	Hot Weather Concreting
03350	Concrete Finishing
03390	Concrete Curing
03420	Precast Concrete Structures
03604	Non-Shrink Grout
DIVISION 04 - MASONRY	
04200	Unit Masonry
DIVISION 05 - METALS	
05500	Metal Fabrications
DIVISION 06 - WOOD AND PLASTICS	
06100	Rough Carpentry
DIVISION 07 - THERMAL AND MOISTURE PROTECTION	
07150	Dampproofing
07214	Rigid Insulation
07311	Asphalt Shingles
07920	Joint Sealants
DIVISION 08 - DOORS AND WINDOWS	
08310	Floor Access Doors
08392	Pedestrian Flood Doors and Frames
08540	Fiberglass Windows
DIVISION 09 - FINISHES	
09900	Painting
09905	Shop Coatings
DIVISION 10 - SPECIALTIES	
10140	Signage

TABLE OF CONTENTS (CONT.)

SECTION	TITLE
DIVISION 11 - EQUIPMENT	
11000	Equipment - General
11310	Pumps - General
11311C	Self-Priming Non-Clog Centrifugal Pumps
DIVISION 13 - SPECIAL CONSTRUCTION	
13410	Instrumentation and Control - General
13440	Instruments
13441	Control Loop Descriptions
13442	Programmable Logic Controllers
13444	Control Panels
DIVISION 14 - CONVEYING SYSTEMS	
14320	Hoist Systems
DIVISION 15 - MECHANICAL	
15050	Pipe and Pipe Fittings - General
15062	Ductile Iron Pipe & Fittings (Interior Applications)
15088	Couplings & Connectors
15092	Pipe Sleeves & Seals
15094	Pipe Hangers, Supports, & Bracing
15100	Valves & Specialties - General
15101	Gate Valves
15110	Check Valves
15124	Stainless Steel Slide Gates and Frames
15400	Plumbing - General
15401	Plumbing, Piping and Specialties
15423	Electric Water Heater
15450	Plumbing Fixtures and Trim
15492	Submersible Sump Pump
15600	HVAC - General
15604	Automatic Temperature Control (Electric)
15766	Electric Unit Heaters
15820	Ventilation Fans
15840	Ductwork and Devices
15862	Dampers
15869	Louvers
15907	Testing and Balancing Heating and Ventilating Systems

SECTION TITLE

DIVISION 16 - ELECTRICAL

16000 Electrical - Pump Stations
16073 Short Circuit Coordination and Arc Flash Study
16075 Conduit, Cable, and Wiring Identification and Tagging
16620D Standby Power System - Diesel

APPENDICES

A Geotechnical Explorations Findings - Northern Test Borings
B 2008 Subsurface Investigation Report - Soil Metrics LLC
C 2024 Contaminated Soils Information
D Forcemain Record Drawings
E Permits

SECTION 00100

ADVERTISEMENT FOR BIDS

The City of Bath
Bath, ME
Harward Street Pump Station and Sewer Interceptor Upgrade

General Notice

The City of Bath (Owner) is requesting Bids for the construction of the following Project:

Harward Street Pump Station and Sewer Interceptor Upgrade

Bids for the construction of the Project will be received at the Bath City Hall located at 55 Front Street, Bath, Maine until Tuesday, July 1, 2025 at 2:00 PM local time. At that time the Bids received will be publicly opened and read.

The Project includes the following Work:

Upgrades to the pump station process equipment, installation of a new gravity sewer interceptor, floodproofing, and ancillary systems.

Obtaining the Bidding Documents

The Issuing Office is Wright-Pierce. Information and Bidding Documents for the Project can be found at the following designated website: [https://www.wright-pierce.com/projects]

Bidding Documents may be downloaded from the designated website at a cost of $65 per download.

To be considered a responsive Bidder, the Bidder shall have obtained at least one set of Bidding Documents from the Issuing Office using the name that is to appear on the Bid Form. The designated website will be updated periodically with addenda, lists of plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website. It is the Bidder's responsibility to check the designated website for addenda.

Pre-bid Conference

A pre-bid conference for the Project will be held on June 11, 2025 at 1:00 PM at the Pump Station (1438 Washington Street, Bath, Maine). Attendance at the pre-bid conference is encouraged but not required.

Instructions to Bidders

For all contract requirements regarding funding agency notifications, funding agency requirements, bid submittal, qualifications, procedures, and contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

The Owner reserves the right to waive any informality in or to reject any or all Bids if deemed to be in its best interest.

This Advertisement is issued by:

Owner:	The City of Bath	Date:	May 21, 2025
By:	Chris Wallace	Title:	City of Bath Public Works Director

END OF SECTION

EJCDC® C-111, Advertisement for Bids for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00200

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

TABLE OF CONTENTS

Page

Article 1— Defined Terms 1
Article 2— Bidding Documents 1
Article 3— Qualifications of Bidders 2
Article 4— Pre-Bid Conference 3
Article 5— Site and Other Areas; Existing Site Conditions; Examination of Site; Owner's Safety Program; Other Work at the Site 3
Article 6— Bidder's Representations and Certifications 5
Article 7— Interpretations and Addenda 6
Article 8— Bid Security 6
Article 9— Contract Times 7
Article 10— Substitute and "Or Equal" Items 7
Article 11— Subcontractors, Suppliers, and Others 7
Article 12— Preparation of Bid 8
Article 13— Basis of Bid 9
Article 14— Submittal of Bid 9
Article 15— Modification and Withdrawal of Bid 10
Article 16— Opening of Bids 10
Article 17— Bids to Remain Subject to Acceptance 10
Article 18— Evaluation of Bids and Award of Contract 10
Article 19— Bonds and Insurance 11
Article 20— Signing of Agreement 12
Article 21— Sales and Use Taxes 12
Article 22— Contracts to Be Assigned 12
Article 23— DELETION OF ITEMS 12
Article 24— federal requirements 12
Article 25— SPECIAL LEGAL REQUIREMENTS 12

EJCDC® C-200, Instructions to Bidders for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions.

1.02 Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders.

B. Deleted.

ARTICLE 2—BIDDING DOCUMENTS

2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

2.03 Owner has established a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a plan holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.

2.04 Deleted.

2.05 Deleted.

2.06 *Electronic Documents*

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf). It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

C. After the Contract is awarded, the Owner will provide or direct the Engineer to provide for the use of the Contractor documents that were developed by Engineer as part of the Project design process, as Electronic Documents in native file formats.

1. Electronic Documents that are available in native file format include:

a. Construction Drawings

2. Release of such documents will be solely for the convenience of the Contractor. No such document is a Contract Document.

3. Unless the Contract Documents explicitly identify that such information will be available to the Successful Bidder (Contractor), nothing herein will create an obligation on the part of the Owner or Engineer to provide or create such information, and the Contractor is not entitled to rely on the availability of such information in the preparation of its Bid or pricing of the Work. In all cases, the Contractor shall take appropriate measures to verify that any electronic/digital information provided in Electronic Documents is appropriate and adequate for the Contractor's specific purposes.

4. In no case will the Contractor be entitled to additional compensation or time for completion due to any differences between the actual Contract Documents and any related document in native file format.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 Deleted.

3.02 Deleted.

3.03 *To demonstrate Bidder's qualifications to perform the Work, each Bidder must submit with its bid a completed Qualifications Statement (Section 00450) and such other data as may be called for below or in the Supplementary Conditions. Each Bid must contain evidence of the Bidder's qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of contract.*

3.04 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.05 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

3.06 To be considered a responsive Bidder, the Contractor shall have obtained at least one set of Bidding Documents from the Issuing Office. The Bid will not be awarded to a Bidder unless a record for obtaining at least one set of Bidding Documents exists in the Issuing Office. To meet

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

this requirement and to establish the record of receipt, a prospective Bidder must obtain Bidding Documents using the name that is to appear on the Bid Form.

ARTICLE 4—PRE-BID CONFERENCE

4.01 Deleted.

4.02 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.

4.03 Deleted.

4.04 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

5.01 *Site and Other Areas*

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 *Existing Site Conditions*

A. *Subsurface and Physical Conditions; Hazardous Environmental Conditions*

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:

a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.

c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

d. Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

5.03 *Other Site-related Documents*

A. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:

1. Drawings dated August 1969 prepared by Fay. Spofford & Thorndike Inc., Engineers., Boston, MA., entitled: Pump Stations – Bath – Contract 2, consisting of 8 sheets numbered Sheet No.24 to Sheet No.30.

2. Drawings dated June 1982 prepared by Wright-Pierce, Topsham, ME., entitled City of Bath, Maine Sewer System Separation Projects, consisting of 23 sheets, numbered Sheet No.1 to Sheet No. 23.

3. Drawings dated March 1997 prepared by Environmental Engineering & Remediation, Inc., Portland, ME., entitled City of Bath, Maine Harward Street Pump Station Upgrade, consisting of 10 sheets, numbered Sheet No.1 to Sheet No.10.

4. Drawings dated February 2014 prepared by Ransom Environmental Consultants, Inc., Portland, ME., and Oak Engineers., Portland, ME., entitled Washington Street Forcemain Replacement, consisting of 13 sheets, numbered Sheet No.1 to Sheet No.13.

5. Drawings dated April 2008 prepared by Ransom Environmental Consultants, Inc., Portland, ME., entitled Juniper/Park Street Sanitary Sewer Modifications, consisting of 1 sheet, numbered Sheet C-103.

Owner will make copies of these other Site-related documents available to any Bidder on request.

B. Owner has not verified the contents of these other Site-related documents, and Bidder may not rely on the accuracy of any data or information in such documents. Bidder is responsible for any interpretation or conclusion Bidder draws from the other Site-related documents.

C. The other Site-related documents are not part of the Contract Documents.

D. Bidders are encouraged to review the other Site-related documents, but Bidders will not be held accountable for any data or information in such documents. The requirement to review and take responsibility for documentary Site information is limited to information in (1) the Contract Documents and (2) the Technical Data.

E. No other Site-related documents are available.

EJCDC® C-200, Instructions to Bidders for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.04 *Site Visit and Testing by Bidders*

A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.

B. A Site visit is scheduled immediately following the pre-bid conference.

C. Bidders visiting the Site are required to arrange their own transportation to the Site.

D. All access to the Site other than during a regularly scheduled Site visit must be coordinated through the following Owner or Engineer contact for visiting the Site: Bryan Levitt, WPCF Superintendent (207-443-8348). Bidder must conduct the required Site visit during normal working hours.

E. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

F. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.

G. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

H. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 *Owner's Safety Program*

A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.06 *Other Work at the Site*

A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

review these representations and certifications, and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

ARTICLE 7—INTERPRETATIONS AND ADDENDA

7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.

7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:

A. Maeve Carlson, maeve.carlson@wright-pierce.com, 207-319-1511.

7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received less than seven working days prior to the date for opening of Bids may not be answered. Addenda will be issued not later than five working days before the bid opening. Bidders are responsible for determining that they have received all Addenda issued.

7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such Bid bond will be issued in the form included in the Bidding Documents. Bid security must be at least 5% of the Bidder's maximum Bid price.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 Deleted.

9.03 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.

10.02 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

10.03

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

11.02 If requested by owner, the apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:

11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and

EJCDC® C-200, Instructions to Bidders for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.

12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.

12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.

12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.

12.06 A Bid by an individual must show the Bidder's name and official address.

12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.

12.08 All names must be printed in ink below the signatures.

12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.

12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 *Lump Sum with Unit Prices and Alternates*

A. Bidders must submit a Bid on a lump sum basis for each lump sum item, and on a unit price basis for each unit price item of Work listed in the Bid Form for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.

B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the Bidder. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

D. The total of all unit price "Bid Prices" and all lump sum items will be used by Owner for Bid comparison purposes.

13.02 *Allowances*

A. For cash allowances the Bid price must include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 14—SUBMITTAL OF BID

14.01 Deleted.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement.

14.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids.

15.03 ~~If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.~~ Deleted.

ARTICLE 16—OPENING OF BIDS

16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes

EJCDC® C-200, Instructions to Bidders for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.

18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.

18.05 *Evaluation of Bids*

A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner will announce to all bidders a "Base Bid plus alternates" budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.

C. Deleted.

D. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.

E. Deleted.

F. Deleted.

18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

18.08 Deleted.

ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds, other required bonds (if

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.

19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

19.03 Deleted.

ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

21.01 Owner is exempt from Maine state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes must not be included in the Bid. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information.

ARTICLE 22—CONTRACTS TO BE ASSIGNED

Not used.

ARTICLE 23—DELETION OF ITEMS

23.01 Owner reserves the right to reduce project scope by the elimination of Bid items, reduction of quantities on unit price Bid items, or deleting elements of lump sum Bid items. No adjustment to other Bid items prices will be permitted. In the case of reduction of quantities on unit price items, the unit price will not be adjusted. Such adjustments to project scope will be determined prior to award of the Contract and will be negotiated with the apparent Successful Bidder only. If such negotiations are not satisfactory to Owner, Owner will reject all Bids

ARTICLE 24—FEDERAL REQUIREMENTS

24.01 If the contract price is in excess of $100,000, provisions of the Contract Work Hours and Safety Standards Act at 29 CFR 5.5(b) apply.

24.02 Federal requirements at Article 19 of the Supplementary Conditions apply to this Contract.

ARTICLE 25—SPECIAL LEGAL REQUIREMENTS

Not used.

END OF SECTION

EJCDC® C-200, Instructions to Bidders for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00410

BID FORM FOR CONSTRUCTION CONTRACT

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

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to:

City of Bath

55 Front Street

Bath, ME 04530

Harward Street Pump Station and Sewer Interceptor Upgrade

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

ARTICLE 2—ATTACHMENTS TO THIS BID

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

A. Required Bid security;

B. List of Proposed Subcontractors;

C. List of Proposed Suppliers;

D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids;

E. Required Bidder Qualification Statement with supporting data;

ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 *Base Bid Items*

A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum, unit price and allowance items.

B. Bidder acknowledges that:

1. each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and

2. estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities, determined as provided in the Contract Documents (estimated "*").

EJCDC® C-410, Bid Form for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Item No.	Description	Unit	Quantity	Bid Unit Price	Bid Amount
1	Harward Street Pump Station Upgrade	Lump Sum	1	-	$
2	Additional Earthwork – Excavation and Disposal at Pump Station Site Only	CY*	25		$
3	Crack Repair of Existing Concrete Tanks and Structures	LF*	20		$
4	Repair Surface Defects in Existing Concrete Tanks and Structures	SF*	1300		$
5	Utility Service Allowance	Allowance	1	$32,500	$32,500
6	Wetwell Solids and Debris Removal	CY*	15		$
7	Mobilization/Demobilization	Lump Sum	1	-	$
8	Traffic Control	Lump Sum	1	-	$
9	Uniformed Police Officers	Allowance	1	$2,500	$2,500
10	10" PVC Sewer Pipe	LF*	50		$
11	24" PVC Sewer Pipe	LF*	725		$
12	36" PVC Sewer Pipe	LF*	4,050		$
13	Installation of Owner-Purchased 36" PVC Sewer Pipe	LF*	1,200		$
14	Sanitary Service Connections Within Mainline Trench	LF*	285		$
15	Sanitary Service Connections Beyond Mainline Trench	LF*	295		$
16	4' Diameter Manhole	VF*	50		$
17	5' Diameter Manhole	VF*	360		$
18	6' Diameter Manhole	VF*	150		$
19	Manhole – Install Interior Drop Connections	VF*	100		$
20	Pipe Trench Insulation	LF*	500		$
21	Trench Excavation - Ledge	CY*	1,500		$
22	Test Pit Excavation and Backfill	Each*	20		$
23	Excavation Below Grade and Backfill	CY*	350		$
24	Replacement of Unsuitable Material Above Pipe Bedding and Initial Backfill	CY*	500		$

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Item No.	Description	Unit	Quantity	Bid Unit Price	Bid Amount
25	Loaming, Seeding, & Restoration	Lump Sum	1	-	$
26	Initial Pavement – Binder Course	Tons*	675		$
27	Final Pavement – Surface Course	Tons*	285		$
28	Driveway Pavement Along Sewer Route	Tons*	50		$
29	Driveway Pavement – Type I	Tons*	15		$
30	Driveway Pavement – Type II	Tons*	10		$
31	Walkway Pavement	Tons*	5		$
32	Replacement of Bituminous Curb	LF*	20		$
33	Removal and Reinstallation of Granite Curb	LF*	125		$
34	Removal of Tree Stumps	Each*	25		$
35	Sewer Pipe Cleaning / Decommissioning	LF*	2,000		$
36	Asbestos Cement Pipe Removal and Disposal	LF*	1200		$
37	Existing Sewer Main and Manholes – Abandonment and Flowable Fill	CY*	80		$
38	Installation of Pipe Below Railroad Tracks	Lump Sum	1	-	$
39	Bypass Pumping of Collection System Wastewater Flows	Lump Sum	1	-	$
40	Management of Contaminated Materials and Soils/Fill	Lump Sum	1	-	$
41	Contaminated Soil Excavation with Offsite Disposal and Replacement Backfill	Tons*	50		$
42	Contaminated Groundwater Handling and Disposal	Days*	3		$
43	Clean Existing 14” and 16” Force Main	Lump Sum	1	-	$
44	CSO Structure (SMH-133)	Lump Sum	1	-	$
Total Base Bid			$		

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

3.02 Bid Alternates

A. Bidder will complete the Work in accordance with the Contract Documents for the following bid alternate items.

Alternate A – Office Drive Rebuild					
Item No.	Description	Unit	Quantity	Bid Unit Price	Bid Amount
A1	Remove and Dispose of Pavement and Earth Excavation on Office Drive	SY*	1500		$
A2	Office Drive Binder Course Pavement	Tons*	200		$
A3	Office Drive Surface Course Pavement	Tons*	120		$
A4	Walkway Pavement Along Office Drive	Tons*	5		$
A5	Driveway Pavement Along Office Drive	Tons*	15		$
A6	Office Drive Aggregate Subbase Course Type “D”	CY*	100		$
A7	Office Drive Aggregate Base/Surface Course Type “A”	CY*	20		$
A8	6” Underdrain	LF*	40		$
Total Bid Alternate A ADD			$		

3.03 *Total Bid (Base Bid Plus All Bid Alternates)*

Total Bid (Total of all Lump Sum and Unit Price Bids)	$

The basis of award will be the Base Bid.

ARTICLE 4—DELETED

ARTICLE 5—DELETED

ARTICLE 6—TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

6.02 Deleted.

6.03 Deleted.

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

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 7—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

7.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

7.02 *Instructions to Bidders*

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

7.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 8—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

8.01 *Bidder's Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work, including all Domestic Preference requirements.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

8.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
    a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
    b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
    c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
    d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

EJCDC® C-410, Bid Form for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

BIDDER hereby submits this Bid as set forth above:

Bidder:

_____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

Address for giving notices:

_____

_____

Bidder's Contact:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Phone: _____

Email: _____

Address:

_____

_____

_____

Bidder's Contractor License No.: (if applicable) _____

END OF SECTION

EJCDC® C-410, Bid Form for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00430

BID BOND (PENAL SUM FORM)

Bidder Name: [Full formal name of Bidder] Address *(principal place of business)*: [Address of Bidder's principal place of business]	Surety Name: [Full formal name of Surety] Address *(principal place of business)*: [Address of Surety's principal place of business]
Owner Name: [Full formal name of Owner] Address *(principal place of business)*: [Address of Owner's principal place of business]	Bid Project *(name and location)*: [Owner project/contract name, and location of the project] Bid Due Date: [Enter date bid is due]
Bond Penal Sum: [Amount] Date of Bond: [Date]	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder _____ *(Full formal name of Bidder)* By: _____ *(Signature)* Name: _____ *(Printed or typed)* Title: _____ Attest: _____ *(Signature)* Name: _____ *(Printed or typed)* Title:	Surety _____ *(Full formal name of Surety) (corporate seal)* By: _____ *(Signature) (Attach Power of Attorney)* Name: _____ *(Printed or typed)* Title: _____ Attest: _____ *(Signature)* Name: _____ *(Printed or typed)* Title:
Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.	

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.

EJCDC® C-430, Bid Bond (Penal Sum Form).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation will be null and void if:

   3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

   3.2. All Bids are rejected by Owner, or

   3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.

6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.

7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF SECTION

EJCDC® C-430, Bid Bond (Penal Sum Form).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00450

QUALIFICATIONS STATEMENT

ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business's organizational structure:

Form of Business:	☐ Sole Proprietorship ☐ Partnership ☐ Corporation		
☐ Limited Liability Company ☐ Joint Venture comprised of the following companies:			
	1.		
	2.		
	3.		
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?	☐ Yes ☐ No ☐ Pending		
Identify all		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			

EJCDC C-451, Qualifications Statement.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1.03 Provide information regarding the Business's officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	

ARTICLE 2—LICENSING

2.01 Provide information regarding licensure for Business:

Name of License:			
Licensing Agency:			
License No:		Expiration Date:	
Name of License:			
Licensing Agency:			
License No:		Expiration Date:	

ARTICLE 3—DIVERSE BUSINESS CERTIFICATIONS

3.01 Provide information regarding Business's Diverse Business Certification, if any. Provide evidence of current certification.

Certification	Certifying Agency	Certification Date
☐ Disadvantaged Business Enterprise		
☐ Minority Business Enterprise		
☐ Woman-Owned Business Enterprise		
☐ Small Business Enterprise		
☐ Disabled Business Enterprise		
☐ Veteran-Owned Business Enterprise		
☐ Service-Disabled Veteran-Owned Business		
☐ HUBZone Business (Historically Underutilized) Business		
☐ Other		
☐ None		

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 4—SAFETY

4.01 Provide information regarding Business's safety organization and safety performance.

Name of Business's Safety Officer:		
Safety Certifications		
Certification Name	Issuing Agency	Expiration

4.02 Provide Worker's Compensation Insurance Experience Modification Rate (EMR), Total Recordable Frequency Rate (TRFR) for incidents, and Total Number of Recorded Manhours (MH) for the last 3 years and the EMR, TRFR, and MH history for the last 3 years of any proposed Subcontractor(s) that will provide Work valued at 10% or more of the Contract Price. Provide documentation of the EMR history for Business and Subcontractor(s).

Year									
Company	EMR	TRFR	MH	EMR	TRFR	MH	EMR	TRFR	MH

ARTICLE 5—FINANCIAL

5.01 Provide information regarding the Business's financial stability. If required in the "Submit" check box below, provide a copy of the most recent audited financial statement, and if such audited financial statement is not current, also provide the most current financial statement.

Financial Institution:		
Business address:		
Date of Business's most recent financial statement:		☐ Submit
Date of Business's most recent audited financial statement:		☐ Submit
Financial indicators from the most recent financial statement		
Contractor's Current Ratio (Current Assets ÷ Current Liabilities)		
Contractor's Quick Ratio ((Cash and Cash Equivalents + Accounts Receivable + Short Term Investments) ÷ Current Liabilities)		

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 6—SURETY INFORMATION

6.01 Provide information regarding the surety company that will issue required bonds on behalf of the Business, including but not limited to performance and payment bonds.

Surety Name:			
Surety is a corporation organized and existing under the laws of the state of:			
Is surety authorized to provide surety bonds in the Project location?	☐ Yes ☐ No		
Is surety listed in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" published in Department Circular 570 (as amended) by the Bureau of the Fiscal Service, U.S. Department of the Treasury? ☐ Yes ☐ No			
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

ARTICLE 7—INSURANCE

7.01 Provide information regarding Business's insurance company(s), including but not limited to its Commercial General Liability carrier. Provide information for each provider.

Name of insurance provider, and type of policy (CLE, auto, etc.):			
Insurance Provider		Type of Policy (Coverage Provided)	
Are providers licensed or authorized to issue policies in the Project location?		☐ Yes ☐ No	
Does provider have an A.M. Best Rating of A-VII or better?		☐ Yes ☐ No	
Mailing Address (principal place of business):			
Physical Address (principal place of business):			
Phone (main):		Phone (claims):	

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 8—CONSTRUCTION EXPERIENCE

8.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

8.02 Provide information regarding the Business's previous contracting experience.

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venturer:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a bidder by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been released from a bid in the past 5 years? ☐ Yes ☐ No				
Defaulted on a project or failed to complete any contract awarded to it? ☐ Yes ☐ No				
Refused to construct or refused to provide materials defined in the contract documents or in a change order? ☐ Yes ☐ No				
Been a party to any currently pending litigation or arbitration? ☐ Yes ☐ No				
Provide full details in a separate attachment if the response to any of these questions is Yes.				

8.03 List all projects currently under contract in Schedule A and provide indicated information.

8.04 List a minimum of three and a maximum of six projects completed in the last 5 years in Schedule B and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.

8.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 9—REQUIRED ATTACHMENTS

9.01 Provide the following information with the Statement of Qualifications:

A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.

B. Diverse Business Certifications if required by Paragraph 3.01.

C. Certification of Business's safety performance if required by Paragraph 4.02.

D. Financial statements as required by Paragraph 5.01.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

E. Attachments providing additional information as required by Paragraph 8.02.

F. Schedule A (Current Projects) as required by Paragraph 8.03.

G. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 8.04.

H. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 8.05.

I. Additional items as pertinent.

This Statement of Qualifications is offered by:

Business: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(date signed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address for giving notices:

_____

_____

_____

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

_____

_____

_____

Phone: _____

Email: _____

EJCDC C-451, Qualifications Statement.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Schedule A—Current Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

EJCDC® C-451, Qualifications Statement—Schedule A—Current Projects.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

Schedule B—Previous Experience with Similar Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

EJCDC® C-451, Qualifications Statement—Schedule B—Previous Experience with Similar Projects.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

Schedule B—Previous Experience with Similar Projects

Name of Organization				
Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Project Owner		Project Name		
General Description of Project				
Project Cost		Date Project		
Key Project Personnel	Project Manager	Project Superintendent	Safety Manager	Quality Control Manager
Name				

Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

EJCDC® C-451, Qualifications Statement—Schedule C—Key Individuals.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Safety Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	
Quality Control Manager			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

END OF SECTION

EJCDC® C-451, Qualifications Statement—Schedule C—Key Individuals.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00510

NOTICE OF AWARD

Date of Issuance:
Owner: Owner's Project No.:
Engineer: Engineer's Project No.:
Project:
Contract Name:
Bidder:
Bidder's Address:

You are notified that Owner has accepted your Bid dated [date] for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

Harward Street Pump Station and Sewer Interceptor Upgrade

The Contract Price of the awarded Contract is $[Contract Price]. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

[Number of copies sent] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically.

☐ Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner [number of copies sent] counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

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

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: [Full formal name of Owner]
By *(signature)*: _____
Name *(printed)*: _____
Title: _____

Copy: Engineer

END OF SECTION

EJCDC® C-510, Notice of Award.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00520

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between The City of Bath ("Owner") and [name of contracting entity] ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: Upgrades to the pump station process equipment, installation of a new gravity sewer interceptor, floodproofing, and ancillary systems.

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Harward Street Pump Station and Sewer Interceptor Upgrade.

ARTICLE 3—ENGINEER

3.01 The Owner has retained Wright-Pierce ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by Wright-Pierce.

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

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

4.02 Deleted.

4.03 *Contract Times: Days*

A. The Work will be substantially complete within 540 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 570 days after the date when the Contract Times commence to run.

4.04 Deleted.

4.05 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $1,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $500 for each day that expires after such time until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive, and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

4.06 *Special Damages*

A. Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete.

B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

C. The special damages imposed in this paragraph are supplemental to any liquidated damages for delayed completion established in this Agreement.

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the last day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. 90 percent of the value of the Work completed (with the balance being retainage).

b. 90 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion of the entire construction to be provided under the Contract Documents, Owner shall pay an amount sufficient to increase total payments to Contractor to 98 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

1. Deleted.

6.04 *Consent of Surety*

A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

A. All amounts not paid when due will bear interest at the rate of prime plus 2 percent per annum.

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

A. The Contract Documents consist of all of the following:

1. This Agreement.
2. Bonds:
    a. Performance bond (together with power of attorney).
    b. Payment bond (together with power of attorney).
3. General Conditions.
4. Supplementary Conditions.
5. Specifications as listed in the table of contents of the project manual (copy of list attached).
6. Drawings (not attached but incorporated by reference) consisting of 69 sheets with each sheet bearing the following general title: Harward Street Pump Station and Sewer Interceptor Upgrade.
7. Addenda (numbers _____ to _____, inclusive).
8. Exhibits to this Agreement (enumerated as follows):
    a. Contractor's Bid
    b. _____
9. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.
    e. Warranty Bond, if any.

B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

8.02 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.-

8.04 *Other Provisions*

Deleted.

ARTICLE 9—MISCELLANEOUS

Not used.

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

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

Owner:	Contractor:
_____ *(typed or printed name of organization)*	_____ *(typed or printed name of organization)*
By: _____ *(individual's signature)*	By: _____ *(individual's signature)*
Date: _____ *(date signed)*	Date: _____ *(date signed)*
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
	(If [Type of Entity] is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)
Attest: _____ *(individual's signature)*	Attest: _____ *(individual's signature)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address for giving notices:	Address for giving notices:
_____	_____
_____	_____
_____	_____
Designated Representative:	Designated Representative:
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address:	Address:
_____	_____
_____	_____
_____	_____
Phone: _____	Phone: _____
Email: _____	Email: _____
(If [Type of Entity] is a corporation, attach evidence of authority to sign. If [Type of Entity] is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)	License No.: _____ *(where applicable)*
	State: _____

END OF SECTION

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00550

NOTICE TO PROCEED

Owner:	City of Bath, Maine	Owner's Project No.:	
Engineer:	Wright-Pierce	Engineer's Project No.:	21119
Contractor:		Contractor's Project No.:	
Project:	Harward Street Pump Station and Sewer Interceptor Upgrade		
Contract Name:			
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on [date Contract Times are to start] pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

> The number of days to achieve Substantial Completion is 450 from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of [date, calculated from commencement date above]; and the number of days to achieve readiness for final payment is 480 from the commencement date of the Contract Times, resulting in a date for readiness for final payment of [date, calculated from commencement date above].

Before starting any Work at the Site, Contractor must comply with the following:

Owner: City of Bath

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Date Issued: _____

Copy: Engineer

END OF SECTION

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00610

PERFORMANCE BOND

Contractor Name: [Full formal name of Contractor] Address *(principal place of business)*: [Address of Contractor's principal place of business]	Surety Name: [Full formal name of Surety] Address *(principal place of business)*: [Address of Surety's principal place of business]
Owner Name: City of Bath, Maine Mailing address *(principal place of business)*: 55 Front Street, Bath ME 04530	Contract Description *(name and location)*: [Owner's project/contract name, and location of the project] Contract Price: [Amount from Contract] Effective Date of Contract: [Date from Contract]
Bond Bond Amount: [Amount] Date of Bond: [Date] *(Date of Bond cannot be earlier than Effective Date of Contract)* Modifications to this Bond form: ☐ None ☐ See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.	

EJCDC® C-610, Performance Bond.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

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

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

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

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

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

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

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

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

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

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

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

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

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

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

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

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

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

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

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

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

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

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

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

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

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

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

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

14. Definitions

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

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

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

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

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

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

16. Modifications to this Bond are as follows: [Describe modification or enter "None"]

END OF SECTION

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00615

PAYMENT BOND

Contractor Name: [Full formal name of Contractor] Address *(principal place of business)*: [Address of Contractor's principal place of business]	Surety Name: [Full formal name of Surety] Address *(principal place of business)*: [Address of Surety's principal place of business]
Owner Name: City of Bath, Maine Mailing address *(principal place of business)*: 55 Front Street, Bath ME, 04530	Contract Description *(name and location)*: [Owner's project/contract name, and location of the project] Contract Price: [Amount, from Contract] Effective Date of Contract: [Date, from Contract]

Bond

Bond Amount: [Amount]

Date of Bond: [Date]

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

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

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

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

EJCDC® C-615, Payment Bond.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

    5.1. Claimants who do not have a direct contract with the Contractor

        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2. Pay or arrange for payment of any undisputed amounts.

    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

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

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

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

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

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

        16.1.1. The name of the Claimant;

        16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

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

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

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

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

18. Modifications to this Bond are as follows: [Describe modification or enter "None"]

END OF SECTION

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

CONTENTS OF SUPPLEMENTARY CONDITIONS

Section No.	Section Title	Page No.
SC-1 to SC-18	Supplementary Conditions Amendments to General Conditions	00800-1
SC-20	State Funding Agency Requirements	SC-20

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

SC-1.01.A.3 APPLICATION FOR PAYMENT

Add the following language to the end of Paragraph 1.01.A.3:

> The Application for Payment form to be used on this Project is EJCDC No. C-620 or similar approved format. The Agency must approve all Applications for Payment before payment is made.

SC-1.01.A.8 CHANGE ORDER

Add the following language to the end of Paragraph 1.01.A.8:

> The Change Order form to be used on this Project is EJCDC No. C-941. Agency approval is required before Change Orders are effective.

SC-1.01.A.22 ENGINEER

Add the following language to the end of Paragraph 1.01.A.22:

> The Engineer’s Consultants on this Project are as follows: None

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SC-1.01 A.30 OWNER

Add the following to the end of Paragraph 1.01.A.30 of the General Conditions:

Owner is referred to as Grantee in certain sections of these Contract Documents. Owner and Grantee are one and the same.

SC-1.01 A.50 WORK CHANGE DIRECTIVE

Add the following language at the end of the last sentence of Paragraph 1.01.A.50

The Work Change Directive form to be used on this Project is EJCDC C-940 (2018). A Work Change Directive cannot change Contract Price or Contract Times without a subsequent Change Order.

SC-1.01 A.51 NON-RESIDENT CONTRACTOR

Add the following paragraph immediately after Paragraph 1.01.A.50 of the General Conditions, which is to read as follows:

51. Non-Resident Contractor -

a. A person who is not a resident in the State where the proposed construction is to be located, or

b. Any partnership that has no member thereof resident in the State where the proposed construction is to be located.

c. Any corporation established under laws other than those of the State in which the proposed construction is located.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

Add a new paragraph immediately after Paragraph 2.01.C of the General Conditions, which is to read as follows:

D. *Non-Resident Contractor*: The Contractor, if a corporation established under laws other than the State in which the proposed construction is located, shall file with the Owner, notice of the name of its resident attorney, appointed as required by the laws of the State in which the proposed construction is located. The Contractor, if a resident of a State other than that in which the proposed construction is located and not a corporation, shall file, at the time of execution of the Agreement, with the Owner a written appointment of a resident of the State in which the construction is located, having an office or place of business therein, to be his/her true and lawful attorney upon whom all lawful processes in any actions or proceedings against him/her may be served; and in such writing, which shall set forth said attorney's place of residence, shall agree that any lawful process against him/her which is served on said attorney shall be of the same legal force and validity as if served on him/her and that the authority shall continue in force so long as any liability remains outstanding against him/her in said State. The power of attorney shall be filed in the office of the Secretary of State if required, and copies certified by the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

Secretary shall be sufficient evidence thereof. Such appointment shall continue in force until revoked by an instrument in writing, designating in a like manner some other person upon whom such processes may be served, which instrument shall be filed in the manner provided herein for the original appointment.

2.06 *Electronic Transmittals*

SC-2.06 Delete Paragraphs 2.06.B and 2.06.C in their entirety and insert the following in their place:

B. *Electronic Documents Protocol:* The parties shall conform to the following provisions in Paragraphs 2.06.B and 2.06.C, together referred to as the Electronic Documents Protocol ("EDP" or "Protocol") for exchange of electronic transmittals.

1. *Basic Requirements*

a. To the fullest extent practical, the parties agree to and will transmit and accept Electronic Documents in an electronic or digital format using the procedures described in this Protocol. Use of the Electronic Documents and any information contained therein is subject to the requirements of this Protocol and other provisions of the Contract.

b. The contents of the information in any Electronic Document will be the responsibility of the transmitting party.

c. Electronic Documents as exchanged by this Protocol may be used in the same manner as the printed versions of the same documents that are exchanged using non-electronic format and methods, subject to the same governing requirements, limitations, and restrictions, set forth in the Contract Documents.

d. Except as otherwise explicitly stated herein, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any third party for any portion of the Work on the Project, or any Project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.

e. When transmitting Electronic Documents, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the receiving party's use of software application packages, operating systems, or computer hardware differing from those established in this Protocol.

f. Nothing herein negates any obligation 1) in the Contract to create, provide, or maintain an original printed record version of Drawings and Specifications, signed and sealed according to applicable Laws and Regulations; 2) to comply with any applicable Law or Regulation governing the signing and sealing of design documents or the signing and electronic transmission of any other documents; or 3) to comply with the notice requirements of Paragraph 18.01 of the General Conditions.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

2. *System Infrastructure for Electronic Document Exchange*

   a. Each party will provide hardware, operating system(s) software, internet, e-mail, and large file transfer functions ("System Infrastructure") at its own cost and sufficient for complying with the EDP requirements. With the exception of minimum standards set forth in this EDP, and any explicit system requirements specified by attachment to this EDP, it is the obligation of each party to determine, for itself, its own System Infrastructure.

      1) The maximum size of an email attachment for exchange of Electronic Documents under this EDP is 10 MB. Attachments larger than that may be exchanged using large file transfer functions or physical media.

      2) Each Party assumes full and complete responsibility for any and all of its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, or otherwise enabling its System Infrastructure, including operating systems and software, for use with respect to this EDP.

   b. Each party is responsible for its own system operations, security, back-up, archiving, audits, printing resources, and other Information Technology ("IT") for maintaining operations of its System Infrastructure during the Project, including coordination with the party's individual(s) or entity responsible for managing its System Infrastructure and capable of addressing routine communications and other IT issues affecting the exchange of Electronic Documents.

   c. Each party will operate and maintain industry-standard, industry-accepted, ISO-standard, commercial-grade security software and systems that are intended to protect the other party from: software viruses and other malicious software like worms, trojans, adware; data breaches; loss of confidentiality; and other threats in the transmission to or storage of information from the other parties, including transmission of Electronic Documents by physical media such as CD/DVD/flash drive/hard drive. To the extent that a party maintains and operates such security software and systems, it shall not be liable to the other party for any breach of system security.

   d. In the case of disputes, conflicts, or modifications to the EDP required to address issues affecting System Infrastructure, the parties shall cooperatively resolve the issues; but, failing resolution, the Owner is authorized to make and require reasonable and necessary changes to the EDP to effectuate its original intent. If the changes cause additional cost or time to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in price or time under the appropriate process in the Contract.

   e. Each party is responsible for its own back-up and archive of documents sent and received during the term of the contract under this EDP, unless this EDP establishes a Project document archive, either as part of a mandatory Project website or other communications protocol, upon which the parties may rely for document archiving during the specified term of operation of such Project document archive. Further, each party remains solely responsible for its own post-Project back-up and archive of Project documents after the term of the Contract, or after termination of the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

Project document archive, if one is established, for as long as required by the Contract and as each party deems necessary for its own purposes.

f. If a receiving party receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving party will advise the sending party of the incomplete transmission.

g. The parties will bring any non-conforming Electronic Documents into compliance with the EDP. The parties will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the communication.

h. The Owner will operate a Project information management system (also referred to in this EDP as "Project Website") for use of Owner, Engineer and Contractor during the Project for exchange and storage of Project-related communications and information. Except as otherwise provided in this EDP or the General Conditions, use of the Project Website by the parties as described in this Paragraph will be mandatory for exchange of Project documents, communications, submittals, and other Project-related information. The following conditions and standards will govern use of the Project Website:

1) Describe the period of time during which the Project Website will be operated and be available for reliance by the parties;

2) Provide any minimum system infrastructure, software licensing and security standards for access to and use of the Project Website;

3) Describe the types and extent of services to be provided at the Project Website (such as large file transfer, email, communication and document archives, etc.); and

4) Include any other Project Website attributes that may be pertinent to Contractor's use of the facility and pricing of such use.

C. *Software Requirements for Electronic Document Exchange; Limitations*

1. Each party will acquire the software and software licenses necessary to create and transmit Electronic Documents and to read and to use any Electronic Documents received from the other party (and if relevant from third parties), using the software formats required in this section of the EDP.

a. Prior to using any updated version of the software required in this section for sending Electronic Documents to the other party, the originating party will first notify and receive concurrence from the other party for use of the updated version or adjust its transmission to comply with this EDP.

2. The parties agree not to intentionally edit, reverse engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes any Electronic Document or information contained therein that was transmitted in a software data format, including Portable Document Format (PDF), intended by sender not to be modified, unless the receiving party obtains the permission of the sending party or is citing or quoting excerpts of the Electronic Document for Project purposes.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

SC2.06 Supplement Paragraph 2.06 of the General Conditions by adding the following paragraph:

D. Requests *by Contractor for Electronic Documents in Other Formats*

1. Release of any Electronic Document versions of the Project documents in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be at the sole discretion of the Owner.

2. To extent determined by Owner, in its sole discretion, to be prudent and necessary, release of Electronic Documents versions of Project documents and other Project information requested by Contractor ("Request") in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be subject to the provisions of the Owner's response to the Request, and to the following conditions to which Contractor agrees:

   a. The content included in the Electronic Documents created by Engineer and covered by the Request was prepared by Engineer as an internal working document for Engineer's purposes solely, and is being provided to Contractor on an "AS IS" basis without any warranties of any kind, including, but not limited to any implied warranties of fitness for any purpose. As such, Contractor is advised and acknowledges that the content may not be suitable for Contractor's application, or may require substantial modification and independent verification by Contractor. The content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other devices that may affect subsequent reuse.

   b. Electronic Documents containing text, graphics, metadata, or other types of data that are provided by Engineer to Contractor under the request are only for convenience of Contractor. Any conclusion or information obtained or derived from such data will be at the Contractor's sole risk and the Contractor waives any claims against Engineer or Owner arising from use of data in Electronic Documents covered by the Request.

   c. Contractor shall indemnify and hold harmless Owner and Engineer and their subconsultants from all claims, damages, losses, and expenses, including attorneys' fees and defense costs arising out of or resulting from Contractor's use, adaptation, or distribution of any Electronic Documents provided under the Request.

   d. Contractor agrees not to sell, copy, transfer, forward, give away or otherwise distribute this information (in source or modified file format) to any third party without the direct written authorization of Engineer, unless such distribution is specifically identified in the Request and is limited to Contractor's subcontractors. Contractor warrants that subsequent use by Contractor's subcontractors complies with all terms of the Contract Documents and Owner's response to Request.

3. In the event that Owner elects to provide or directs the Engineer to provide to Contractor any Contractor-requested Electronic Document versions of Project information that is not explicitly identified in the Contract Documents as being available to Contractor, the Owner shall be reimbursed by Contractor on an hourly basis (at $130

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

per hour) for any engineering costs necessary to create or otherwise prepare the data in a manner deemed appropriate by Engineer.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.02 *Standards Specifications, Codes, Laws and Regulations*

SC-3.02.A Add the following paragraphs immediately following *Paragraph 3.02.A.2:*

3. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
4. Where the date of a reference standard in provided, reference shall be to the version of the reference standard associated with that date, regardless if the reference standard has been superseded by a version with a later date, discontinued, or replaced."

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

SC-4.01 Delete Paragraph 4.01.A in its entirety and insert the following in its place:

A. The Contract Times will commence to run on the day indicated in the Notice to Proceed. A Notice to Proceed may be issued at any time within 30 calendar days after the Effective Date of the Agreement.

4.05 *Delays in Contractor's Progress*

SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered abnormal weather conditions. Requests for time extensions due to abnormal weather conditions will be submitted to the Engineer within five days of the end of the abnormal weather condition event.

ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.03 *Subsurface and Physical Conditions*

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Northern Test Boring Inc. Boring Log – Bath Sewer Project	December 17, 2024	• Boring Logs included in Appendix A.
Northern Test Boring Inc. Geotechnical Probes – Bath Sewer Project	November 30, 2023	• Geotechnical Probe results included in Appendix A.
Subsurface Investigation Report Soil Metrics LLC – Project Manual for 2008 Combined Sewer Overflow Abatement Projects	May 9, 2007	• Boring logs for samples B-1, B-2, and B-3 as identified on Page 2, and boring log data on pages 5 through 7. • Laboratory Test Data for samples B-2, and B-3 summarized on pages 10 through 13
ASTM Phase 1 Environmental Site Assessment, Former M.W. Sewall & Co. Bulk Plant – 1090 High Street, Bath, ME, by Ransom Consulting, LLC	July 3, 2024	• Soil Boing and Test Pit Logs and associated figures, included in Appendix C.

F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
No drawings known to the Owner.		

G. Contractor may request copies from the Engineer of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents.

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Report Title	Date of Report	Technical Data

ASTM Phase 1 Environmental Site Assessment, Former M.W Sewall & Co. Bulk Plant – 1090 High Street, Bath, ME, by Ransom Consulting, LLC	July 3, 2024	• Table 1: Soil Sample Analytical Results.
		• Table 2: Water Sample Analytical Results.
		• Table 3: Soil Vapor Analytical Results.
		• Table 4: Summary of Duplicate Sample Analytical Results and associated figures, including
		  • Figure 2 – Site Plan
		  • Figure 3 – Soil & Soil Vapor Sample Exceedances
		  • Figure 4 – Groundwater Contours and Sample Exceedances
		Included in Appendix C.

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
No drawings known to the Owner		

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition).

2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition).

6.02 *Insurance—General Provisions*

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

D. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: Engineer's Consultants, as specifically identified in Article 1

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

E. *Workers' Compensation and Employer's Liability:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	Policy limits of not less than:
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Jones Act (if applicable)	
Bodily injury by accident—each accident	$N/A
Bodily injury by disease—aggregate	$N/A
Employer's Liability	
Each accident	$100,000
Each employee	$500,000
Policy limit	$500,000
Stop-gap Liability Coverage	
For work performed in monopolistic states, stop-gap liability coverage must be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	$N/A

F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
2. damages insured by reasonably available personal injury liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.
    a. Such insurance must be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
4. Underground, explosion, and collapse coverage.
5. Personal injury coverage.
6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).
6. Any limitation or exclusion based on the nature of Contractor's work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	$2,000,000
Products—Completed Operations Aggregate	$2,000,000
Personal and Advertising Injury	$1,000,000
Bodily Injury and Property Damage—Each Occurrence	$1,000,000

J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	$500,000
Each Accident	$1,000,000
Property Damage	
Each Accident	$N/A
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$1,000,000

K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	$5,000,000
General Aggregate	$5,000,000

L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of $5,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.

N. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

Contractor's Professional Liability	Policy limits of not less than:
Each Claim	$1,000,000
Annual Aggregate	$2,000,000

O. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, Contractor shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance meeting the following requirements, (3) furnish a copy of the endorsement to Owner, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify Owner of such submittal.

Railroad Protective Liability Insurance	Policy limits of not less than:
Each Claim	$1,000,000
Aggregate	$1,000,000

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

    a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.

    b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.

2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).

4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of $250,000.

5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of $250,000.

6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.

7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.

8. include performance/hot testing and start-up, if applicable.

9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.

10 include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:

    a. Engineer and Engineer's consultants as listed in SC-1.01.

11. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:

    a. 36" PVC Pipe - $200,000

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7:00 AM to 7:00 PM, Monday through Friday.

2. Owner's legal holidays are State mandated holidays.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

D. Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-7.05 *"Or Equals"*

Add a new subparagraph SC-7.05.B.1 immediately after subparagraph 7.05.B:

1. It shall be Contractor's responsibility to coordinate all submittals to Engineer for approval to eliminate any conflicts which might arise due to the use of "or equal" items. Any additional costs incidental to the use of "or equal" items shall be paid by Contractor.

SC-7.06 *Substitutes*

Add a new subparagraph SC-7.06.E.1 immediately after subparagraph 7.06.E:

1. It shall be Contractor's responsibility to coordinate all submittals to Engineer for approval to eliminate any conflicts which might arise due to the use of substitutes. Any additional costs incidental to the use of substitutes shall be paid by Contractor.

SC-7.07 *Concerning Subcontractors and Suppliers*

Delete Paragraph 7.07.B in its entirety and insert [Deleted].

Amend Paragraph 7.07.E by deleting the second sentence of the paragraph and insert the following in its place: "Owner may not require that Contractor use a specific replacement."

SC-7.09 *Permits*

Add the following subparagraph immediately after Paragraph 7.09.A:1. Local permit fees for permits required from the Owner will be waived.

Add the following paragraph immediately after Paragraph 7.09.A:

B. The following permits/approvals have been or will be obtained by the Owner. Copies of the permit approvals are in the Appendices of the Bidding Documents for permits that have been obtained. Full copies of the permit applications and approvals will be on file at the Owner's Offices. It is the responsibility of the Contractor to be familiar with and comply with the applicable provisions of each permit as they apply to the work:

1. U.S. Army Corps of Engineers General Permit

2. Maine Department of Transportation Underground Pipe Crossing License.

7.10 *Taxes*

SC-7.10 Add a new paragraph immediately after Paragraph 7.10.A:

B. Owner is exempt from payment of sales and compensating use taxes of the State of Maine and of cities and counties thereof on all materials to be incorporated into the Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the Work.
2. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Contractor, or to supplies or materials not incorporated into the Work.

ARTICLE 8—OTHER WORK AT THE SITE

SC-8.02 COORDINATION

No changes to this article.

ARTICLE 9—OWNER'S RESPONSIBILITIES

SC-9.13 OWNER'S SITE REPRESENTATIVE

No changes to this article.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

SC-10.03 Add the following new paragraph immediately after Paragraph 10.03.B:

C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:

1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
3. *Liaison*
    a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
    b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
    c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
4. *Review of Work; Defective Work*

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.

b. Observe whether any Work in place appears to be defective.

c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*

a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

6. *Payment Requests:* Review Applications for Payment with Contractor.

7. *Completion*

a. Participate in Engineer's visits regarding Substantial Completion.

b. Assist in the preparation of a punch list of items to be completed or corrected.

c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.

d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.

5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Authorize Owner to occupy the Project in whole or in part.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies,
and American Society of Civil Engineers. All rights reserved.

ARTICLE 11—CHANGES TO THE CONTRACT

No changes in this Article.

ARTICLE 12—CLAIMS

No changes to this Article.

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 *Cost of the Work*

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

a. For purposes of this paragraph, "small tools and hand tools" means any tool or equipment whose current price if it were purchased new at retail would be less than $500.

SC-13.03 UNIT PRICE WORK

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the extended price of a particular item of Unit Price Work amounts to 5 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.03 Defective Work

SC 14.03 Add new paragraph immediately after Paragraph 14.03.F

G. Installation of materials that are non-compliant with Domestic Preference requirements shall be considered defective work. Contractor should ensure that Engineer has an approved Manufacturer's Certification, or waiver, prior to any domestic preference compliant item being delivered to the project site.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

SC-15.01 PROGRESS PAYMENTS

SC-15.01 Add the following language at the end of Paragraph 15.01.B.4:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage or invest the retainage for the benefit of the Contractor.

SC-15.01 Add new paragraph immediately after Paragraph 15.01.B.4:

5. The Application for Payment form to be used on this Project is EJCDC C-620. The Agency must approve all Applications for Payment before Payment is made.

SC-15.01 Add new paragraph immediately after Paragraph 15.01.B.5:

6. By submitting an Application for Payment based in whole or in part on furnishing equipment or materials, Contractor certifies that such equipment and materials are compliant with Domestic Preference requirements. Manufacturer's Certification for material(s) satisfy these requirements. Refer to the Sample Language for Manufacturer's Certification provided in these Contract Documents.

SC-15.01 Add the following paragraph immediately after Paragraph 15.01.C.2.c:

a. The materials presented for payment in an Application for Payment comply with Domestic Preference requirements.

SC-15.01 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

The Application for Payment with Engineer's recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 15.01.E will become due twenty (20) days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC-15.01 Add the following new paragraph after Paragraph 15.01.B.2: For All Stored Materials:

i. The Contractor shall submit the Manufacturer's short-term and long-term storage and shall have established a written program to implement the Manufacturer's required storage procedures, including written schedule for all required maintenance activities.

ii. For each payment requisition that includes payment for stored materials, Contractor shall include the following documentation:

   a. Identification of the item(s), including model number, serial number and photographs.

   b. Copy of the updated maintenance schedule including certification that all required maintenance has been performed.

   c. Lien waivers for the preceding monthly payments.

iii. Contractor shall furnish evidence that payment for stored materials has in fact been paid to the respective supplier(s) within sixty days of payment by Owner. Failure to provide such evidence of payment may result in the withdrawal of previous approval(s) and removal of the cost of related materials and equipment from the next submitted Application for Payment.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

b. For Off-Site Stored Materials:
   i. Payment for off-site stored materials will be determined on a case-by-case basis at the discretion of the Owner and, if considered acceptable by Owner, the off-site facility shall be no more than 2 hours from the job site by car.
   ii. Contractor shall provide the Owner and/or Engineer guaranteed right-of-entry to the storage facility to inspect the stored materials. Contractor shall be responsible for paying travel costs and Engineer's time associated with inspections.
   iii. Contractor's Builder's Risk certificate of insurance shall explicitly identify the off-site storage location as well as transportation of stored materials from the storage facility to the job site.

Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

1. Fifteen days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

SC-15.03 SUBSTANTIAL COMPLETION

SC-15.03 Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

SC-15.03 Add the following to the end of the Paragraph 15.03.C:

Substantial Completion shall only be granted for the Milestones identified in the Agreement.

SC-15.04 Add the following new paragraph after Paragraph 15.04.A and related subparagraphs:

B. Owner and Engineer define the phrase "a separately functioning and usable part of the Work that can be used by the Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work" as meaning the following:

1. Equipment system start-up and demonstration testing shall be completed and documented. Equipment shall be demonstrated to operate in the manual and automatic modes. The equipment system shall consist of all equipment and appurtenances serving the same function. Equipment alarms shall be confirmed to dial out via the Owner's alarm system.
2. All relevant operation and maintenance manual submittals are completed.
3. All relevant Owner training is completed and documented.
4. All equipment safety-related items (e.g., equipment guards, handrails, ESTOPs, etc.) shall be completed, demonstrated and documented.
5. All relevant ventilation system start-up, balancing, testing and training have been completed and documented.
6. All relevant electrical systems are completed and documented (e.g., megger test reports, grounding report, VFD settings, circuit breaker settings, etc.).

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

7. Spare parts are transferred and documented.

C. If the above conditions are met, then the Owner will consider Partial Use or Occupancy with the following conditions:

1. The structures, equipment system and appurtenances shall remain fully covered under the Contractor's Builder's Risk policy.
2. Any damages, complications and consequences resulting from other on-going construction activities shall be addressed by the Contractor.
3. The operation and maintenance activities associated with the equipment system and appurtenances shall be performed by the Owner; however, the Contractor shall provide a reasonable amount of assistance when requested by the Owner.
4. Final clean-up and touch up coatings shall be completed prior to Substantial Completion.
5. No reduction in retainage will be made.
6. The mechanical warranty on the equipment system and appurtenances shall begin.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No changes in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

No changes in this Article.

ARTICLE 18—MISCELLANEOUS

No changes in this Article.

END OF SECTION

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

00800_SC-20- ARPA 00 72 14 Supplemental General Conditions

Notice: The contract or delivery order to which this addendum is attached is made using federal assistance provided to the State of Maine by the US Department of Treasury under the American Rescue Plan Act ("ARPA"), Sections 602 and 603 of the Social Security Act, Pub. L. No. 117-2 (March 11, 2021).

1. Equal Opportunity

The Contractor shall comply with Executive Order 11246 of September 24, 1965 entitled "Equal Opportunity," as amended by Executive Order 11375 of October 13, 1967 and as supplemented by in Department of Labor Regulations (41 CFR Part 60). The equal opportunity clause for federally assisted construction contracts at 41 CFR Part 60-1.4 is incorporated by reference.

2. Contract Work Hours and Safety Standards Act

If the Contract is in excess of $100,000 and involves the employment of mechanics or laborers, Contractor shall comply with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, Contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than 1½ times the basic rate of pay for all hours worked in excess of 40 hours in the work week unless a higher rate is required by state or federal law. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

Contractor shall comply with the following required provisions:

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

b. Violation; liability for unpaid wages; liquidated damages: In the event of any violation of the clause set forth in paragraph (a) of this section the Contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a) of this section, in the sum of $29 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a) of this section.

c. Withholding for unpaid wages and liquidated damages: The State of Maine shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b) of this section.

d. Subcontracts: The Contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a) through (d) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a) through (d) of this section.

e. The Contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid.

f. Records to be maintained under this provision shall be made available by the Contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Department of Treasury, and the Department of Labor, and the Contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

3. Environmental Compliance

a. Contracts and subgrants of amounts in excess of $150,000 must comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401–7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251–1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

b. The Contractor shall comply with all applicable standards, orders, or requirements issued under section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738, Environmental Protection Agency regulations (40 CFR Part 15), and section 308 of the Federal Water Pollution Control Act (33U.S.C. 1318), that relate generally to inspection, monitoring, entry reports, and information, and with all regulations and guidelines issued thereunder.

c. The Contractor shall comply with all applicable standards, orders, or requirements issued under the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response Compensation and Liabilities Act (CERCLA); and any applicable Federal, Codes or Local environmental regulation.

4. Protection for Whistleblowers

a. In accordance with 41 U.S.C. § 4712, Contractor may not discharge, demote, or otherwise discriminate against an employee in reprisal for disclosing to any of the list of persons or entities provided below, information that the employee reasonably believes is evidence of gross mismanagement of a federal contract or grant, a gross waste of federal funds, an abuse of authority relating to a federal contract or grant, a substantial and specific danger to public health or safety, or a violation of law, rule, or regulation related to a federal contract (including the competition for or negotiation of a contract) or grant.

b. The list of persons and entities referenced in the paragraph above includes the following:

i. A member of Congress or a representative of a committee of Congress;

ii. An Inspector General

iii. The Government Accountability Office;

iv. A Treasury employee responsible for contract or grant oversight or management;

v. An authorized official of the Department of Justice or other law enforcement agency;

vi. A court or grand jury; or

vii. A management official or other employee of Contractor, contractor, or subcontractor who has the responsibility to investigate, discover, or address misconduct.

c. Contractor shall inform its employees in writing of the rights and remedies provided under this section, in the predominant native language of the workforce.

5. Procurement of recovered materials

The Contractor shall comply with section 6002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act. The requirements of Section 6002 include procuring only items designated in guidelines of the Environmental Protection Agency (EPA) at 40 CFR part 247 that contain the highest percentage of recovered materials practicable, consistent with maintaining a satisfactory level of competition, where the purchase price of the item exceeds $10,000 or the value of the quantity acquired during the preceding fiscal year exceeded $10,000; procuring solid waste management services in a manner that maximizes energy and resource recovery; and establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines (2 CFR 200.323).

6. Nondiscrimination

The Contractor shall ensure that no person is denied benefits of, or otherwise be subjected to discrimination in connection with the Contractor's performance under this agreement, on the grounds of race, religion, color, national origin, sex, and handicap. Accordingly, and to the extent applicable, the Contractor covenants and agrees to comply with the following:

a. Title VI of the Civil Rights Act of 1964, which prohibits recipients of federal financial assistance from excluding from a program or activity, denying benefits of, or otherwise discriminating against a person on the basis of race, color, or national origin (42 U.S.C. § 2000d et seq.), as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, which are herein incorporated by reference and made a part of this contract (or agreement). Title VI also includes protection to persons with "Limited English Proficiency" in any program or activity receiving federal financial assistance, 42 U.S.C. § 2000d et seq., as implemented by the Department of the Treasury's Title VI regulations, 31 CFR Part 22, and herein incorporated by reference and made a part of this contract or agreement.

b. The Fair Housing Act, Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§ 3601, et seq.), which prohibits discrimination in housing on the basis of race, color, religion, national origin, sex, familial status, or disability

c. Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. § 794)

d. The Age Discrimination Act of 1975 (42 U.S.C. § 6101 et seq.) and regulations issued thereunder (45 CFR Part 90).

e. Title II of the Americans with Disabilities Act of 1990, as amended (42 U.S.C. §§ 12101 et seq.), which prohibits discrimination on the basis of disability under programs, activities, and services provided or made available by state and local governments or instrumentalities or agencies thereto.

7. Lobbying

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

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

c. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

d. The Interim Final Rule, New Restrictions on Lobbying, issued by the Office of Management and Budget to implement the provisions of section 319 of Public Law 101-121 (31 U.S.C., Art 1352) is incorporated by reference.

8. Drug-Free Workplace

The Contractor will comply with the provisions of the Drug-Free Workplace Act of 1988 (Public Law 100-690, title V, subtitle D; 41 U.S.C. 701 et seq.) and maintain a drug-free workplace.

9. Increasing Seat Belt Use in the United States

Pursuant to Executive Order 13043, 62 FR 19217 (Apr. 18, 1997), Contractor is encouraged to adopt and enforce on-the-job seat belt policies and programs for its their employees when operating company owned, rented or personally owned vehicles.

10. Reducing Text Messaging While Driving

Pursuant to Executive Order 13513, 74 FR 51225 (October 6, 2009), Contractor is encouraged to adopt and enforce policies that ban text messaging while driving, and to establish workplace safety policies to decrease accidents caused by distracted drivers.

11. Debarment and Suspension

If the Contract is in excess of $25,000, this Contract is a covered transaction for purposes of 2 C.F.R. Part 180 and 2 C.F.R. Part 3000. As such, the Contractor is required to verify that none of the Contractor's principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935). The Contractor must comply with 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters into. This certification is a material representation of fact relied upon by The State of Maine. If it is later determined that the Contractor did not comply with 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C, in addition to remedies available to The State of Maine, the federal government may pursue available remedies, including but not limited to suspension and/or debarment. The bidder or proposer agrees to comply with the requirements of 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

12. Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment

Contractor shall use no funds provided under this Contract to:

a. Procure or obtain;

b. Extend or renew a contract to procure or obtain; or

c. Enter into a contract (or extent or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115-232, section 889, covered telecommunications equipment is telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).

i. For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera

Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).

ii. Telecommunications or video surveillance services provided by such entities or using such equipment.

iii. Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

d. The Contractor shall insert the substance of this clause, including this paragraph, into all subcontracts and other contractual instruments (2 CFR 200.216).

Data for Infrastructure Projects and Capital Expenditure Projects

14.1 Programmatic Data for Infrastructure Projects (Expenditure Category 5 (EC 5)): For all projects listed under the Water, Sewer[1], and Broadband Expenditure Categories (see Appendix 1 of the Compliance and Reporting Guidance for a listing of expenditure categories), more detailed project-level information is required. The Contractor/ Sub-recipient acknowledges that they must provide the below-referenced data associated with the services tied to this service contract/sub-award. This information will be provided to the State of Maine Contracting Department (Owner/Department) by the Contractor/Sub-recipient. Contractors and Sub-recipients are only required to provide the specific information tied to the project associated with this contract/sub-award that fits into one or more listed ECs. Each project will be required to report expenditure data as described above, but will also report the following information:

1. <u>All Water and Sewer projects (EC 5.1-5.18):</u>
    - Projected/actual construction start date (month/year)
    - Projected/actual initiation of operations date (month/year)
    - Public Water System (PWS) ID Number
    - National Pollutant Discharge Elimination System (NPDES) Permit Number
    - Median Household Income of Service Area[2]
    - Lowest Quintile Income of the Service Area[2]

2. <u>All Broadband Projects (EC 5.19-5.21):</u>
    - Projected/actual construction start date (month/year)
    - Projected/actual initiation of operations date (month/year)
    - Location Details
    - Confirm that the project is designed to, upon completion, reliably meet or exceed symmetrical 100 Mbps download and upload speeds.
        - If the project is not designed to reliably meet or exceed symmetrical 100 Mbps download and upload speeds, explain why not, and

[1] Definitions for water and sewer Expenditure Categories can be found in the EPA's handbooks. For "clean water" expenditure category definitions, please see: https://www.epa.gov/sites/production/files/2018-03/documents/cwdefinitions.pdf. For "drinking water" expenditure category definitions, please see: https://www.epa.gov/dwsrf/drinking-water-staterevolving-fund-national-information-management-system-reports.
[2] *For median income and lowest quintile income of Census Tracts and other geographic areas, Contractor/Sub-recipient should refer to the most recent American Community Survey 5-year estimates available through the Census website.

  - Confirm that the project is designed to, upon completion, meet or exceed 100 Mbps download speed and between at least 20 Mbps and 100 Mbps upload speed, and be scalable to a minimum of 100 Mbps download speed and 100 Mbps upload speed.
- Confirm that the service provider for the project has, or will upon completion of the project, either participated in the Federal Communications Commission (FCC)'s Affordable Connectivity Program (ACP) or otherwise provided access to a broad-based affordability program that provides benefits to households commensurate with those provided under the ACP to low-income consumers in the proposed service area of the broadband infrastructure (applicable only to projects that provide service to households).
- Detailed Project Information:
  - Project technology type(s) (Planned/Actual)
    - Fiber
    - Coaxial Cable
    - Terrestrial Fixed Wireless
    - Other (specify)
  - Total miles of fiber deployed (Planned/Actual)
  - Total number of funded locations served (Planned/Actual)
  - Pre-SLFRF Investment
    - Total Number of Funded Locations Served receiving 25/3 Mbps or below
    - Total Number of Funded Locations Served receiving between 25/3 Mbps and 100/20 Mbps
  - Post-SLFRF
    - Total Number Receiving Minimum 100/100 Mbps
    - Total Number Receiving Minimum 100/20Mbps and scalable to 100/100 Mbps
  - Total number of funded locations served, broken out by type (Planned/Actual):
    - Residential
      - Total Housing Units
    - Business
    - Community Anchor Institution
- Location-by-Location Project Information

  For each location served by a Project, the Owner/Department must collect from the Contractor/Sub-recipient and submit the following information to Treasury using a predetermined file format that will be provided by Treasury (collection of certain fields will begin in October 2022, as specified below):
- Latitude/longitude at the structure where service will be installed (required starting October 2022) Technology used to offer service at the location (required starting October 2022)
- Location type (required starting October 2022)
  - Residential
    - If Residential, Number of Housing Units
  - Business
  - Community anchor institution
- Speed tier at the location post-SLFRF investment (collection to be phased in)
  - Maximum download speed offered
  - Maximum download speed delivered
  - Maximum upload speed offered
  - Maximum upload speed delivered
  - Latency

- Standardized FCC Identifiers
    - Fabric ID # (Broadband Serviceable Fabric Locations)
    - FCC Issued Provider ID #

3. Wage Rate Disclosures and Certifications for Capital Expenditure and Infrastructure Projects.

A. N/A

B. To the extent that the Contractor/Sub-recipient employs laborers and mechanics as defined by the Davis Bacon Act, the Contractor/Sub-recipient must provide a project employment and local impact report detailing:

- The number of employees of contractors and sub-contractors working on the project;
- The number of employees on the project hired directly;
- The number of employees on the project hired through a third party;
- The wages and benefits of workers on the project by classification; and
- Whether those wages are at rates less than those prevailing;
- Contractor/Sub-recipient must maintain sufficient records to substantiate this information upon request.

C. To the extent that the Contractor/Sub-recipient employs laborers and mechanics as defined by the Davis Bacon Act, the Contractor/Sub-recipient must provide a project workforce continuity plan, detailing:

- How the Contractor/Sub-recipient will ensure the project has ready access to a sufficient supply of appropriately skilled and unskilled labor to ensure high-quality construction throughout the life of the project, including a description of any required professional certifications and/or in-house training;
- How the Contractor/Sub-recipient will minimize risks of labor disputes and disruptions that would jeopardize timeliness and cost-effectiveness of the project;
- How the Contractor/Sub-recipient will provide a safe and healthy workplace that avoids delays and costs associated with workplace illnesses, injuries, and fatalities, including descriptions of safety training, certification, and/or licensure requirements for all relevant workers (e.g., OSHA 10, OSHA 30);
- Whether workers on the project will receive wages and benefits that will secure an appropriately skilled workforce in the context of the local or regional labor market;
- Whether the project has completed a project labor agreement;
- Whether the project prioritizes local hires
- Whether the project has a Community Benefit Agreement, with a description of any such agreement.

SECTION 00920

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	City of Bath, ME	Owner's Project No.:	
Engineer:	Wright-Pierce	Engineer's Project No.:	21119
Contractor:		Contractor's Project No.:	
Project:	Harward Street Pump Station and Sewer Interceptor Upgrade		
Contract Name:			

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: [Enter date, as determined by Engineer]

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

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

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

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

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

END OF SECTION

EJCDC® C-625, Certificate of Substantial Completion.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00935

NOTICE OF ACCEPTABILITY OF WORK

Owner:	City of Bath, Maine	Owner's Project No.:	
Engineer:	Wright-Pierce	Engineer's Project No.:	21119
Contractor:		Contractor's Project No.:	
Project:	Harward Street Pump Station and Sewer Interceptor Upgrade		
Contract Name:			
Notice Date:	Effective Date of the Construction Contract:		

The Engineer hereby gives notice to the Owner and Contractor that Engineer recommends final payment to Contractor, and that the Work furnished and performed by Contractor under the Construction Contract is acceptable, expressly subject to the provisions of the Construction Contract's Contract Documents ("Contract Documents") and of the Agreement between Owner and Engineer for Professional Services dated [date of professional services agreement] ("Owner-Engineer Agreement"). This Notice of Acceptability of Work (Notice) is made expressly subject to the following terms and conditions to which all who receive and rely on said Notice agree:

1. This Notice has been prepared with the skill and care ordinarily used by members of the engineering profession practicing under similar conditions at the same time and in the same locality.
2. This Notice reflects and is an expression of the Engineer's professional opinion.
3. This Notice has been prepared to the best of Engineer's knowledge, information, and belief as of the Notice Date.
4. This Notice is based entirely on and expressly limited by the scope of services Engineer has been employed by Owner to perform or furnish during construction of the Project (including observation of the Contractor's Work) under the Owner-Engineer Agreement, and applies only to facts that are within Engineer's knowledge or could reasonably have been ascertained by Engineer as a result of carrying out the responsibilities specifically assigned to Engineer under such Owner-Engineer Agreement.
5. This Notice is not a guarantee or warranty of Contractor's performance under the Construction Contract, an acceptance of Work that is not in accordance with the Contract Documents, including but not limited to defective Work discovered after final inspection, nor an assumption of responsibility for any failure of Contractor to furnish and perform the Work thereunder in accordance with the Contract Documents, or to otherwise comply with the Contract Documents or the terms of any special guarantees specified therein.
6. This Notice does not relieve Contractor of any surviving obligations under the Construction Contract, and is subject to Owner's reservations of rights with respect to completion and final payment.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

END OF SECTION

EJCDC® C-626, Notice of Acceptability of Work.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00936

CONSENT OF SURETY TO FINAL PAYMENT

To: _____ (Owner)
_____
_____

From: _____ (Contractor)
_____
_____

CONTRACT TITLE: _____
BOND NUMBER: _____

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the _____ (Surety Company) on the bond of the Contractor hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety Company of any of its obligations to the Owner as set forth in the said Surety Company's Bond.

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand this _____ day of _____, 20___.

_____
Surety Company Name

_____
Signature of Authorized Representative

_____
Printed Name and Title

Attest: (Seal)

Note: Power of Attorney should be attached in instances where same applies.

END OF SECTION

SECTION 00937

CONTRACTOR'S AFFIDAVIT

STATE OF _____

COUNTY OF _____

Before me, the undersigned, a _____
(Notary Public, Justice of Peace, Alderman)

in and for said County and State personally appeared, _____
(Individual, Partner or duly

_____ who being duly sworn according to law
(Authorized Representative of Corporate Contractor)

deposes and says that the cost of all the Work, and outstanding claims and indebtedness of whatever nature arising out of the performance of the contract between

_____
(Owner)

and _____ of _____
(Contractor)

dated _____ for the construction of the _____
(Agreement Date) (Project)

_____ and necessary appurtenant installations have been paid in full.

_____
(Individual, Partner, or duly authorized representative of corporate contractor)

Sworn to and subscribed before me
This _____ day of _____, 20___

END OF SECTION

SECTION 00938

CONTRACTOR'S RELEASE

KNOW ALL PERSONS BY THESE PRESENTS that _____ (Contractor)
of _____, County of _____ and State of _____

do hereby acknowledge that _____ (Contractor) has this day had, and received of and from _____ (Owner) the sum of One Dollar and other valuable considerations in full and complete satisfaction and payment of all sums of money owed, payable and belonging to _____ (Contractor) by any means whatsoever, for on account of a Contract Agreement between _____ (Owner) and _____ (Contractor) dated _____ (Agreement Date) for _____ (Project)

NOW, THEREFORE, the said _____ (Contractor)

(for myself, my heirs, executors and administrators) (for itself, its successors and assigns) do/does, by these presents remise, release, quit-claim and forever discharge _____ (Owner), of and from all claims and demands, arising from or in connection with the said contract dated _____ (Agreement Date), and of and from all, and all manner of action and actions, cause and causes of action and actions, suits, debts, dues, duties, sum and sums of money, accounts, reckonings, bonds, bills, specialties, covenants, contracts, agreements, promises, variances, damages, judgments, extents, executions, claims and demand, whatsoever in law or equity, or otherwise, against _____ (Owner) its successors and assigns, which (I, my heirs, executors, or administrators) (it, its successors and assigns) ever had, now have or which (I, my heirs, executors, or administrators) (it, its successors and assigns) hereafter can, shall or may have, for, upon or by reason of any matter, cause, or thing whatsoever; from the beginning of recorded time to the date of these presents.

IN WITNESS WHEREOF, _____
(Contractor)

has caused these presents to be duly executed this _____ day of _____ 20_____

Signed, Sealed and Delivered in the presence of:

_____ _____(seal)
(Individual -Contractor)

_____(seal)
(Partnership - Contractor)

_____ By _____(seal)
(Partner)

Attested:

_____
(Corporation)

_____ By _____
(Secretary) (President or Vice President)

(Corp. Seal)

END OF SECTION

SECTION 00939

WAIVER OF LIEN - MATERIALS AND LABOR

STATE OF _____
COUNTY OF _____

To: _____ (Owner)
_____
_____

WHEREAS, _____ (the undersigned) have been employed by _____ (Contractor) on the _____ (Project Name) to furnish the following:
_____
_____
_____ (description of material and services).

NOW THEREFORE, the undersigned, for good and valuable considerations do hereby waive and release any and all lien, or right of lien, or claim to lien on said above project and premises under the Law, in relation to Mechanics' Liens Law, on account of labor and materials, or both, furnished by the undersigned to or on account of the said contract for the said project and premises only so far as that portion of work which has been included in our requisition dated _____ and all prior requisitions.

THIS WAIVER AND RELEASE is being made to the undersigned in the amount of $ _____ which sum the undersigned certifies to be the balance due the undersigned for all labor, materials or both, furnished by the undersigned to or on account of the said contract as included on Contractor's requisition dated _____.

GIVEN UNDER our hand and seal, this _____ day of _____, 20 __.

By: _____
Manufacturer, Supplier or Subcontractor Name

_____
Signature of Authorized Representative

_____
Printed Name and Title

END OF SECTION

SECTION 00940

WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner:	City of Bath, Maine	Owner's Project No.:	
Engineer:	Wright-Pierce	Engineer's Project No.:	21119
Contractor:		Contractor's Project No.:	
Project:	Harward Street Pump Station and Sewer Interceptor Upgrade		
Contract Name:			
Date Issued:	Effective Date of Work Change Directive:		

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to: [Check one or both of the following]

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: $ _____ [increase] [decrease] [not yet estimated].

Contract Time: _____ days [increase] [decrease] [not yet estimated].

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:		
Title:		
Date:		

EJCDC® C-940, Work Change Directive.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SECTION 00941

CHANGE ORDER NO.: [Number of Change Order]

Owner:	City of Bath, Maine	Owner's Project No.:	
Engineer:	Wright-Pierce	Engineer's Project No.:	21119
Contractor:		Contractor's Project No.:	
Project:			
Contract Name:	Harward Street Pump Station and Sewer Interceptor Upgrade		
Date Issued:		Effective Date of Change Order:	

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

Description:

[Description of the change]

Attachments:

[List documents related to the change]

Change in Contract Price	Change in Contract Times [as days or dates]
Original Contract Price: $	Original Contract Times: Substantial Completion: Ready for final payment:
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. [Number of previous CO]: $	[Increase] [Decrease] from previously approved Change Orders No.1 to No. [Number of previous CO]: Substantial Completion: Ready for final payment:
Contract Price prior to this Change Order: $	Contract Times prior to this Change Order: Substantial Completion: Ready for final payment:
[Increase] [Decrease] this Change Order: $	[Increase] [Decrease] this Change Order: Substantial Completion: Ready for final payment:
Contract Price incorporating this Change Order: $	Contract Times with all approved Change Orders: Substantial Completion: Ready for final payment:

	Recommended by Engineer (if required)	Accepted by Contractor
By:		
Title:		
Date:		
	Authorized by Owner	Approved by Funding Agency (if applicable)
By:		
Title:		
Date:		

END OF SECTION

EJCDC® C-941, Change Order EJCDC® C-941, Change Order, Rev.1.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies and American Society of Civil Engineers. All rights reserved.

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Location: The work locations include areas within the right-of-ways on the following streets and within easements as shown on the drawings in the City of Bath, ME.
   1. High Street
   2. Office Drive
   3. Denny Road
   4. Park Street
   5. Winship Street
   6. Washington Street

B. Work Included: Upgrading the City of Bath Harward Street Pump Station and Gravity Sewer Interceptor. The major proposed work under this Contract includes:
   1. Construction of:
      a. New 8-foot diameter Combined Sewer Overflow structure and all ancillary systems as indicated on the Drawings;
      b. Other appurtenances as shown on the Drawings and specified herein.
      c. Pump station pumps, sump pumps, process piping, valves, slide gates, manual bar racks, supports, and all ancillary systems at the Harward Street Pump Station as indicated on the Drawings;
      d. Electrical, controls, SCADA panels, lighting, and generator at the Harward Street Pump Station;
      e. Windows, doors, building modifications, and HVAC system at the Harward Street Pump Station;
      f. Approximately 25 LF of 14-inch force main pipe to connect into the existing and combination air/vacuum relief valve;
      g. Approximately 5,900 LF of 36-inch and 24-inch gravity sanitary sewers pipe from the Dike Newell School to the Harward Street Pump Station;
      h. Sewer manholes with new 4-foot, 5-foot, and 6-foot structures;
      i. Sewer service laterals;
      j. Removal and disposal or abandonment of existing sewer manholes, sewer pipes, and sewer service laterals;
      k. Cleaning of approximately 3,000 LF of existing Harward Street Pump Station 16” force main pipe from pig launch at Harward Street Pump Station to terminus manhole on Bowery Street;
      l. Other appurtenances as shown on the Drawings and specified herein.
   2. Demolition of:
      a. Existing pump station pump, sump pumps, process piping, valves, slide gates, supports, and all ancillary systems as indicated on the Drawings;
      b. Electrical, control, SCADA panels, and lighting;
      c. Windows, Doors, HVAC system, and Generator;
      d. Approximately 25 LF segment of force main;
      e. Gravity sanitary sewer;

f. Sewer manholes;
g. Abandonment of existing gravity sewer and manholes
h. Abandonment and/or infill of existing sanitary sewer and sewer manholes
i. Other appurtenances as shown on the Drawings and specified herein.

3. Renovation of:
   a. Pump Station exterior wall, brick veneer, and cracked concrete;
   b. Floodproofing of existing pump station
   c. Other appurtenances as shown on the Drawings and specified herein.
4. Reconstruction of Office Drive (Bid Alternate A):
   a. Removal of existing pavement, regarding, and placement of new pavement from STA 100+00 to STA 106+00, as indicated on the Drawings.
5. Maintain pump station and gravity sewer flow as detailed in Part 3 of this section.
6. Remove and/or relocate equipment as indicated on the Drawings.
7. Pre-purchased Materials:
   a. Owner has purchased approximately 1,200 LF of 36-inch PVC sewer pipe. The pipe is stored at the Owner's facilities at the City of Bath Landfill in its native shipping container.
   b. Contractor shall incorporate the pipe into the project, including transporting the pipe to the work site and installing the pipe complete in accordance with the specifications.

C. Removals, Relocations and Rearrangements
1. Examine the existing site for the work of all trades which will influence the cost of the work under the bid. This work shall include removals, relocations and rearrangements which may interfere with, disturb or complicate the performance of the work under the bid involving systems, equipment and related service lines, which shall continue to be utilized as part of the finished project. The Contractor is responsible for all coordination in this regard.
2. Provide in the bid a sufficient amount to include all removals, relocations, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

B. The project has been reviewed by the New England District of the U.S. Army Corps of Engineers (USACE) and authorized under General Permit 6 of the Maine General Permit. Contractor to adhere to terms and conditions of Maine General Permit. Refer to the General Conditions and Supplementary Conditions and Appendix E for more information. Contractor to coordinate project schedule with Owner such that the permit reissuance can be requested if applicable work is not completed by October 14, 2026.

C. The project is under review by the Maine Department of Environmental Protection (Maine DEP) for a Natural Resources Protection Act (NRPA) permit. The permit is expected to be issued prior to Contract Award. No work within natural resource areas can begin until the NRPA permit is finalized. Contractor to adhere to all conditional requests and terms of the permit regarding work in wetlands. Refer to the General Conditions and Supplementary Conditions.

D. Previous soils testing indicates that contaminated soils have been identified within the area of work at 1090 High Street. Previous testing indicates that the hazardous materials at the time of testing were below the contamination threshold for construction work and excavation. The Contractor will be required to monitor soil and groundwater conditions and potentially conduct testing for contamination during excavation. Refer to Specification Section 02080A and Appendix C for additional information.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 MAINTAIN EXISTING WORKS

A. Existing Operations:
   1. The existing pump station provides influent flow and conveyance to the WWTF. The station also has a manual bar rack to facilitate screening of solids.
   2. Typical raw sewerage influent flows to the pump station are as follows:
      a. Minimum: 0.50-mgd;
      b. Annual Average: 1.40-mgd;
      c. Maximum: 5.20-mgd;
   3. Contractor shall be required to convey the entire range of influent flows for the duration of the project. Bypass pumping shall be variable speed to match influent flows. Refer to Section 01515 for requirements regarding Bypass Pumping.
   4. Utilities include municipal water, electric power, telephone, and fuel oil. Refer to Section 01500.

B. Maintain Conveyance:
   1. State and federal regulations require that at all times during construction work under this contract, the pump station remain operational and sewers convey wastewater throughout construction, until such time as the new facilities are accepted and on-line.
   2. The Contractor shall provide, maintain and operate all temporary facilities such as dams, pumping equipment, conduits, and all other labor and equipment necessary to intercept the sewage flow before it reaches the points where it would interfere with the work, and carry it past the work.
   3. The Contractor's operations shall not hinder the delivery, storage and use of materials and supplies, nor hinder staff duties, nor disrupt utility service.
   4. The Owner must have access to the existing pump station and equipment at all times unless a specific exception is granted by the Owner.

5. Maintain all existing sewer and storm drain services.

C. Maintain Existing Combined Sewer Overflow (CSO)
   1. There is an existing CSO in SMH-1142. That CSO is being relocated to a new location in SMH-137. The CSO in SMH-1142 must be maintained and active until the new CSO in SMH-137 has been installed, tested, and accepted.
   2. Until the new pump station pumps are installed, tested, and accepted, thereby increasing the capacity of the station to 6.0 MGD, the new CSO gate in SMH-137 shall be set at an elevation to divert all flows in excess of 5.2 MGD through the CSO pipe. Contractor shall coordinate elevation in the field with the Engineer.

D. Minimize Interference:
   1. The Contractor shall at all times conduct their operations so as to interfere as little as possible with existing works. The Contractor shall develop a program, in cooperation with the Owner, Engineer, and interested officials, which shall provide for the construction and putting into service of the new works in the most orderly manner possible. This program shall be adhered to except as deviations therefrom are expressly permitted.
   2. Work of connecting with, cutting into, and reconstructing existing pipes or structures shall be planned to interfere with the operation of the existing facilities for the shortest possible time and when the demands on the facilities best permit such interference. It may be necessary to work outside of normal working hours to minimize interference. Before starting work which will interfere with the operation of existing facilities, the Contractor shall do all possible preparatory work and shall see that all tools, materials, and equipment are made ready and at hand.
   3. The Contractor shall limit their personnel to the proposed work areas and limits of work.

3.2 FLOOD CONSIDERATIONS

A. The pump station and portions of the horizontal work are located adjacent to the Kennebec River.

B. The pump station and portions of the horizontal work are in the FEMA 100-year flood plain. Contractor to note that the 100-year base flood elevation is 8-feet.

C. The pump station site and surrounding area are subject to periodic flooding.

D. Contractor shall protect new work and materials from flooding and shall repair or replace damaged work and/or materials at no additional cost to the Owner.

3.3 CONSTRUCTION SEQUENCE

A. Construction of the proposed pump station and piping will disrupt the existing pump station and sewer operations. To maintain operation and to minimize disruption, the construction must be divided into phases or sequenced appropriately. The construction sequence phases and dates must allow the facility to maintain treatment as specified in paragraph 3.1.B.
   1. Decommissioning of the existing CSO outfall cannot occur until after the new CSO outfall is installed, tested, and approved by Engineer. Contractor shall set the CSO slide gate elevation such that all flows in excess of 6.0 MGD are diverted to the CSO overflow. Contractor shall coordinate slide gate elevation with Engineer and Owner after installation.

2. Demolition of the existing pump station pumps and ancillary equipment, and emergency power system cannot begin until the bypass pumping system is in place and operational, and until all equipment for the new pumping system and emergency power system are on site. The gate valve upstream of the forcemain bypass assembly must be installed to allow bypass pumps to pump into the existing force main. The operating volume of the wet well is approximately 12,000 gallons and the average influent flow is approximately 990 gpm under dry weather conditions.
3. Telemetry system components including but not limited to antenna and cellular modem are to be re-used. Removal and relocation of the existing telemetry system cannot begin until the existing pumps are decommissioned and bypass pumping is initiated.
4. The Contractor shall clean the existing 16” force main prior to startup and testing of the new pumps at Harward Street pump station.
5. The Contractor may deviate from this construction sequencing as outlined in paragraph 3.3.C.

B. The Contractor shall submit to the Engineer for review and acceptance a complete schedule of their proposed sequence of construction operations prior to commencing any work. This schedule shall include the Contractor's plans for doing the work. The sequencing plan and schedule shall clearly identify critical timeframes for taking facilities offline and for placing facilities into service, including sufficient time required for new equipment and/or processes to be tested and proven reliable before proceeding to the next item. This reliability testing is above and beyond any specified demonstration and site acceptance testing.

C. The Contractor shall submit to the Engineer a written request to deviate from the above sequence with adequate supporting information to demonstrate to the Engineer that the continuity and degree of treatment will not be adversely affected.

D. The Contractor shall include the cost of all temporary facilities required to maintain flows during the construction period in their bid price. The cost shall include the cost for all labor, tools, equipment and materials necessary.

E. The Contractor shall notify the Owner a minimum of seven (7) days in advance of any work which may affect or disrupt the operation of the existing facilities and two (2) calendar weeks in advance of removing tanks or wetwells from service. Once the interruption occurs the Contractor must maintain a workforce on-site to complete the work in the agreed upon time.

F. Any work by the Contractor which requires the mechanical or electrical isolation of an existing piece of equipment, process or system shall be coordinated with the Engineer. Any and all isolation of electrical or mechanical equipment or process shall be accomplished in strict accordance with applicable codes and standards and the stricter of the Contractor's or Owner’s lock-out/tag-out procedures.

G. The Contractor shall have all materials and equipment on-site, and shall receive the Owner's approval, prior to initiating work which requires any part of the existing pump station to be off-line.

H. The Contractor shall allow in the Bid reasonable time to accommodate operations at the existing pump station, including the need for the Owner to respond to emergencies. The Contractor shall not be eligible for additional compensation due to interruptions of the Contractor's schedule, in order for the Owner to respond to routine conditions.

3.4 SCHEDULE LIMITATIONS AND WORK RESTRICTIONS/REQUIREMENTS

A. Traffic Control:
   1. A project-specific Traffic Control Plan shall be submitted prior to the Pre-Construction Meeting (refer to Section 01570). The Traffic Control Plan shall identify traffic management requirements for each distinct component of the project.
   2. Contractor shall provide one lane for the passage of traffic within any work zone unless approved by the Owner.
   3. Contractor shall maintain access to all residences and businesses at all times.
   4. Contractor shall maintain access for garbage collection and mail services to all residences and businesses at all times. Contractor shall coordinate with these service providers.
   5. Contractor shall maintain access for bus routes, schools, day care facilities, etc. at all times. Contractor shall coordinate efforts with local school district to ensure access.

B. Proposed Road Closures:
   1. Road closures shall be requested in writing and must be initially approved by the Public Works Director and formally approved by the City of Bath Police Chief.

C. Pavement Maintenance and Winter Shutdown Period:
   1. The Contractor shall maintain pipe trenches with compacted gravel until pavement operations can be completed.
   2. No excavation in paved roadways shall be allowed after November 15.
   3. All streets shall be paved prior to any “winter shutdown period”, which is defined as November 15th to April 1st. Any temporary pavement placed prior to winter shutdown shall be removed during the following construction season. The substantial completion time and the contract completion dates (or days) include the noted "winter shutdown period".

END OF SECTION

SECTION 01045

CUTTING, CORING AND PATCHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included - This section establishes general requirements pertaining to cutting, excavating, coring, fitting, and patching of the Work required to:
   1. Make alterations to existing structures.
   2. Make the parts fit properly.
   3. Replace work not conforming to requirements of the Contract Documents.
   4. Contractor is responsible for all cutting, coring, and rough and finish patching. Contractor shall coordinate the work of any and all subcontracting trades performing the work.
   5. Contractor is responsible for reviewing with the Owner and Engineer and receiving permission to proceed prior to cutting and coring and patching.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Perform all cutting, coring and patching in strict accordance with pertinent requirements of these Specifications, and in the event no such requirements are determined, in conformance with the Engineer's written direction.

1.4 SUBMITTALS

A. In accordance with the requirements specified in Section 01340. Provide the following information at least 30 days prior to cutting or coring:
   1. Identification and qualifications of cutting/coring subcontractor(s) including: company name, business address contact information, or if by Contractor, indicated as such.
   2. Key plan and schedule of cuts/cores indicating the: location of the cut/core, size (i.e., wall, floor, roof, etc.), equipment to be used and identification of any potential obstructions or embedded conduits and wiring.

B. Request for the Engineer's consent to proceed:
   1. Prior to cutting which affects structural safety, submit written request to the Engineer for permission to proceed with cutting.
   2. Should conditions of the work, or schedule, indicate a required change of materials or methods for cutting and patching, Contractor shall notify the Engineer and secure written permission prior to proceeding.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials for replacement of work shall be equal to those of adjacent construction and shall comply with the pertinent sections of these Specifications.

B. Concrete and grout for rough patching shall be as specified in Divisions 3 and 4.

PART 3 - EXECUTION

3.1 CONDITIONS

A. Inspection:

1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, coring, backfilling, and patching.
2. After uncovering the work, inspect conditions affecting installation of new work.

B. Discrepancies:

1. If uncovered conditions are not as anticipated, immediately notify the Engineer and secure needed directions.
2. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION PRIOR TO CUTTING AND CORING

A. Provide all required protection including, but not necessarily limited to, shoring, bracing and support to maintain structural integrity of the work.

B. All cutting and coring shall be performed in such a manner as to limit the extent of patching.

C. All holes cut through concrete and masonry walls or slabs shall be core drilled unless otherwise approved. No structural members shall be cut without approval of the Engineer and all such cutting shall be done in a manner directed by Engineer. No holes may be drilled in beams or other structural members without obtaining prior approval. All work shall be performed by mechanics skilled in this type of work.

D. If holes are cored through floor slabs they shall be drilled from below.

E. The Contractor shall determine from Owner's information, logical deduction and field testing if there are embedded electrical conduits, wiring or piping in the coring locations and shall readjust locations if possible to avoid coring through them. If concealed embedded conduit and piping are damaged, or severed, the coring contractor shall immediately notify the Contractor, Owner and RPR to determine impact of the damage and develop and implement a plan to repair the damage and reactive the lines.

F. If embedded concealed conduit, wiring or pipe is damaged or severed and all reasonable steps were taken by the Contractor to identify embedded items, and alternate routing was investigated, the repair work will be compensated by the Owner through a Change Order. If it was reasonable to expect an embedded item could have been present at the location, the Contractor shall repair at no additional cost to the Owner.

3.3 CORING

A. Coring shall be performed with an approved non-impact rotary tool with diamond core drills. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.
B. All equipment shall conform to OSHA standards and specifications pertaining to plugs, noise and fume pollution, wiring and maintenance.
C. Provide protection for existing equipment, utilities and critical areas against water or other damage caused by drilling operation.
D. Slurry or tailings resulting from coring operations shall be vacuumed or otherwise removed from the area following drilling. Slurry or tailings shall not be allowed to enter floor drains.
E. Work area (e.g., adjacent walls, floors, ceilings, pipes, conduits, etc.) shall be cleaned to remove splash residues from coring operation.

3.4 CUTTING

A. Cutting shall be performed with a concrete wall saw and diamond saw blades of proper size.
B. Provide for control of slurry generated by sawing operation on both sides of wall.
C. When cutting a reinforced concrete wall, the cutting shall be done so as not to damage bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.
D. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.
E. Provide equipment of adequate size to remove cut panel.
F. Slurry or tailings resulting from cutting operations shall be vacuumed or otherwise removed from the area following drilling. Slurry or tailings shall not be allowed to enter floor drains.
G. Work area (e.g., adjacent walls, floors, ceilings, pipes, conduits, etc.) shall be cleaned to remove splash residues from cutting operation.

3.5 PERFORMANCE

A. Perform all required excavating and backfilling as required under pertinent sections of these specifications. Perform cutting, coring and demolition by methods which will prevent damage to other portions of the work and will provide proper surfaces to receive installation of repair and/or new work. Perform fitting and adjustment of products to provide finished installation complying with the specified tolerances and finishes.
B. Coring or cutting which exposes cut surfaces of reinforcing steel or structural steel shall be coated. Coating shall be 10 mil (dry film thickness) applied in two 5 mil (dry film thickness) coats of a single component moisture cured coal tar urethane or two part coal tar epoxy corrosion barrier. Alternately the exposed steel can be cut back two inches from the surface and a non-shrink grout applied over the steel flush to the concrete core or cut surface.

C. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.
D. Finish patching shall match existing surfaces as approved.

END OF SECTION

SECTION 01050

COORDINATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Contractor is required to work in close proximity to Owner's existing facilities. The Contractor, under this Contract, will be responsible for coordinating construction activities with Owner to ensure that services, facilities, and safe working conditions are maintained.

B. Any damage to existing structures, equipment and property, accepted equipment or structures, and property or work in progress by others; as a result of the Contractor's or their subcontractor's operations shall be made good by the Contractor at no additional cost to the Owner.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 COORDINATION WITH OTHERS

A. City of Bath:

1. Contractor shall coordinate access, egress, detours and traffic control, if required, at each site with the Bath Police Department. The Contractor shall notify Bath Police, Fire Department and Rescue Squad at least 24 hours in advance of any street closings or detours.
2. Contractor shall coordinate all work on City property with the Public Works personnel.
3. The Contractor shall be responsible for coordinating and maintaining public services to all public and private properties.

B. Bath Water District (BWD)

1. Contractor shall be responsible for coordinating all work in the vicinity of water lines with the BWD.

C. Central Maine Power Company (CMP):

1. The Contractor shall be responsible for coordinating all work around CMP facilities with CMP and shall bear all costs of inspection requirements, temporary facilities relocation and other requirements. Refer to Section 01150 for service to the pump station.

D. Consolidated Communications:

1. The Contractor shall be responsible for coordinating and providing telephone service to all construction sites, both temporary and permanent. The Contractor shall also be responsible for coordinating all work around Consolidated Communications facilities with Consolidated Communications and shall bear all costs of inspection requirements, temporary facilities relocation and all other requirements.

E. The Contractor shall provide the Resident Project Representative and City Engineer a construction schedule indicating the times to perform the work required. The Contractor shall update the schedule when required and give the facility one week notice before the start of any work. The Contractor shall provide the facility personnel enough time to obtain materials and perform the work required of them. The Contractor shall daily communicate with the Resident Project Representative and City personnel concerning updating the schedule, job progress, delay or early starts that affect the treatment process, facility staffing, etc.

F. Weekly coordination meetings shall be held between the Contractor, Owner's personnel and the Resident Project Representative. This meeting shall cover the following:
   1. Work to be completed the following week
   2. Project Schedule
   3. Shop Drawing and O&M issues
   4. Outstanding RFIs and Clarifications
   5. Change Orders and Field Orders
   6. Review of Record Drawing Information
   7. Discussion/Resolution of any old issues
   8. New issues discussion
   9. Contractor's Safety and Health Plan Updates

G. The Contractor shall be responsible for explicitly notifying all equipment suppliers, electrical subcontractor, and the instrumentation supplier that they are required to coordinate their work with the instrumentation supplier by providing operating sequences, input/out specifications with wiring diagrams for all equipment, and that they shall review and comment on each other's shop drawings to ensure that all interfaces are compatible.

H. Snow Removal Coordination: The Contractor shall be responsible for all snow removal activities in construction and laydown areas onsite. Contractor is to coordinate closely with Owner's operations staff to maintain access to all areas of the facility to facilitate normal operations.

1.4 CONTRACTOR'S USE OF PREMISES

A. Contractor shall have use of the premises as defined in the General Conditions for the performance of the Work.
   1. Pump Stations
      a. Contractor laydown area, trailer location, and parking areas shall be coordinated with the Owner.
      b. Restricted access: A record of all personnel entering and exiting the site shall be kept at all times. This includes all deliveries and activities after hours.

B. Contractor work hours will be limited to the hours defined in Division 0. Any work outside these hours will require permission of the Owner and adequate notice.

C. Contractor shall maintain access and utilities to the Pump Station and all other adjacent facilities at all times. Whenever access is cut off in one direction, an alternative route for accessing all equipment and tankage must be maintained.

D. Contractor shall coordinate delivery schedules, site access, and other construction-related activities with any other contractors that may be hired by the Owner during the course of construction.
E. Contractor shall assume full responsibility for security of all of their, and their subcontractors', materials and equipment stored on the site.
F. If directed by the Owner, Contractor shall move any stored items which interfere with operations of Owner.
G. Obtain and pay for use of additional storage or work areas if needed to perform the Work.
H. Contractor shall not have access to Owners lunch room, toilet or locker room facilities at any time and shall provide all necessary facilities in accordance with Specification Section 01500.

END OF SECTION

SECTION 01070

ABBREVIATIONS & SYMBOLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Where any of the following abbreviations are used in these Specifications, they shall have the meaning set forth opposite each.

AASHTO	American Association of State Highway & Transportation Officials
AC	Alternating Current
ACI	American Concrete Institute
ACP	Asbestos Cement Pipe
AGA	American Gas Association
AIC	Ampere Interrupting Capacity
AGMA	American Gear Manufacturers Association
AIEE(IEEE)	American Institute of Electrical Engineers (Institute of Electrical and Electronics Engineers, Inc.)
AISC	American Institute of Steel Construction
AMP	Ampere 125-16
Amer. Std.	American Standard for Cast Iron Pipe Flanges and Flanged Fittings, Class l25 (ASA Bl6 ll960)
ANSI	American National Standards Institute
API	American Petroleum Institute
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American or Brown and Sharpe Wire Gage
AWWA	American Water Works Association
CCTV	Closed Circuit Television
CF	Cubic Foot
CFM	Cubic Foot Per Minute
CFS	Cubic Foot Per Second
CI	Cast Iron
CIPP	Cured-in-Place Pipe
CIPRA	Cast Iron Pipe Research Association
CSI	Construction Specifications Institute
CY	Cubic Yard
DC	Direct Current
DEP	Department of Environmental Protection
DI (DIP)	Ductile Iron (Pipe)
DOT	Department of Transportation
EDR	Equivalent Directional Radiation

EPA	U.S. Environmental Protection Agency
FPS	Feet Per Second
FT	Feet
GAL	Gallons
GPD	Gallons Per Day
GPM	Gallons Per Minute
HP	Horsepower
IBR	Institute of Boiler and Radiator Manufacturers
IN	Inches
ISA	Instrument Society of America
KVA	Kilovolt-ampere
KW	Kilowatt
LB	Pound
MACP	Manhole Assessment and Certification Program
MAX	Maximum
MGD	Million Gallons Per Day
MIN	Minimum
NACE	National Association of Corrosion Engineers
NASSCO	National Association of Sewer Service Companies
NBS	National Bureau of Standards
NEC	National Electrical Code, Latest Edition
NEMA	National Electrical Manufacturers Association
NEWWA	New England Water Works Association
NPT	National Pipe Thread
OS&Y	Outside Screw and Yoke
PCA	Portland Cement Association
PPM	Parts Per Million
PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch Gage
PVC	Polyvinyl Chloride
RPM	Revolutions Per Minute
RUS	Rural Utility Service
SF	Square Foot
STL. W.G.	U.S. Steel Wire, Washburn and Moen, American Steel and Wire Cos., or Roebling Gage
SY	Square yard
TDH	Total Dynamic Head
USAS	Standards of the United States of America Standards Institute (formerly American Standards Association)
USS GAGE	United States Standard Gage
VC	Vitrified Clay
WSP	Working Steam Pressure
Fed. Spec.	Federal Specifications issued by the Federal Supply Service of the General Service Administration, Washington, D.C.

END OF SECTION

SECTION 01100

ALTERNATES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Each Bidder shall be held fully responsible for examining the scope of the Alternates generally defined herein and for recognizing any modifications to the Work caused by any Alternate

B. Alternate:
   1. To enable the Owner to compare total costs where alternate materials and methods might be used, an Alternate has been established as described in this Section of these Specifications.

C. Submittals:
   1. All Alternates described in this Section are required to be reflected on the Bid Form as submitted by bidders. However, do not submit alternates other than as described in this Section, except as provided for "substitutions" under the General Conditions.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

PART 2 - PRODUCTS

2.1 PRODUCT HANDLING

A. If the Owner elects to proceed on the basis of the described Alternatives, make all modifications to the Work required in furnishing and installing the selected Alternative or Alternatives to the approval of the Engineer and at no additional cost to the Owner other than as proposed on the Bid Form.

2.2 ALTERNATE NO. A – RECONSTRUCTION OF OFFICE DRIVE

A. The work of this ALTERNATE shall consist of road reconstruction of Office Drive from STA 100+00 to STA 106+00, complete in all respects. The work included in this ALTERNATE effects nearly every Section of these specifications and alternates. See DRAWINGS C-19 to C-25 for explicit details.

PART 3 - EXECUTION

3.1 ADVANCE COORDINATION

A. Immediately after award of the Contract, or as soon thereafter as the Owner has made a decision on whether the Alternate will be selected, thoroughly and clearly advise all necessary personnel and suppliers as to the nature and extent of Alternates selected

by the Owner. Use all means necessary to alert those personnel and suppliers involved as to all changes in the work caused by the Owner's selection or rejection of the Alternate.

END OF SECTION

SECTION 01150A

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. For lump sum items, payment shall be made to the Contractor in accordance with an accepted Progress Schedule and Schedule of Values on the basis of actual work completed.

B. For unit-price items, payment shall be based on the actual amount of work accepted and for the actual amount of materials in place, as shown by the final measurements.

1. All units of measurement shall be standard United States convention as applied to the specific items of work by tradition and as interpreted by the Engineer.
2. At the end of each day's work, the Contractor's Superintendent or other authorized representative of the Contractor shall meet with the Resident Project Representative and determine the quantities of unit price work accomplished and/or completed during the work day.
3. The Resident Project Representative will then prepare two "Daily Progress Reports" which shall be signed by both the Resident Project Representative and Contractor's Representative.
4. Once each month the Resident Project Representative will prepare two "Monthly Progress Summation" forms from the month's accumulation of "Daily Progress Reports" which shall also be signed by both the Resident Project Representative and Contractor's Representative.
5. These completed forms will provide the basis of the Engineer's monthly quantity estimate upon which payment will be made. Items not appearing on both the Daily Progress Reports and Monthly Progress Summation will not be included for payment. Items appearing on forms not properly signed by the Contractor will not be included for payment.
6. After the work is completed and before final payment is made there for, the Engineer will make final measurements to determine the quantities of various items of work accepted as the basis for final settlement.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SCOPE OF PAYMENT

A. Payments to the Contractor will be made for the actual quantities of the Contract items performed and accepted in accordance with the Contract Documents. Upon completion of the construction, if these actual quantities show either an increase or decrease from the quantities given in the Bid Form, the Contract unit prices will still prevail.

B. The Contractor shall accept compensation, as herein provided, in full payment for furnishing all materials, labor, tools, equipment, and incidentals necessary to the completed work and for performing all work contemplated and embraced by the Contract; also for all loss or damage arising from the nature of the Work, or from the

action of the elements, or from any unforeseen difficulties which may be encountered during the prosecution of the Work and until its final acceptance by the Engineer, and for all risks of every description connected with the prosecution of the work, except as provided herein, also for all expenses incurred in consequence of the suspension of the work as herein authorized.

C. The payment of any partial estimate or of any retained percentage except by and under the approved final invoice, in no way shall affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damage due to such defects.

1.4 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

A. When alterations in the quantities of work not requiring supplemental agreements, as hereinbefore provided for, are ordered and performed, the Contractor shall accept payment in full at the Contract price for the actual quantities of work done. No allowance will be made for anticipated profits. Increased or decreased work involving supplemental agreements will be paid for as stipulated in such agreements.

1.5 OMITTED ITEMS

A. Should any items contained in the bid form be found unnecessary for the proper completion of the work contracted, the Engineer may eliminate such items from the Contract, and such action shall in no way invalidate the Contract, and no allowance will be made for items so eliminated in making final payment to the Contractor.

1.6 PARTIAL PAYMENTS

A. Partial payments shall be made monthly as the work progresses. Partial payment shall be made subject to the provisions of the Supplemental and General Conditions. Contractor's Partial Payment Requests shall be submitted in two parts; one part for EPA/DEP grant eligible quantities and one part for non-eligible quantities. The breakdown of quantities will be determined by the Engineer.

B. Technical Specifications may include Special Payment Provisions which provide additional restrictions on partial payments.

1.7 PAYMENT FOR MATERIAL DELIVERED

A. When requested by the Contractor and at the discretion of the Owner, payment may be made for all or part of the value of acceptable, non-perishable materials and equipment which are to be incorporated into bid items, have not been used, and have been delivered to the construction site or placed in storage places acceptable to the Owner. Payment shall be subject to the provisions of the General and Supplementary Conditions.

B. No payment shall be made upon fuels, supplies, lumber, false work, or other materials, or on temporary structures or other work of any kind which are not a permanent part of the Contract.

1.8 FINAL PAYMENT

A. The Engineer will make, as soon as practicable after the entire completion of the project, a final quantity invoice of the amount of the Work performed and the value of such Work. Owner shall make final payments of the sum found due less retainages subject to the provisions of the General and Supplementary Conditions.

1.9 INCIDENTAL WORK

A. Incidental work items for which separate payment is not made include (but are not limited to) the following items:

1. Clearing, grubbing and stripping
2. Protection of existing trees beyond the limits of disturbance
3. Dust control
4. Temporary Construction Dewatering
5. Clean-up
6. Erosion control
7. Pipe bedding and backfill
8. Compaction testing of backfill
9. Restoration of property, and replacement of fences, curbs, structures, sign posts, guard rails, rock wall, mail boxes, traffic loop detectors and other minor items disturbed by the construction activities
10. Coordination with the Owner, Utilities and others, including related inspection cost (refer to Section 01050)
11. Utility crossings and relocations, unless payment is otherwise made
12. Project Signs
13. Trench boxes, steel and/or wood sheeting as required, including that left in place
14. Project record documents
15. Materials testing
16. Construction schedules, bonds, insurance, shop drawings, warranties, guarantees, certifications, and other submittals required by the Contract Documents
17. Repair and replacement of water lines under two inches in size, culverts, underdrains, rock lined drainage trenches in streets and other utilities damaged by construction activities and corresponding proper disposal of removed materials unless otherwise paid for
18. Cleaning, testing and disinfection of all water lines and appurtenances
19. Maintenance of all existing sewers flows and repair of existing sewer pipes
20. Final cleaning of gravity sewers and storm drains
21. Removal and disposal of existing sewer structures and pipe as and where indicated in the Drawings, unless payment is made otherwise.
22. Temporary utilities for construction and to maintain existing service during construction
23. Temporary utility services to buildings as required to maintain service during construction
24. Quality assurance testing
25. Temporary construction and other facilities not to be permanently incorporated into the Work necessary for construction sequencing and maintenance of operations, including but not limited to scaffolding and staging.
26. Weather protection
27. Permits not otherwise paid for or provided by the Owner
28. Visits to the Project site or elsewhere by personnel or agents of the Contractor, including manufacturer's representatives, as may be required
29. On-site and other facilities acceptable to Engineer for the storage of materials, supplies and equipment to be incorporated into the Work

30. Facilities start-up services required by the Contract Documents
31. Pipe markings
32. Pavement markings
33. Removal of existing pavement, unless payment is otherwise made.
34. Earthwork (except ledge)
35. Pre-construction photos and videos
36. Construction administration and insurance
37. All excavation except the test pits specifically shown or ordered by the Engineer to establish sewer line and water line locations, earth excavation below grade and rock excavation.
38. Test pits to establish in place field soils density, groundwater conditions, or requirements for dewatering.
39. Test pits for the Contractor's benefit.
40. Connection of existing sewer mains (12" diameter and smaller) to new manhole structures.
41. Capping of pipes to be abandoned in place without any requirements to clean or flowable fill as identified herein.
42. Removing and resetting of existing shrubs, plants, and vegetation disturbed during construction, other than those identified on the Drawings to be removed and reset.
43. Protection of existing block and stone retaining walls unless otherwise identified to be removed, relocated or modified in the Drawings.
44. Installing temporary pavement markings on binder course that will not be surfaced within 14 days of installation.
45. Installing raised pavement markers and temporary symbols on the binder course within 48 hours of installing any section of the binder course and maintaining these throughout the project duration.
46. Locating and verifying the locations of water and sewer services within the limits of work. Capping or plugging existing underground utilities as shown on the plans and Dye testing as required to determine bulkheading and reconnection requirements.
47. Modifying, to include coring, patching and parging of existing sewer and drainage structures to accommodate new pipes as shown on plans.
48. Removal and subsequent delivery of replaced frames and/or covers, to a location within the City limits designated by the Owner.
49. Raising and lowering of existing frames and covers of buried utilities to grade unless payment is otherwise provided.
50. Removal of temporary or permanent pavement markings, prior to paving. This includes removing markings that are applied on the winter binder layer, prior to installation of the wearing course.
51. Impervious material trench dams.
52. Bracing/support of utility poles during excavation.
53. Flushing and final cleaning of sewer system.
54. Relocation and installation of property owner structures and shrubs.
55. Bollards
56. Contaminated Soils and Water management monitoring and services of an Environmental Professional

1.10 DESCRIPTION OF PAY ITEMS – BASE BID

A. The following sections describe the measurement of and payment for the work to be done under the respective items listed in the Bid Form for the base bid.

B. Each unit or lump sum price stated in the Bid Form shall constitute full compensation, as herein specified, for each item of the work completed.

(1) – Harward Street Pump Station Upgrade

A. Method of Measurement: Lump Sum

B. Basis of Payment:

1. Upgrade of the Harward Street Pump Station shall be paid for at the Contract lump sum price stated in the Bid Schedule.

2. Said lump sum price shall constitute full compensation for furnishing all labor, materials, tools and equipment necessary for upgrade of the Harward Street Pump Station site, complete, operational, and satisfactorily tested, including, but not limited to, site and equipment demolition including removal of the existing pavement and concrete walkways at the pump station site, removal of existing generator and fence, removal of existing force main to extents shown, other demolition as indicated on the drawings, site preparation, fill material, excavation and backfill, clearing and grubbing, dewatering, modifications to the existing building, all equipment, automatic standby generator, temporary and permanent electrical service work, instrumentation, new force main piping from the pump station to the transition to the existing force main, air vacuum/release valve manhole modifications, pump station bypass pumping, concrete generator pad, loaming and seeding, erosion control, grading, cleaning, start-up and testing, and all appurtenant work needed for complete and operational systems at the pump station as indicated on the Drawings and as specified.

(2) – Additional Earthwork – Excavation and Disposal at Pump Station Site Only

This pay item is applicable for work at the pump station site, exclusive of piping. Refer to the bid item titled ‘Excavation Below Grade and Replacement Backfill’ for additional earthwork associated with piping.

Should modifications in the pump station structures or ductbanks be ordered, and should such modifications increase or decrease the quantity of earth excavation below normal grade from that indicated on the Drawings or specified, adjustment shall be made therefore under this Item.

The quantity of earth excavation and backfill above normal grade to be considered under this adjustment class shall be that quantity omitted in accordance with the requirements of the Engineer. The limits of measurement shall be as hereinbefore defined and as indicated on the Drawings.

The quantities to be considered under this Item shall be cumulative, that is, an increase on any part of the work shall offset a decrease on any other part of the work, and the final adjustment shall be based on the net increase or decrease.

If an additional quantity of earth excavation and backfill below normal grade is ordered or permitted by the Engineer, the Contractor shall be paid therefore at the unit price for this Item.

The unit price for this adjustment class shall constitute full compensation for excavation and all work incidental thereto including drainage.

If the quantity of excavation done by the Contractor is less than that indicated on the drawings or specified, the Owner shall receive credit for such decrease at the unit price for this Item.

If in the opinion of the Engineer, the material below normal grade of any excavation is unsuitable for foundation, it shall be removed to such limits as the Engineer may direct, whether done by hand or by machine.

The quantity of excavation below normal grade to be paid for under this Item shall be equal to the number of cubic yards of unsuitable material excavated, measured to the extent of the work done as ordered by the Engineer.

The unit price as stated in the Bid Schedule shall constitute full compensation for excavation below normal grade and disposal of unsuitable material.

(3) – Crack Repair of Existing Concrete Tanks and Structures

A. Method of Measurement:
   1. Crack repairs to existing concrete structures are to be provided under this item. The cracks to be repaired will be field located by the Engineer during construction.
   2. Cracks to be repaired shall be delineated as follows:
      a. Cracks that are dry at the time of repair.
      b. Cracks that are wet at the time of repair.
   3. The quantities to be considered under these items shall be based on the actual linear feet of cracks repaired and measured to the extent as ordered by the Engineer. This Bid Item does not include repair of cracks in new tanks and structures. Cracks in new concrete structures are considered to be structural defects to be repaired by the Contractor at no additional expense to the Owner.

B. Basis of Payment:
   1. Payment for these items shall be paid for at each of the unit prices as stated in the Bid Schedule.
   2. The unit price as stated in the Bid Schedule shall be full compensation for furnishing all labor, materials, tools and equipment as necessary for cleaning and removing all debris from cracks and installing crack repair material including all necessary appurtenances, materials and equipment. All crack repairs shall be in accordance with the Drawings and Specifications and manufacturer’s instructions.

(4) – Repair Surface Defects in Existing Concrete Tanks and Structures

A. Method of Measurement:
   1. Miscellaneous repairs to surface defects in existing concrete tanks and structures are to be provided under this item. The areas to be repaired will be field located by the Engineer during construction.
   2. Surface defects to be repaired include, but are not limited to: spalls, honeycomb areas, delaminated concrete, air voids (bugholes), degraded concrete, etc.
   3. The quantities to be considered under these items shall be based on the actual volume repaired and measured to the extent as ordered by the Engineer.
   4. General Contractor assume an average repair thickness of 2 inches.
   5. This Bid Item does not include repairs to surface defects in new concrete tanks and structures. Surface defects in new concrete structures are to be repaired by the Contractor at no additional expense to the Owner.

B. Basis of Payment:
   1. Payment for these items shall be paid for at each of the unit prices as stated in the Bid Schedule.
   2. The unit price as stated in the Bid Schedule shall be full compensation for labor, materials, and equipment as necessary for removal and disposal of deficient and degraded concrete, preparation of concrete surfaces to receive repair materials and for placing new concrete repair material including all necessary forming, bonding agents and primers, curing, finishing and environmental controls. All concrete repairs shall be in accordance with the Drawings and Specifications.

(5) – Utility Service Allowance

A. Method of Measurement:
   1. Cash Allowance for electrical utility services.

B. Basis of Payment:
   1. The allowance shall only cover the cost charged to the Contractor by the local power company for permanent electrical service to include service disconnection and re-energization, new transformers if necessary, wiring and meter. Refer to Section 16000. Excluded from this allowance are any costs associated with providing temporary services for Contractor's use during construction, cost associated with coordination between Contractor and power company, and costs for work required by the Contractor for electrical service.
   2. Payment for this item shall be on the basis of invoices presented by the Local power company to the Contractor for the work. No markup will be added by the Contractor to the power company invoice.

(6) – Wetwell Solids and Debris Removal

A. Method of Measurement:
   1. The quantity of grit/sludge/rags/solids/debris removal to be paid for under this Item shall be the volume of material measured in place prior to removal. If measurement in place is not possible, the number of cubic yards shall be calculated based on the weight of material disposed of at the City of Bath Landfill, divided by 3,240 pounds per cubic yard conversion factor.

B. Basis of Payment:
   1. Payment for these items shall be paid for at each of the unit prices as stated in the Bid Schedule.
   2. The unit price as stated in the Bid Schedule per cubic yard of debris removed from structures and properly disposed of in an environmentally acceptable manner at the City of Bath Landfill shall constitute full compensation for debris removal and disposal.
   3. This pay item includes furnishing all labor, materials, tools, equipment, trucking costs, decanting, and incidentals required to clean the structure to facilitate the proposed work by either pump, vacuum, or otherwise to collect and remove accumulated debris, grit, rags, solids, and/or sludge, decant the material at the Bath Water Pollution Control Facility, and then dispose of the decanted material at the City of Bath Landfill (disposal fees at the landfill will be waived by the City).

(7) – Mobilization/Demobilization

A. Method of Measurement: Lump sum. Total of bid item shall not exceed 3% of Total Amount of the Bid.

B. Basis of Payment: Mobilization/demobilization costs are those costs of initiating and ending the contract. Payment for mobilization/demobilization shall be a lump sum at the price as stated in the Bid Form. 75% of the lump sum will be payable when the Contractor is operational on the site and the remaining 25% of the lump sum will be payable when the Contractor leaves the site following the completion of all contract work. For purposes of payment on this item, "Operational" shall mean the Contractor has provided all required and properly executed bonds and insurance certificates and the owner has approved the following: Construction Schedule, Erosion Control Plan, Pre-Blast Survey and Blasting Plan, Traffic Control Plan, Project Sign (and installed), Temporary Facilities, and Pre-Construction photographs/videos. Only one lump sum payment divided into the two partial payments described herein shall be made to cover all mobilization/demobilization costs throughout the entire contract.

(8) – Traffic Control

A. Method of Measurement: Traffic regulation and control will be paid for at the Lump Sum unit price as stated in the Bid Schedule.

B. Basis of Payment: Payment for traffic regulation and control shall constitute full compensation for all traffic regulation and control efforts and including all labor, materials, equipment, signage and supervision required to provide comprehensive and professional traffic regulation and control at all project locations. The traffic control plan, temporary pavement markings for traffic re-routing and pedestrian safety are included in this item. Payment under this item will be made for full-time dedicated flaggers only. Part-time flaggers will not be considered adequate. The lump sum shall be paid in partial payments over the course of the project, where the percentage paid is equal to the percentage of completion of the entire Contract.

(9) – Uniformed Police Officer – Allowance

A. Method of Measurement: Allowance of $2,500 to be included and carried in the bid schedule.

B. Basis of Payment:

1. Payment shall cover the cost charged to the Contractor by the Bath Police Department for providing Uniformed Police Officers and a cruiser for the traffic control in addition to the required flagger, only in areas required by the Engineer, Owner, and/or MEDOT. Excluded from this payment are any costs associated with traffic control, including flaggers that are paid for under the Traffic Control Item.
2. Payment for this item shall be on the basis of invoices presented by the Police Department to the Contractor for the work. No mark-up shall be added to the invoice by the Contractor.

(10), (11) and (12) – 10", 24", and 36" PVC Sewer Pipe

A. Method of Measurement: Sewer pipe measured for payment shall be the number of linear feet installed measured along the center line of the pipe as laid including fittings. Pipes shall be measured between centers of the manholes minus half the inside diameter of each manhole. Pipe installed into the manhole will not be measured for payment. The 24" Overflow pipe shall be considered a sewer pipe and paid for under this bid item.

B. Basis of Payment:

1. The contract unit price per linear foot for sewer pipe shall be full compensation for all labor, materials, and equipment necessary to complete this work including sawcut, management, removal and disposal of pavement; excavation (except ledge excavation), dewatering, bedding, furnishing and installing pipe and fittings, making connections to new and existing manholes (and storm drain pipe for the 24" Overflow pipe), installation of impervious material dams, backfill including aggregate base and subbase material, compaction, testing; light cleaning prior to each CCTV inspection; post-CCTV inspection of the sewer, providing video files, database, and written logs on external hard drives; maintaining existing flows during construction of new facilities, and all else incidental thereto for which payment is not provided under other items.
2. Payment for this work on interim requisitions shall be according to the following percentages:
    a. Sewer pipe acceptably set in place and backfilled – 90 percent.
    b. Sewer pipe successfully tested – 10 percent.

(13) – Installation of Owner-Purchased 36" PVC Sewer Pipe

A. Description: Owner has utilized grant money to pre-purchase some of the 36" sewer pipe to be installed by the contractor. This item shall cover the cost associated with installation of the pipe by the contractor.

B. Method of Measurement: Sewer pipe measured for payment shall be the number of linear feet installed measured along the center line of the pipe as laid including fittings. Pipes shall be measured between centers of the manholes minus half the inside diameter of each manhole. Pipe installed into the manhole will not be measured for payment.

C. Basis of Payment:
   1. The contract unit price per linear foot for sewer pipe shall be full compensation for all labor and equipment necessary to complete this work including transport of materials from Owner's storage site, sawcut, management, removal and disposal of pavement; excavation (except ledge excavation), dewatering, bedding, furnishing and installing pipe and fittings, making connections to new and existing manholes, installation of impervious material dams, backfill including aggregate base and subbase material, compaction, testing; light cleaning prior to each CCTV inspection; post-CCTV inspection of the sewer, providing video files, database, and written logs on external hard drives; maintaining existing flows during construction of new facilities, and all else incidental thereto for which payment is not provided under other items.
   2. Payment for this work on interim requisitions shall be according to the following percentages:
      a. Sewer pipe acceptably set in place and backfilled - 90 percent.
      b. Sewer pipe successfully tested - 10 percent.

(14) – Sanitary Service Connections Within Mainline Trench

A. Description: This item includes extending sanitary service laterals from the new sewer main to existing house service laterals within the limits of the trench excavation.
B. Method of Measurement: This item shall consist of furnishing, installing and connecting existing house sanitary service leads of all sizes, from new sanitary sewer mains to the existing sewer service within the limits of the mainline trench excavation as shown on the Drawings and/or as determined in the field. Measurement shall be along the centerline of the new service pipe from the point of connection at the sewer main to the connection with existing sewer service, within the mainline trench, measured along the centerline of the pipe.
C. Basis of Payment: The contract unit price per linear foot shall include, but not be limited to, furnishing and installing pipe and fittings, excavating (except ledge excavation), bedding, filter fabric, backfilling including aggregate base and subbase material, compaction, testing, resetting existing features, connection to existing service as directed, maintaining existing flows and all else incidental thereto for which payment is not provided under other items.

(15) – Sanitary Service Connections Beyond Mainline Trench

A. Description: This item includes extending sanitary service laterals from the edge of the new sewer main mainline trench to existing house service laterals located outside the limits of the mainline trench.
B. Method of Measurement: This item shall consist of furnishing, installing and connecting existing house sanitary service leads of all sizes, from the edge of the mainline trench to the existing sewer service as shown on the Drawings and/or as determined in the field. Measurement shall be along the centerline of the new service pipe from the edge of the mainline trench to the point of connection with the existing sewer service lateral, measured along the centerline of the pipe.
C. Basis of Payment: The contract unit price per linear foot shall include, but not be limited to, furnishing and installing pipe and fittings, excavating (except ledge excavation), bedding, filter fabric, backfilling including aggregate base and subbase material, compaction, testing, resetting existing features, connection to existing

service as directed, maintaining existing flows and all else incidental thereto for which payment is not provided under other items.

(16), (17) and (18) – 4-Foot, 5-Foot, and 6-Foot Diameter Sewer Manholes

A. Method of Measurement: Sewer manholes accepted for payment shall be the actual vertical feet of structures installed and accepted complete in place, from the lowest invert to finish grade as indicated in the Contract Documents, or as directed by the Engineer.

B. Basis of Payment:

1. The contract unit price per vertical foot shall be full compensation for all labor, materials, tools and equipment necessary to complete this work including sawcut, management, removal and disposal of pavement; excavation (except ledge excavation), removal and disposal of existing manhole, frame and cover; bedding; furnishing and installing precast concrete sections, frames, and covers; furnishing and installing frost protective wrap; masonry materials; waterproofing; constructing inverts; connection to sewer pipes; backfilling including aggregate base and subbase material; compaction; cleaning; testing; and all else incidental thereto for which payment is not provided under other items.
2. Payment for this item shall be as follows:
    a. Manhole acceptably set in place and backfilled - 90 percent.
    b. Manhole successfully cleaned and tested - 10 percent.

(19) – Manhole – Install Interior Drop Connections

A. Method of Measurement: Manhole interior drop connections measured for payment shall be the actual vertical feet of pipe furnished and installed measured from the invert of inlet pipe to the lowest invert of the drop piping as indicated in the Contract Documents or as directed by the Engineer.

B. Basis of Payment: The contract unit price per vertical foot shall be full compensation for all labor, materials, tools and equipment necessary to complete this work including furnishing and installing pipe, fittings and pipe supports; reconstructing inverts; and all else incidental thereto for which payment is not provided under other items.

(20) – Pipe Trench Insulation

A. Method of Measurement: Pipe trench insulation accepted for payment shall be the actual linear feet of trench insulation installed and accepted complete in place.

B. Basis of Payment: The contract unit price per linear foot for pipe trench insulation shall be full compensation for all labor, materials, tools and equipment necessary to complete this work including excavation, bedding, insulation, backfill, compaction and all else incidental thereto for which payment is not provided under other items.

(21) – Trench Excavation – Ledge

A. Method of Measurement:

1. Ledge excavation measured for payment shall be the number of cubic yards of ledge removed during construction. This quantity shall be determined by:
    a. Exposing the ledge profile for measurement. Excavation and backfill of the earth overburden shall be considered incidental, and no separate payment shall be made therefore.

b. Should the Contractor elect to pre-drill and blast ledge without exposing the ledge surface for measurement, ledge depths shall be determined by the Resident Project Representative at the time of drilling or, when direct drilling observation is not conducted, the ledge profile shall be measured after excavation, and 20% of the ledge volume thus measured shall be deducted due to ledge expansion caused by the blasting operation.

2. The payment limit for trench width shall be between vertical planes which are a distance apart equal to the sum of 18 inches plus 1-1/3 times the nominal outside diameter of pipe which is to be installed in the trench (min. of 3 feet) and extending from the top of the ledge surface to a depth of 6 inches below the invert grade of the pipe. Where two pipes are installed in the same trench, trench ledge excavation shall be measured as the actual volume of ledge removed between vertical planes which are a distance apart equal to the sum of 3 feet plus the sum of the pipes nominal outside diameter. Where three pipes are installed in the same trench, trench ledge excavation shall be measured as the actual volume of ledge removed between vertical planes which are a distance apart equal to the sum of 4.5 feet plus the sum of the pipes nominal outside diameter.

3. Ledge excavation for structures (including manholes) shall be measured as 18 inches outside the structure and extending to a depth of 6 inches below the base of the structure indicated on the Drawings.

4. Rocks or boulders greater than two cubic yards volume shall be considered as ledge excavation. Volume of rocks shall be determined from their average length, width, and depth as measured by the Engineer.

B. Basis of Payment:

1. The contract unit price per cubic yard for ledge excavation shall be full compensation for all labor, materials, tools and equipment necessary to complete the excavation including conducting the pre-blast survey, drilling, blasting, excavating, loading and disposing the excess or unusable material outside the work limits, suitable replacement backfill, and all else incidental thereto for which payment is not provided under other items.

2. Not all the potential ledge locations are identified on the Drawings and ledge could be encountered anywhere within the limits of work. Such ledge, if encountered, is not considered a Differing Subsurface or Physical Condition. The unit price in the bid form shall apply to all ledge encountered and removed.

(22) – Test Pit Excavation and Backfill

A. Method of Measurement: The quantity to be paid for under this item shall be the actual number of test pits performed as authorized by the Engineer.

B. Basis of Payment: Test pit excavations shall be paid for at the unit price per each test pit as stated in the Bid Schedule. Said unit price shall be full compensation for furnishing all labor, tools, and equipment; for sawcut and removal of pavement, excavation (except ledge excavation), dewatering, backfill including aggregate base and subbase, compaction, temporary pavement; providing the test pit result information to the Engineer and for all other work and expenses incidental thereto for which payment is not provided under other items.

(23) – Excavation Below Grade and Replacement Backfill

A. Method of Measurement: Quantity to be paid for under this item shall be the number of cubic yards of material removed and replaced below the pipe or structure bedding with materials from off-site as authorized by the Engineer. The payment limit for this item shall be between vertical planes that are a distance apart equal to the sum of 18 inches plus 1-1/3 times the nominal inside diameter of pipe to be installed (minimum 3 feet) extending from the typical excavation depth called out in the contract drawings (bottom of bedding layer) to the depth accepted by the Engineer for the length of the excavation as directed by the Engineer.

B. Basis of Payment:

1. Excavated unsuitable materials below the bedding elevation shall be paid for at the unit price per cubic yard stated in the Bid Schedule. Said unit price shall be full compensation for furnishing all labor, equipment, and tools necessary for the excavation of unsuitable material including the disposal of materials; and including furnishing installing and compacting replacement suitable backfill, and filter fabric, and for all other work and expenses incidental thereto for which payment is not provided under other items.
2. Material excavated below pipe bedding grade that could have, in the opinion of the Engineer, remained in place through the use of adequate dewatering efforts shall be replaced by the Contractor at no additional cost to the Owner.

(24) – Replacement of Unsuitable Material Above Pipe Bedding and Initial Backfill

A. Method of Measurement: Quantity to be paid for under this item shall be the number of cubic yards of material removed and replaced with materials from off-site as authorized by the Engineer. The payment limit for this item shall be between vertical planes that are a distance apart equal to a maximum of 6-feet extending from the top of the initial backfill layer to the bottom of the aggregate subbase layer as called out in the contract drawings for the length of the excavation as directed by the Engineer.

B. Basis of Payment:

1. Excavated unsuitable materials shall be paid for at the unit price per cubic yard stated in the Bid Schedule. Said unit price shall be full compensation for furnishing all labor, equipment, and tools necessary for the excavation of unsuitable material including the disposal of materials; furnishing installing and compacting replacement suitable backfill, and for all other work and expenses incidental thereto for which payment is not provided under other items.
2. Material excavated that could have, in the opinion of the Engineer, remained in place through the use of adequate dewatering efforts shall be replaced by the Contractor at no additional cost to the Owner.

(25) – Loaming, Seeding & Restoration

A. Method of Measurement: Loaming, seeding and restoration measured for payment shall be per lump sum for all work as shown on the drawings.

B. Basis of Payment:

1. The lump sum price shall be full compensation for furnishing all labor, materials, and equipment required to place and grade loam, furnish and place seed, mulch, lime, fertilize and water, assure and maintain grass growth until final acceptance by the Engineer; and for all other work including grading of

paved and unpaved areas disturbed during construction and expenses indicated thereto for which payment is not provided under other items. This price shall include clean-up and restoration of property including property boundary monuments and markers (by a Maine-licensed PLS), replacement of shrubs, fences, trees and mulch that are not identified to be removed and which are displaced at the convenience of the Contractor. This price includes the clearing, grubbing and stripping and stockpiling of topsoil. Areas disturbed for the Contractor's convenience shall be restored at no additional cost to the Owner.

2. 80% at the completion of the installation of the loaming, seeding and restoration, upon acceptance by the Engineer. 20% upon final contract completion and consistent coverage and growth of the new turf.

(26), (27), (28), (29), (30), and (31) – Initial Pavement (Binder Course), Final Pavement (Surface Course), Driveway Pavement Along Sewer Route, Driveway Pavement – Type I, Driveway Pavement – Type II, and Walkway Pavement

A. Method of Measurement:
   1. The quantity of bituminous concrete pavement to be paid for under this item includes:
      a. Initial Pavement - The number of tons of initial pavement placed and removed at the direction of the Engineer, calculated as described below, within the payment limits shown on the Drawings.
      b. Final Pavement - The number of tons of final pavement placed at the direction of the Engineer, calculated as described below, within the payment limits shown on the Drawings.
      c. Driveway Pavement Along Sewer Route – The number of tons of driveway pavement placed at the direction of the Engineer, calculated as described below, within the pay limits shown on the Drawings.
      d. Driveway Pavement – Pump Station Site – Type I – The number of tons of Type I driveway pavement placed at the direction of the Engineer, calculated as described below, within the payment limits shown on the Drawings.
      e. Driveway Pavement – Pump Station Site – Type II – The number of tons of Type II driveway pavement placed at the direction of the Engineer, calculated as described below, within the payment limits shown on the Drawings.
      f. Walkway Pavement– The number of tons of sidewalk pavement hand-placed at the direction of the Engineer, calculated as described below, within the payment limits shown on the Drawings.
   2. Actual widths will be used in computing area wherever the width of pavement removed and replaced is less than the limits indicated on the Drawings.
   3. The conversion factor to change volume of bituminous concrete pavement measured in place to tons will be 0.055 tons per square yard per inch of thickness.

B. Basis of Payment:
   1. Pavement shall be paid for at the Contract unit price per ton stated in the Bid Schedule.

2. Said unit price shall be full compensation for furnishing all materials, labor, equipment and tools necessary for the placement and removal of pavement, preparation of base material, milling (grinding) of existing pavement in preparation of final pavement where payment is not provided under other items, grinding for transitions into driveways and roads, application of tack coat, placement and grading of gravel shoulder material to back up overlay pavement, installation of pavement markings, and all else incidental thereto for which payment is not provided under other items. No additional payment will be made to the Contractor for repair work done by them in maintaining bituminous concrete pavement.

(32) – Replacement of Bituminous Curb

A. Method of Measurement: The quantity of replacement of bituminous curb to be paid for under this item shall be the linear feet of curb removed and replaced within the payment limits defined in the Documents and directed by the Engineer. Curb removed for the convenience of, or damaged by, the Contractor is not covered by this bid item.

B. Basis of Payment: Replacement of bituminous curb shall be paid for at the unit price per linear foot stated in the Bid Schedule. Said unit price shall be full compensation for all labor, materials, equipment and tools required for the removal and placement of bituminous curb including excavation and backfill, disposal of curb that is removed, placement of new curb, repair of loam and seed behind curb, and for all other work and expenses incidental thereto for which payment is not provided under other items.

(33) – Removal and Reinstallation of Granite Curb

A. Method of Measurement: Granite curb measured for payment shall be the actual linear footage of granite curb removed, reinstalled and accepted as complete by the Engineer.

B. Basis of Payment: The contract unit price per linear foot for granite curb shall constitute full compensation for all equipment necessary to complete this work, including subgrade preparation, placement of concrete fill, backfill and all labor and appurtenances incidental thereto for which payment is not provided under other items.

(34) – Removal of Tree Stumps

A. Method of Measurement: The quantity to be paid for under this item shall be the actual number of tree stumps completely removed as directed by the Engineer, with the resulting void completely restored. Tree stumps removed for the convenience of the Contractor is not covered by this bid item. Tree stumps removed that are within the limits of the pipe trench shall not be eligible for payment under this item.

B. Basis of Payment: Removal of trees with stumps, backfill loam and seed shall be paid for at the unit price per each as stated in the Bid Schedule. Said unit price shall be full compensation for furnishing all materials, labor, tools, and construction equipment; for complete removal of the tree and stump, backfilling the void with suitable material compacted in 8-inch lifts, grading of unpaved areas disturbed during construction, providing 6-inch of loam and seeding the top of the restored area for new grass growth, and for all other work and expenses incidental thereto for which payment is not provided under other items.

(35) – Sewer Pipe Cleaning / Decommissioning

A. Method of Measurement: Sewer pipe cleaning and decommissioning measured for payment shall be the number of linear feet cleaned, measured along the center line of the pipe as laid including fittings. Pipes shall be measured between centers of the manholes minus half the inside diameter of each manhole.

B. Basis of Payment: The Contract unit price per linear foot for Sewer Pipe Cleaning / Decommissioning shall be full compensation for all labor, subcontractors, materials, tools and equipment necessary to complete this work including pressure washing, capping, and plugging sewer pipes; pressure washing sewer manholes; maintaining system flows around the sewers that are being cleaned / decommissioned; and all else incidental thereto for which payment is not provided under other items.

(36) – Asbestos Cement Pipe Removal and Disposal

A. Method of Measurement: Removal and Disposal of Asbestos Cement Pipe accepted for payment shall be the actual number of linear feet of Asbestos Cement Pipe (all diameters) removed and disposed of in accordance with local, State and Federal Regulations.

B. Basis of Payment: The Contract unit price per linear foot for Removal and Disposal of Asbestos Cement Pipe shall be full compensation for all labor, subcontractors, materials, tools and equipment necessary to complete this work including excavation, handling and removing of pipe, bagging of pipe and miscellaneous friable pieces of pipe and contaminated trench materials, transporting to the City of Bath Landfill, coordination with regulatory agencies and Owner, and all else incidental thereto for which payment is not provided under other items. Disposal fees at the City of Bath Landfill will be waived by the City.

(371) – Existing Sewer Main and Manholes – Abandonment and Flowable Fill

A. Method of Measurement: The quantity of flowable fill to be paid for under this item shall consist of the actual number of cubic yards of flowable concrete measured and accepted complete in place as directed by the Engineer within the limits shown on the plans.

B. Basis of Payment: The contract unit price per cubic yard for concrete flowable fill shall be full compensation for all labor, materials, equipment, pumping and supervision necessary to complete this work including cutting and capping of pipe/manhole to be filled, pumping of and consolidation of the fill and all else incidental thereto for which payment is not provided under other items.

(38) – Installation of Pipe Below Railroad Tracks

A. Method of Measurement: Installation of sewer pipe below the railroad tracks will be paid for at the Lump Sum unit price as stated in the Bid Schedule.

B. Basis of Payment: Payment for installation of pipe below railroad crossings via pipe boring and jacking shall constitute full payment for all labor, materials, tools, and equipment necessary to install sewer pipe beneath the railroad tracks, including supply and installation of casing pipe and spacers; supply and installation of sewer pipe installed within the casing pipe between the manholes on either side of the railroad tracks and sealing to casing pipe; development of jacking and boring plan and sheeting plan; excavation and stabilization of jacking and receiving pits;

coordination with Maine DOT; supply of equipment necessary to complete the work; and all else incidental thereto for which payment is not provided under other items.

(39) – Bypass Pumping of Collection System Wastewater Flows

A. Method of Measurement: Lump Sum

B. Basis of Payment: Payment for this item shall be a lump sum at the bid price as stated in the Bid Schedule. Said lump sum price shall constitute full compensation for all bypass pumping and trucking of wastewater flows in the collection system during the construction of the project. Bypass pumping of flows at the pump station are not included in this bid item and shall be included in Bid Item 1. Lump sum price shall also include all materials and labor necessary to facilitate bypass pumping, including pumps, piping, pumper trucks, traffic control, coordination, all else incidental thereto for which payment is not provided under other items. The lump sum shall be paid in partial payments over the course of the project, where the percentage paid is equal to the percentage of completion of gravity sewer pipe installed.

(40) – Management of Contaminated Materials and Soils/Fill

A. Method of Measurement: Management of contaminated materials measured for payment shall be based on the lump sum price stated in the Bid Schedule.

B. Basis of Payment: Management of contaminated materials and soil/fill shall be paid for at the lump sum price stated in the Bid Schedule. Said unit price shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals required for managing contaminated materials and soil/fill; segregating, handling, staging, testing, and characterization of all soil and fill material suspected of being contaminated as well as the costs associated with characterizing the destination site as required to assess background conditions; all controls necessary to maintain compliance with regulatory requirements relative to handling contaminated soils and materials; submittal and approval of all required and specified Plans; analytical testing and characterization of all excavated soil and fill material handled; health and safety equipment; securing a staging area for stockpiling soil pending analytical testing, reuse, or disposal; protecting the excavation and stockpile areas; controlling the spread of airborne contaminants; all notifications, fees, permits, and taxes; and all other requirements specified in other sections of the Contract Documents; and any other work not covered by other bid items. All costs related to transporting soils to and, if not disposed of offsite, and reused, from the staging area shall be included for payment in this item.

(41) – Contaminated Soil Excavation with Offsite Disposal and Replacement Backfill

A. Method of Measurement:

1. Contaminated Soil Excavation with offsite disposal measured for payment shall be the actual number of tons of material so excavated and shall be measured based on the tonnage slips from the contaminated soil disposal site.
2. Removal of existing curbing, catch basins, manholes, culverts and sewers are to be considered incidental to this item only if they are located within the contaminated soil zone.

B. Basis of Payment:

1. The contract unit price per ton for Contaminated Soil Excavation with Offsite Disposal shall be made on a per ton basis for the weight of actual material

transported from the project, weighed and disposed of at the designated contaminated soil disposal site. Price and payment for this item shall include the furnishing of all labor, materials, equipment and incidentals necessary to complete the work as specified by the Engineer during construction. Work shall include excavation to clean materials, compaction of the resulting excavation sub grade, replacement of the removed contaminated soil with properly compacted sub-base, transport to a Maine State approved disposal location, cost of the disposal, and providing to the Owner manifests from the receiving facility for all contaminated material. The manifests shall provide the quantity of material that was legally disposed of and location(s) of where the soil was disposed.

(42) - Contaminated Groundwater Handling and Disposal

A. Method of Measurement: Contaminated groundwater handling with onsite treatment and disposal or offsite disposal at a licensed facility during excavation activities measured for payment shall be the actual number of days of dewatering needed within the areas indicated in the specifications as having the potential for contamination. Refer to information in Appendix C of these Specifications for available information on potential groundwater contamination depths.

B. Basis of Payment: The contract unit price per day for contaminated groundwater handling and disposal shall be made on a per 8-hour day basis during which dewatering activities are taking place within the areas identified in the specifications as having the potential for contamination. Price and payment for this item shall include the furnishing of all labor, materials, equipment and incidentals necessary to complete the work as specified by the Engineer during construction. Work shall include excavation dewatering within the areas identified in the specifications as having the potential for contamination, proper treatment and disposal on-site or disposal at a licensed offsite facility of contaminated dewatering discharge water, the cost of disposal, obtaining all necessary treatment and discharge permits, and if disposing of contaminated dewatering discharge water at an offsite facility, providing to the Owner manifests from the receiving offsite disposal facility for all contaminated material received. The manifests shall provide the quantity of water that was legally disposed of and location(s) of where the water was disposed.

(43) – Cleaning of Existing 14” and 16” Force Main

A. Method of Measurement: Cleaning the existing Harward Street pump station force main will be paid for at the Lump Sum unit price as stated in the Bid Schedule.

B. Basis of Payment: Payment for this bid item shall be paid for at the lump sum as stated in the Bid Schedule and shall be full compensation for furnishing all labor, materials, tools, and equipment required for cleaning approximately 3,000 linear feet of the existing force main from the existing pump station pig launch to the terminus manhole on Bowery Street.

(44) – CSO Structure (Manhole SMH-133)

A. Method of Measurement: Installing the new CSO structure will be paid for at the Lump Sum unit price as stated in the Bid Schedule.

B. Basis of Payment:
   1. Payment for this bid item shall be paid for at the lump sum as stated in the Bid Schedule and shall be full compensation for all labor, materials, tools and equipment necessary to complete this work including excavation (except ledge excavation), bedding; furnishing and installing precast concrete sections, hatches, slide gate; constructing inverts and fillets; connection to sewer pipes; backfilling including aggregate base and subbase material; compaction; cleaning; testing; placing structure into operation, and all else incidental thereto for which payment is not provided under other items.
   2. Manhole acceptably set in place and backfilled - 90 percent.
   3. Manhole successfully cleaned and tested - 10 percent.

1.11 DESCRIPTION OF PAY ITEMS – BID ALTERNATES

A. The following sections describe the measurement of and payment for the work to be done under the respective items listed in the Bid Form associated with bid alternates.
B. Each unit or lump sum price stated in the Bid Form shall constitute full compensation, as herein specified, for each item of the work completed.

(A1) – Remove and Dispose of Pavement and Earth Excavation on Office Drive

A. Method of Measurement: The quantity of removal and disposal of pavement on Office Drive shall be the number of square yards of existing roadway, driveway, and walkway pavement removed, measured and calculated within the limits indicated on the Alternate A drawings. This also includes the number of square yards of soil material removed for the placement of additional aggregate where the road is proposed to be widened beyond the existing road width. This excludes pavement removal and pavement and excavation for the installation of the sewer force main or any other work included in the base bid.
B. Basis for Payment: The contract unit price per square yard for this bid item shall constitute full compensation for all materials, labor and equipment necessary to complete excavation for roadway reconstruction and pavement to the depths as indicated in the Alternate A plans, including excavation, saw cutting, removal of existing pavement, removal of soil for placement of aggregate where the road is proposed to be widened beyond the existing road width, removal of walkways, transportation of existing bituminous pavement and existing aggregate off site, subgrade preparation, dust control and all else incidental thereto for which payment is not provided under other items.

(A2), (A3), (A4), and (A5) – Office Drive Binder Course Pavement, Office Drive Surface Course Pavement, Walkway Pavement Along Office Drive, and Driveway Pavement Along Office Drive

A. Method of Measurement:
   1. The quantity of bituminous concrete pavement to be paid for under this item includes:
      a. Driveway Pavement Along Office Drive – The number of tons of driveway pavement hand-placed at the direction of the Engineer, calculated as described below, within the pay limits shown on the Alternate A Drawings. This excludes the driveway pavement and shown on the base bid Drawings.

b. Walkway Pavement Along Office Drive– The number of tons of sidewalk pavement hand-placed at the direction of the Engineer, calculated as described below, within the payment limits shown on the Alternate A Drawings. This excludes walkway pavement shown on the base bid Drawings.

c. Office Drive Binder Course Pavement – The number of tons of binder course pavement placed within the roadway at the direction of the Engineer, calculated as described below, within the payment limits shown on the Alternate A Drawings for the Office Drive rebuild. This excludes trench pavement or any other pavement shown on the base bid Drawings.

d. Office Drive Surface Course Pavement – The number of tons of surface course pavement placed within the roadway at the direction of the Engineer, calculated as described below, within the payment limits shown on the Alternate A Drawings for the Office Drive rebuild. This excludes trench pavement or any other pavement shown on the base bid Drawings.

2. Actual widths will be used in computing area wherever the width of pavement removed and replaced is less than the limits indicated on the Drawings.

3. The conversion factor to change volume of bituminous concrete pavement measured in place to tons will be 0.055 tons per square yard per inch of thickness.

B. Basis of Payment:

1. Pavement shall be paid for at the Contract unit price per ton stated in the Bid Schedule.

2. Said unit price shall be full compensation for furnishing all materials, labor, equipment and tools necessary for the placement and removal of pavement, preparation of base material, milling (grinding) of existing pavement in preparation of final pavement where payment is not provided under other items, grinding for transitions into driveways and roads, application of tack coat, placement and grading of gravel shoulder material to back up overlay pavement, installation of pavement markings, and all else incidental thereto for which payment is not provided under other items. No additional payment will be made to the Contractor for repair work done by them in maintaining bituminous concrete pavement.

<u>(A6) – Office Drive Aggregate Subbase Course Type “D” and (A7) Office Drive Aggregate Base/Surface Course Type “A”</u>

This pay item is applicable for the aggregate material required to shim coat/fine grade Office Drive in preparation for paving, as shown in the Alternate A Drawings. This shall also be used for walkway and driveway base aggregate in preparation for paving, as shown in Alternate A Drawings. These unit prices will not be paid for aggregate used for manholes and pipe trench backfill or paving items included in the base bid. These items exclude any aggregate for work related to the base bid.

A. Method of Measurement: Placement of aggregate measured for payment shall be the number of cubic yards of aggregate placed for roadways, driveways, and walkways measured and calculated within the limits indicated on the plans, complete and in place.

B. Basis for Payment: The contract unit price per cubic yard for placement of aggregate subbase and base shall constitute full compensation for all materials, labor and equipment necessary to complete this work including excavation, saw cutting, milling, and grinding of existing pavement, transportation of existing bituminous pavement and existing base material to approved stockpiling sites, furnishing and transporting aggregate subbase and base material to the project site, preparing subgrade, placing, grading, compaction, dust control and all else incidental thereto for which payment is not provided under other items.

(A8) – 6" Underdrain

A. Method of Measurement: 6" underdrain pipe measured for payment under these items shall be the number of linear feet installed measured along the center line of the pipe as laid.

B. Basis of Payment: The contract unit price per linear foot for perforated underdrain pipe installed shall be full compensation for all labor, materials, and equipment necessary to complete this work including sawcut, management, removal and disposal of pavement; excavation (except ledge excavation), utility crossings and relocations, bedding, furnishing and installing pipe and fittings, connecting the pipe to structures, coring of structures, screened stone, aggregate base backfill where required, filter fabric, backfill, compaction, removal and disposal of existing storm drain pipes, catch basins, and replacement drainage structures, connections to existing pipes and existing structures as required include coring, patching and parging of existing drainage structures to accommodate new pipes, location tape, and all else incidental thereto for which payment is not provided under other items.

END OF SECTION

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: To enable orderly review during progress of the work, and to provide for systematic discussion of problems, the Engineer will conduct project meetings throughout the construction period.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Persons designated by the Contractor to attend and participate in the project meetings shall have all required authority to commit the Contractor to solutions agreed upon in the project meetings.

1.4 SUBMITTALS

A. Agenda items: To the maximum extent practicable, advise the Engineer at least 24 hours in advance of project meetings regarding all items to be added to the agenda.

B. Minutes: The Engineer will compile minutes of each project meeting and will furnish a copy to the Contractor. The Contractor may make and distribute such other copies as they wish.

PART 2 - PRODUCTS

(No products are required in this Section.)

PART 3 - EXECUTION

3.1 MEETING SCHEDULE

A. Except as noted below for Preconstruction Meeting, project meetings will be held monthly. Coordinate as necessary to establish mutually acceptable schedule for meetings.

3.2 MEETING LOCATION

A. Meetings will be held at the Engineers' field office, unless the Owner and/or Engineer determine that virtual meetings are applicable and appropriate for any reason (e.g., COVID, Safety and Health Plan, etc.).

1. If meetings are required by Owner/Engineer to be held virtually, Engineer will host the meetings via Microsoft Teams. All required meeting attendees are responsible for providing hardware necessary to view, share, be heard and hear content of the meeting.

3.3 PRECONSTRUCTION MEETING

A. Preconstruction meeting will be scheduled within twenty days after the Effective Date of the Agreement, but before the Contractor starts work at the site. Provide attendance by authorized representatives of the Contractor and all major subcontractors. The Engineer will advise other interested parties and request their attendance.

B. Minimum agenda: Distribute data on, and discuss:
   1. Identification of key project personnel for Owner, Engineer, Contractor, funding/regulatory Agencies.
   2. Responsibilities of Owner, Engineer, Resident Project Representative, Contractor.
   3. Channels and procedures for communications.
   4. Construction schedule, including sequence of critical work.
   5. Easements, permits.
   6. Contract Documents, including distribution of required copies of original documents and revisions.
   7. Processing of Shop Drawings and other data submitted to the Engineer for review.
   8. Processing of field decisions and Change Orders.
   9. Rules and regulations governing performance of the Work, including funding/regulatory Agency requirements.
   10. Procedures for safety and first aid, security, quality control, housekeeping, and other related matters.

3.4 PROJECT MEETINGS

A. Attendance: To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of the Work. The Superintendent shall attend. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspects of the Work are involved.

B. Minimum agenda:
   1. Review, revise as necessary, and approved minutes of previous meeting.
   2. Review progress of the Work since last meeting, including status of submittals for approval.
   3. Review schedule of work to be accomplished prior to next meeting.
   4. Discuss monthly partial payment request.
   5. Review status of change order requests and Work Directive Changes.
   6. Identify problems which impede planned progress.
   7. Develop corrective measures and procedures to regain planned schedule.
   8. Complete other current business.

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULES – SHORT FORM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Within ten (10) days after the effective date of the Agreement between Owner and Contractor submit to the Engineer an estimated progress schedule as specified herein.

B. Form of Schedules:
   1. Narrative: Completely describe the construction methods to be employed.
   2. Network Analysis System:
      a. Provide a separate horizontal schedule line for each trade or operation and show concurrent and preceding activities.
      b. Present in chronological order the beginning of each trade or operation showing duration and float time.
      c. Scale: Identify key dates and allow space for updating and revision.
   3. Mathematical Analysis:
      a. A mathematical analysis shall accompany the network diagram. A computer printout will be acceptable.
      b. Information shall be included on activity numbers, duration, early start, late start, etc. and float times.

C. Content of Schedules:
   1. Provide complete sequence of construction by activity:
      a. Shop Drawings, Project Data and Samples:
         i. Submittal dates.
         ii. Dates reviewed copies will be required.
      b. Decision dates for:
         i. Products specified by allowances.
         ii. Selection of finishes.
      c. Estimated product procurement and delivery dates.
      d. Dates for beginning and completion of each element of construction.
   2. Identify work of separate phases and logically grouped activities.
   3. Show the projected percentage of completion for each item of work as of the first day of each month.
   4. Provide separate sub-schedules, if requested by the Engineer, showing submittals, review times, procurement schedules, and delivery dates.
   5. Schedule sheets shall be printed in color on 11”x17” paper, unless a smaller size paper is allowed by the Engineer.

D. Updating:
   1. Show all work activities including those already complete.
   2. Show all changes occurring since previous submission.
   3. Indicate progress of each activity, show completion dates.
   4. Include:
      a. Major changes in scope.
      b. Activities modified since previous updating.

c. Revised projections due to changes.
d. Other identifiable changes.

5. Provide narrative report, including:
   a. Discussion of problem areas, including current and anticipated delay factors.
   b. Corrective action taken or proposed.
   c. Description of revisions that may affect schedules.
   d. Description of activities to be performed in the next 6-week period.
   e. Updated list of key shop drawings, project data and samples to be submitted in the next 6-week period.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Submit updated schedules with each progress payment request.
B. Submit 4 copies of initial and updated schedules to the Engineer.

END OF SECTION

SECTION 01320

SAFETY AND HEALTH PLAN

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work, as outlined herein and in the General and Special Conditions of the Contract Documents. Within 10 days after the effective date of the Agreement between Owner and Contractor, submit to the Engineer a Safety and Health Plan as specified herein. Refer to submittals section below.
2. Contractor shall comply with all applicable Laws and Regulations related to the safety of persons or property, or for the protection of persons or property from damage, injury, illness, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
3. Contractor shall designate a qualified and experienced safety representative (OSHA defined "Competent Person") at the site whose duties and responsibilities shall be the prevention of accidents and maintaining and supervising of safety precautions and programs, including a "Job Hazards Analysis".
4. The Contractor shall be solely responsible to provide all labor, equipment, and utilities sufficient to ensure no construction noise, particulates, or odors, are allowed to accumulate to levels which adversely affect health or work in, or near the construction area.

B. Content of Safety and Health Plan:

1. Prepare complete safety and health plan in accordance with the requirements of CFR Title 29 Part 1926 - Safety and Health Regulations for Construction.
   a. Provide documentation that Contractor's hazardous communication program is up to date.
   b. Provide documentation that Contractor's safety training is up to date.
   c. Prepare a project specific Safety and Health Plan addressing construction safety and protection, including but not limited to excavations, fall protection, egress, as well as provisions for construction in hazardous environmental conditions, confined space entry, electrically-classified spaces, chemical storage/handling, biological hazards, etc., at the project site.
2. Safety provisions for confined space entry shall follow the requirements of CFR Title 29 Part 1926, Subpart AA – Confined Spaces in Construction and will be incorporated into the Safety and Health Plan.
   a. The Owner has provided Table 1 at the end of this section listing confined space locations which may be encountered during the execution of this Contract. The Contractor is required to perform a site evaluation to

identify all hazards and potential hazards in work areas whether included in Table 1 or not, prior to control of site.

b. The Contractor shall be responsible for all aspects of construction site safety including development of appropriate confined space entry procedures. The plan shall include, but not necessarily be limited to, the following:
   i. Definitions
   ii. Confined Space Evaluations
   iii. Equipment Selection
   iv. Confined Space Entry Training Documentation
   v. Permit Required Confined Space Entry Requirements
   vi. Testing (Monitoring) and Ventilation
   vii. Confined Space Entry Permit Form
   viii. Rescue and Emergency Procedures
   ix. Emergency Contact Information

c. The Contractor shall inform the Owner and Engineer's representative whenever work will be performed in a confined space and the permit space program that the Contractor will follow.

d. The Contractor shall inform the Owner and Engineer's representative of any hazards confronted or created during entry operations, either through a briefing or during the entry operation.

e. The Contractor will coordinate entry operations with the Owner when both Owner personnel and Contractor personnel will be working in or near permit spaces.

f. The Owner, Engineer, their representatives, independent testing laboratories and government agencies, when inspecting the site, shall be supplied by the Contractor proper safety equipment when entry into a confined space is required.

3. The Owner has provided Table 2 at the end of this section listing the spaces that are considered “classified” per NFPA 820 (Standard for Fire Protection in Wastewater Treatment and Collection Facilities) where the Contractor may be required to carry out work tasks. The Contractor is required to perform a site evaluation to identify all hazards and potential hazards in work areas whether included in Table 2 or not, prior to control of site. Contractor shall implement appropriate safety precautions and/or construction practices to comply with classification requirements. Contractor shall ensure that all employees and subcontractors working in these areas have received appropriate training and are properly equipped in accordance with Contractor's Safety and Health Plan.

4. The Owner has provided Table 3 at the end of this section listing chemical storage and handling spaces where the Contractor may be required to carry out work tasks. The Contractor is required to perform a site evaluation to identify all hazards and potential hazards in work areas whether included in Table 2 or not, prior to control of site. Contractor shall ensure that all employees and subcontractors working in these areas have received appropriate training and are properly equipped in accordance with Contractor's Safety and Health Plan.

C. Updating:
   1. Contractor shall be responsible for updating the Safety and Health Plan as appropriate throughout the course of the construction period.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Submit the Contractor's site-specific Safety and Health Plan to the Engineer, in accordance with Section 01340. Submit hardcopy submittals, if required.
B. Submit updated Safety and Health Plans as necessary during the course of the project.
C. The Safety and Health Plan is provided “for information only” to inform the Owner, Engineer and Resident Project Representative of the project specific safety program requirements; however, if the Safety and Health Plan incomplete (e.g., missing elements relevant to the project work), inadequate (e.g., outdated qualifications) or not project-specific, it will be returned “revise and resubmit”. Delays related to an incomplete Safety and Health Plan are the responsibility of the Contractor.
D. The Contractor will overview the plan with the Owner (and staff), Engineer (and Resident Project Representative) prior to work beginning at the project site, and subsequently when/if the safety plan is updated.
E. Contractor's most current Safety and Health Plan shall be available at the construction site throughout the construction project.

1.4 ON-SITE COORDINATION MEETINGS

A. Contractor shall review key aspects of Safety and Health Plan at the Pre-Construction Meeting, and subsequent on-site safety informational meeting.
B. Contractor shall report to Engineer and Owner at each progress meeting concerning compliance with the Safety and Health Plan for the most recent construction period and new considerations and requirements for the upcoming period.
C. Contractor shall hold weekly on-site coordination meetings with Resident Project Representative and Owner to ensure that Owner's staff is aware of key Safety and Health Plan requirements of the current phase of construction.

1.5 OWNER’S CONFINED SPACE ENTRY PROGRAM INFORMATION

A. A copy of the Owner’s Confined Space Entry Program is available for viewing at the facility and is not included herein.

SITE-SPECIFIC INFORMATION

A. Refer to Tables 1, 2 and 3 below for site specific information, excluding items such as manholes, handholes, etc.

TABLE 1
HARWARD STREET PUMP STATIONFACILITY
CONFINED SPACES LISTING

Confined Space Location	Hazard Description
Wet Well	Possible lack of oxygen or presence of explosive or hazardous gases - Hydrogen Sulfide.

Note: This list has been provided by the Owner based upon their knowledge of the site and may not include all site hazards. Its intent is to aid the Contractor in determining the magnitude of effort needed to fulfill the safety and health requirements of this Contract.

TABLE 2
HARWARD STREET PUMP STATION FACILITY
CLASSIFIED SPACES LISTING (NFPA 820)

Location	NFPA 820 Classification
Wet Well Entrance	Class 1, Division 1
Wet Well	Class 1, Division 1

Note: This list has been provided by the Owner based upon their knowledge of the site and may not include all site hazards. Its intent is to aid the Contractor in determining the magnitude of effort needed to fulfill the safety and health requirements of this Contract.

TABLE 3
HARWARD STREET PUMP STATION FACILITY
CHEMICAL HAZARDS LISTING

Location	Chemical Hazard
Pump Room Building	None

Note: This list has been provided by the Owner based upon their knowledge of the site and may not include all site hazards. Its intent is to aid the Contractor in determining the magnitude of effort needed to fulfill the safety and health requirements of this Contract.

END OF SECTION

SECTION 01340

SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Submit all shop drawings, operations and maintenance manuals, Manufacturers' certificates, project data, and samples required by the Specifications.

B. General Submittals Requirements: This project shall utilize:
   1. Submittals – Electronic via Web-Based Software with Hard Copy for Record
      a. The Contractor shall utilize the web-based software provided by the Engineer for the Project Team. The Contractor shall provide contact information for its members of the Project Team for the web-based software. The Contractor shall conform to the format and work-flow of the web-based software provided for the Project.
      b. The Contractor shall submit to the Engineer an electronic submittal of shop drawings and O&M Manuals in portable document format (PDF) transmitted via the provided web-based software tool. The Engineer shall return an electronic PDF of the submittal review comments to the Contractor through the provided web-based software tool. The electronic submittals shall serve as the electronic record of the project.
      c. In addition, completed shop drawings and completed operations and maintenance (O&M) manuals shall be provided in hard copy (paper) format, for the record, in accordance with the following requirements.
         i. Shop drawings and O&M manuals shall be considered "completed" once an action code of "0" or "1" has been attained, as specified below, unless otherwise directed by the Engineer.
         ii. Once completed, the Contractor shall provide 1 hard copy sets for Owner and Resident Project Representative.
         iii. Hard copy submittals shall be updated on a monthly basis, for those submittals completed during the preceding month.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SHOP DRAWINGS

A. Shop Drawings are required for each and every element of the work.

B. Shop Drawings are generally defined as all fabrication and erection drawings, diagrams, brochures, schedules, bills of material, manufacturers data, spare parts lists, and other data prepared by the Contractor, their subcontractors, suppliers, or manufacturers which illustrate the manufacturer, fabrication, construction, and installation of the work, or a portion thereof.

C. The Contractor shall provide a completed Contractor Submittal Certification Form (copy provided for Contractor's use at the end of this Specification Section) which shall be attached to every copy of every shop drawing and signed by the Contractor and Manufacturer (where applicable). Shop Drawings shall show the principal dimensions, weight, structural and operating features, space required, clearances, type and/or brand of finish or shop coat, grease fittings, etc., depending on the subject of the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct for the work.
   1. Each shop drawing submittal shall include a complete copy of the relevant specification section markup up to reflect “compliance” or “deviation” on an item-by-item basis.

D. Shop Drawings shall be submitted as a complete package by specification section, unless otherwise reviewed and approved by the Engineer. It is the intent that all information, materials and samples associated with each specification section be included as a single submittal for the Engineer's review. Any deviation from this requirement, shall be requested in writing with an anticipated shop drawing breakdown/schedule prior to any associated submittal. An exception to this requirement are shop drawings for reinforcing steel, miscellaneous metals and structural steel, which shall be submitted separately for each structure unless otherwise permitted by the Engineer.

E. The Contractor shall be responsible for the prompt and timely submittal of all shop and working drawings so that there shall be no delay to the work due to the absence of such drawings.

F. No material or equipment shall be purchased or fabricated especially for the Contract until the required shop and working drawings have been submitted as hereinabove provided and reviewed for conformance to the Contract requirements. All such materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by said drawings.

G. Until the necessary review has been made, the Contractor shall not proceed with any portion of the work (such as the construction of foundations), the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which review is required.

H. All shop and working drawings shall be submitted to the Engineer by and/or through the Contractor, who shall be responsible for obtaining shop and working drawings from their subcontractors and returning reviewed drawings to them. Shop drawings shall be formatted to standard paper sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard sizes shall be: (a) 24 inches by 36 inches; (b) 11 inches by 17 inches, and (c) 11 inches by 8-1/2 inches. Provision shall be made in preparing the shop drawings to provide a binding margin on the left hand side of the sheet. Shop drawings submitted other than as specified herein may be returned for resubmittal without being reviewed.

I. Only drawings which have been checked and corrected by the fabricator should be submitted to the Contractor by their subcontractors and vendors. Prior to submitting drawings to the Engineer, the Contractor shall check thoroughly all such drawings to confirm that the subject matter thereof conforms to the Drawings and Specifications in all respects. All drawings which are correct shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer.

J. If a shop drawing shows any deviation from the Contract requirements, the Contractor shall make specific mention of the deviations in the transmittal. Shop Drawings that contain significant deviations that are not brought to the attention of the Engineer may be subject to rejection.

K. Should the Contractor submit equipment that requires modifications to the structures, piping, electrical conduit, wires and appurtenances, layout, etc., detailed on the Drawings, Contractor shall also submit details of the proposed modifications. If such equipment and modifications are accepted, the Contractor, at no additional cost to the Owner, shall do all work necessary to make such modifications.

L. A maximum of two submissions of each Shop Drawing will be reviewed, checked, and commented upon without charge to the Contractor. Any additional submissions which are ordered by the Engineer to fulfill the stipulations of the Drawings and Specifications, and which are required by virtue of the Contractor's neglect or failure to comply with the requirements of the Drawings and Specifications, or to make those modifications and/or corrections ordered by the Engineer in the review of the first two submissions of each Shop Drawing, will be reviewed and checked as deemed necessary by the Engineer, and the cost of such review and checking, as determined by the Owner, and based upon Engineer's documentation of time and rates established for additional services in the Owner-Engineer Agreement for this Project, may be deducted from the Contractor to make all modifications and/or corrections as may be required by the Engineer in an accurate, complete, and timely fashion. Resubmittals for the sole purpose of providing written responses to review comments will not be considered a resubmittal counting towards the two submission limit.

M. Shop Drawings that include drawings or other material that is illegible or too small may be returned without review.

1.4 SAMPLES

A. The Contractor shall submit samples when requested by the Engineer to establish conformance with the specifications, and as necessary to define color selections available. Submittals of “samples” shall be documented through the electronic submittal process by including a photograph of the item(s) and indicating the date the sample was mailed and/or delivered.

1.5 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance (O&M) Manuals are required for certain elements of the project, as specified herein.

B. The Contractor shall provide a completed Operation and Maintenance Manual Certification Form (copy provided for Contractor's use at the end of this Specification Section) which shall be attached to every copy of every Manual and signed by the Contractor and Manufacturer.

C. Each hard copy of an O&M Manual shall be provided in a stand-alone binder or shall be suitable for insertion into a 3-ring binder. Include the General Contractor's and Manufacturer's representative's contact information on the front cover. O&M manuals must be appropriate for the project and customized for the project. If a Manufacturer's standard O&M manual is included in the submittal, all non-applicable content must be removed or crossed out.

D. O&M Manuals shall contain the following operational information:
   1. Safety Precautions: List personnel hazards, equipment or product safety precautions for all operating conditions.
   2. Operator Prestart: Include all procedures required to set up and prepare each system, equipment or component for use.
   3. Startup Procedures: Provide a narrative description for all startup operating procedures, include all control sequences.
   4. Shutdown Procedures: Provide a narrative description for all shutdown operating procedures, include all control sequences.
   5. Post-Shutdown Procedures: Provide a narrative description for all post-shutdown operating procedures, include all control sequences.
   6. Normal Operating Procedures: Provide a narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.
   7. Emergency Operations: Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
   8. Operator Service Requirements: Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, alignment, spare parts installation and gage reading or recording.
   9. Environmental Conditions: Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which the equipment should not be allowed to run.

E. O&M Manuals shall contain the following maintenance information:
   1. Lubrication Data: Include a table showing recommended lubricants for specific temperature ranges and applications. Also, include charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, capacities and a lubrication schedule showing service interval frequency
   2. Preventative Maintenance Plan: Include the manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation as well as to ensure minimization of corrective

maintenance and repair. Provide the manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide the manufacturer's specified frequency and procedures for each separate operation.

3. Troubleshooting Guides: Include recommendations on procedures and instructions for correcting problems and making repairs. Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
4. Wiring and Control Diagrams: Provide Wiring diagrams and control diagrams. All diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to the actual installation numbering.
5. Maintenance and Repair Procedures: Include instructions and list the tools required to restore products and/or equipment to proper conditions or operating standards.
6. Removal and Replacement Instructions: Include step-by-step procedures, list required tools/supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.
7. Spare Parts and Supply Lists: Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration shall be required for facilities at remote locations. List spare parts and supplies that have a long lead times to obtain.
8. Corrective Maintenance Work Hours: Include the manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

F. O&M Manuals shall contain the following additional information:

1. Parts Identification: Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirements to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items.
    a. When illustrations omit a part number and description, both the illustration and a separate listing shall show the index, reference, or key number which shall cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and

subassemblies. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

2. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for all primary components included in product systems.
3. Personnel Training Requirements: Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
4. Testing and Special Tools: Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.
5. Contractor Information: Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the respective product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.
6. Written confirmation from the manufacturer that the Contractor has coordinated the equipment One Year Service Call in accordance with specification Section 01800.

1.6 MANUFACTURER'S CERTIFICATES

A. Prior to accepting the installation, the Contractor shall submit manufacturer's certificates for each item specified.
B. Such manufacturer's certificates shall state that the equipment has been installed under either the continuous or periodic supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements, to the manufacturer's satisfaction. All costs for meeting this requirement shall be included in the Contractor's bid price.

1.7 SUBMISSION REQUIREMENTS

A. Accompany submittals with a transmittal cover sheet, containing:
   1. Date.
   2. Project title and number.
   3. Contractor's name and address.
   4. The sequential shop drawing number for each shop drawing, project data and sample submitted shall be:
      a. Specification Section number followed by a dash and then a sequential number beginning with 01 (e.g., 16000-01).
      b. Under limited situations when additional different pieces of equipment are submitted under the same specification section, those submittals shall be numbered sequentially (e.g. 05500-01, 05500-02, 05500-03, etc.).

c. Resubmittals shall include an alphabetic suffix after the corresponding sequential number (e.g., 16000-01A).
d. O&M submittals shall be numbered with the Specification Section number followed by a dash, the letters "OM", another dash, and then a sequential number beginning with 01 (e.g. 16000-OM-01). Resubmittals of O&Ms shall include an alphabetic suffix after the corresponding sequential number (e.g. 16000-OM-01A).

5. Notification of deviations from Contract Documents.
6. Other pertinent data.

B. A completed Contractor Submittal Certification Form shall be attached to each hardcopy and electronic PDF of each shop drawing and must include:
1. Project name
2. Specification Section and sequential number with alphabet suffix for resubmittal
3. Description
4. Identification of deviations from Contract Documents.
5. Contractor's stamp, initialed or signed, certifying review of the submittal, verification of field measurements and compliance with Contract Documents.
6. Where specified or when requested by the Engineer, manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements.
7. Where specified, manufacturer's guarantee.

C. Additional Requirements for Electronic Submittals:
1. Each individual shop drawing or O&M submittal shall be contained in one PDF.
2. The first page of the PDF shall be the Contractor Submittal Certification Form as described above.
3. The electronic PDF shall be **exactly** as submitted in the hardcopy.
4. The electronic PDF shall include an electronic table of contents that is bookmarked for each section of the submittal.
5. The electronic PDF shall be configured such that is fully searchable.
6. PDF versions of 24x36 drawings shall be converted to 24 x 36 PDFs so as not to lose the clarity of the original drawing.
7. Electronic PDF submittals that are not submitted in accordance with the requirements stated above will not be reviewed by the Engineer.
8. Electronic submittals shall be transmitted via the protocol established in Part 1 above.

1.8 RESUBMISSION REQUIREMENTS

A. Revise initial submittals as required and resubmit as specified for initial submittal.
B. Indicate on submittals any changes which have been made other than those required by Engineer. All renumbering of shop drawings, relabeling of individual pieces or assemblies or relocating of pieces or assemblies to other Drawings within the submittal shall be clearly brought to the attention of the Engineer. If relabeling of individual pieces or assemblies has taken place, the labels from the previous submittal shall be indicated to assist in comparing the original and resubmitted shop drawing.

C. All resubmittals shall include a summary of the previous submittal review comments with the vendors' written response as to how the previous comments were addressed.

1.9 ENGINEER'S REVIEW

A. The review of shop and working drawings hereunder will be general only, and nothing contained in this specification shall relieve, diminish or alter in any respect the responsibilities of the Contractor under the Contract Documents and in particular, the specific responsibility of the Contractor for details of design and dimensions necessary for proper fitting and construction of the work as required by the Contract and for achieving the result and performance specified thereunder.

B. The Engineer's review comments will be summarized on a Submittal Review Form, which includes an action code. A description of each action code is provided below.

1. No Exceptions Taken (Status 0 on shop drawing log). The shop drawing complies with the Contract Document requirements. No changes or further information are required. Where appropriate, the submittal review form will be used to alert the Contractor, Owner and Field personnel of remaining items within that specification section that still needs to be submitted.
2. Make Corrections Indicated (Status 1 on shop drawing log). The shop drawing complies with the Contract Document requirements except for minor changes, as indicated. Engineer requires that all comments will be addressed by the Contractor, unless otherwise notified in writing prior to execution of the relevant work.
3. Conditional to Remarks (Status 2 on shop drawing log). The shop drawing potentially complies with the Contract Document requirements, contingent upon satisfactory resolution of all review comments. Resubmittal from the Contractor shall address each review comment and include supplemental information, as necessary.
4. Revise and Resubmit (Status 3 on shop drawing log). The shop drawing does not comply with the Contract Document requirement as submitted, but may with changes indicated and/or submission of additional information. The entire package must be resubmitted with the necessary information and a cover letter which identifies all changes made to the submittal, indicates how each review comment has been addressed and indicates where to find the information in the resubmittal.
5. Rejected (Status 4 on shop drawing log). The shop drawing does not comply with the Contract Document requirements, for the reasons indicated in the remarks, and is unacceptable.
6. For Information Only (Status 5 on shop drawing log). The shop drawing review was for information only.
   In Review (Status 6 on shop drawing log). The shop drawing is currently under review.

CONTRACTOR SUBMITTAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

SHOP DRAWING NUMBER: _____ (SPECIFICATION SECTION OR DRAWING NO:) - _____ (SEQUENTIAL NUMBER (& ALPHA SUFFIX FOR RESUBMITTAL))

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced submittal has been reviewed by the undersigned and I/we certify that the material and/or equipment meets or exceeds the project specification requirements with

☐ NO DEVIATIONS

or

☐ A COMPLETE LIST OF DEVIATIONS AS FOLLOWS:

_____
_____
_____
_____

By: _____ Contractor Date: _____

By: _____ Manufacturer Date: _____

a Any deviations not brought to the attention of the Engineer for review and concurrence shall be the responsibility of the Contractor to correct, if so directed.
b Required on all submittals
c When required by specifications Page ___ of ___

General Contractor's Stamp

OPERATIONS AND MAINTENANCE MANUAL CERTIFICATION FORM

PROJECT: _____ CONTRACTOR'S PROJ. NO: _____

CONTRACTOR: _____ ENGINEER'S PROJ. NO: _____

ENGINEER: _____

O&M NUMBER: _____ (SPECIFICATION SECTION OR DRAWING NO:) - OM- _____ (SEQUENTIAL NUMBER (& ALPHA SUFFIX FOR RESUBMITTAL))

DESCRIPTION: _____

MANUFACTURER: _____

The above referenced operations and maintenance manual has been reviewed by the undersigned and I/we certify that the manual is customized as needed for this project, is suitable for mounting in a 3-ring binder, and contains the following items:

- ☐ Table of Contents
- ☐ Contractor and Manufacturer Contact Information
- ☐ Preventative Maintenance Schedule and Summary
- ☐ Removal and Replacement Instructions
- ☐ Lubrication Schedule
- ☐ Troubleshooting Information
- ☐ Warranty Information
- ☐ Rebuild Information for All Components
- ☐ Startup, Operation and Shutdown Procedures
- ☐ Normal and Emergency Operations
- ☐ Safety Procedures and Precautions
- ☐ Shop Drawings corrected to As-Built Conditions
- ☐ Personnel Training Requirements
- ☐ Project-Related Design Data
- ☐ Serial Numbers
- ☐ Maintenance and Repair Procedures
- ☐ Wiring and Control Diagrams
- ☐ Equipment Drawings & Schematics
- ☐ Equipment Performance Curves
- ☐ Parts and Service Contact Information
- ☐ Manufacturer's Contact Information
- ☐ Emergency Operations Plan
- ☐ List of All Component Part Numbers
- ☐ List of Spare Parts Supplied
- ☐ Testing Equipment & Special Tools
- ☐ Other System Specific Information

By:_____ By:_____
Contractor[a] Manufacturer[b]
Date: _____ Date:_____

[a] Contact information shall include name, address and telephone number.
[b] Required on all Operation and Maintenance Manuals.
[c] When required by Specifications. Page ___ of ___

General Contractor's Stamp

PROCESS EQUIPMENT MANUFACTURER SUBMITTAL CERTIFICATION
(Divisions 11 and 14)

Owner:_____ Date: _____

Project:

Contractor:

Equipment Manufacturer:

Equipment:

As an authorized representative of the equipment manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of Section 11000, Part 1.3.K. The undersigned authorized representative of the manufacturer further certifies that the equipment manufacturer or supplier has: reviewed the Contract Documents, the intended installation by the Contractor, and the intended functional and operational conditions; determined all conditions to be acceptable; and found no conditions which would cause the warranty to be void; or the equipment to function improperly, or not meet the performance requirements.

(Authorized Representative of the Manufacturer) (Date)

END OF SECTION

SECTION 01370

SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide a detailed breakdown of the Contract Sum showing values allocated to each of the various parts of the Work, as specified herein and in other provisions of the Contract Documents.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Use required means to assure arithmetical accuracy of the sums described.
B. When so required by the Engineer, provide copies of the subcontracts or other data acceptable to the Engineer substantiating the sums described.

1.4 SUBMITTALS

A. The proposed schedule of values (hereinafter referred to as "SOV"), meeting the requirements outlined below, shall be submitted to the Engineer for review. The SOV shall be used as the basis for reviewing and approving payment requisitions along with determining percentages of work completed. No payment requisitions will be processed until the Engineer has taken no exceptions to the schedule of values.
B. The SOV shall consist of a detailed breakdown of all the work within the Contract Documents, as specified herein, and shall include a sufficient number of work items to serve as an accurate basis the General Contractor's Application for Payment. Each work item shall include its prorated share of overhead and profit and subcontractor markup. The breakdown shall provide the level of detail outlined below.
   1. General Conditions:
      a. Includes all work indicated in all specifications within Division 0 and 1.
   2. Civil and Site Work:
      a. Includes all work indicated on the Civil (C) Drawings and all specifications within Division 2.
   3. Architectural:
      a. Breakdown by building and structures.
      b. Includes all work indicated on the Architectural (A) Drawings and in all specifications within Divisions 4, 5, 6, 7, 8, 9, 10 and 12.
   4. Structural:
      a. Breakdown by building and structures.
      b. Includes all work indicated on the Structural (S) Drawings and in all specifications within Divisions 3, 5 and 13 (through and including Section 13133).

5. Process Equipment:
   a. Breakdown by process system, including submittals, O&M manuals, equipment, installation, startup, commissioning and training.
   b. Includes all work indicated on the Process (PR) Drawings and in all specifications within Division 11 and relevant specifications in Divisions 14 and 15.
6. Mechanical and Plumbing:
   a. Breakdown by building and structures.
   b. Includes all work indicated on the Mechanical (M) Drawings and in relevant specifications within Division 15.
7. Instrumentation and System Integration:
   a. Breakdown by overall network, overall instruments, overall programming, startup, commissioning, and training.
   b. Includes all work indicated on the Instrumentation (I) Drawings and in all specifications within Division 13 (from Sections 13410 through and including 13460).
8. Electrical:
   a. Breakdown by overall utility service, power distribution, standby power, building and structures, startup and commissioning.
   b. Breakdown ductbank costs on a linear foot basis.
   c. Breakdown conduit and wire separately.
   d. Includes all work indicated on the Electrical (E) Drawings and in all specifications within Division 16.
9. Line items shall be broken down into work performed by the General Contractor or a Subcontractor
10. Provide an aggregate percentage completed calculation for each major subcontractor (e.g., site, HVAC, ATC, systems integrator, plumber, electrician, etc.).
11. If a work item, or series of work items, are separated into construction phases which will require phased payments, the SOV shall have separate line item values for each phase.

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Pre-Construction Record: Contractor shall take digital photographs and video to obtain a visual record of the project area prior to beginning any work at the project site.
2. Notify Engineer at least three (3) working days prior to photographing or videoing the project area so Engineer may, at their option, observe.

1.2 QUALITY

A. Pre-Construction Record: Quality shall be such that the condition of existing pavement, curbing, driveway entrances, sidewalks, walls, doors, equipment, piping, etc. can be readily determined. Pre-construction record photographs and videos shall be taken by the Contractor with the Engineer or RPR present.

B. Electronic files shall be high resolution digital images in *.jpeg format and shall not be compressed or downsized. Electronic files shall not be less 2MB in size

1.3 SUBMITTALS

A. Pre-Construction Record:

1. Submit pre-construction photographs/videos in accordance with Section 01340 prior to initiating any work on-site.

B. The quality of the photos and video are subject to approval by the Engineer.

C. Photographs and videos taken for the project and submitted are released to the Owner and Engineer for reproduction and use for records retention, governmental, commercial, and marketing purposes.

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 REQUIREMENTS INCLUDED

A. General Quality Control.
B. Workmanship.
C. Manufacturer's Instructions.
D. Manufacturer's Certificates.
E. Manufacturer's Field Services.
F. Testing Laboratory Services.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY CONTROL

A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.4 WORKMANSHIP

A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
B. Perform work by persons qualified to produce workmanship of specified quality.
C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.5 MANUFACTURERS' INSTRUCTIONS

A. Comply with instructions in full detail, including each step in sequence. Should instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

1.6 MANUFACTURERS' CERTIFICATES

A. When required by individual Specifications Section, submit manufacturer's certificate that products meet or exceed specified requirements.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in respective Specification Sections, require supplier and/or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.
B. Representative shall submit written report to Engineer listing observations and recommendations.

1.8 TESTING LABORATORY SERVICES

A. Owner will employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services wherever an Independent Testing Laboratory is required by individual specification sections.

B. Services will be performed in accordance with requirements of governing authorities and with specified standards.

C. Reports will present observations and test results and indicate compliance or non-compliance with specified standards and with Contract Documents. Independent Testing Laboratory will submit one copy of each report directly to each of the following: Engineer, Resident Project Representative, Contractor. Reports will be submitted within 5 days of obtaining test results. If test results indicate deficiencies, Independent Testing Laboratory shall telephone or email results to Engineer, Resident Project Representative and Contractor within 24 hours.

D. Contractor shall cooperate with Independent Testing Laboratory personnel; furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.

E. Contractor shall coordinate all testing work and shall notify Engineer and Independent Testing Laboratory at least 24 hours prior to performing work requiring testing services. If scheduled tests or sampling cannot be performed because the work is not ready as scheduled, testing costs associated with the delay will be determined by Engineer and invoiced by Owner to Contractor. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price. If adequate notice is not provided, Contractor shall suspend work on that portion of the Project until testing can be performed. Such suspension will not be grounds for a claim against the Owner for delay, nor will it be an acceptable basis for an extension of time.

F. Payment for Independent Testing Laboratory services shall be as follows:

1. General: Where testing is the Owner's responsibility, payment will be made as stated below unless other requirements are given in Specification Sections. Testing which is the responsibility of the Contractor will be considered an incidental item unless otherwise indicated in Section 01150, Measurement and Payment.
2. Initial Testing: Owner will pay for initial tests.
3. Retesting: Costs of retesting due to non-compliance will be initially paid by Owner. The cost of retesting will be determined by Engineer and Owner will invoice Contractor for this cost. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price via Change Order.
4. Contractor's Convenience Testing: Inspections and tests performed for Contractor's convenience will be paid for by Contractor.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Provide and pay for all temporary applicable utilities required to properly perform the Work at no additional cost to the Owner including the placement and removal of the utilities.
2. Completely remove all temporary equipment and materials upon completion of the Work and repair all damage caused by the installation of temporary utilities.
3. Make all necessary applications and arrangements for electric power, light, water and other utilities with the local utility companies. Notify the local electric power company if unusually heavy loads, such as welders, will be connected.
4. Except as otherwise specified in the various Sections of the Specifications, the General Contractor shall provide, set up and maintain all derricks, hoisting machinery, scaffolding, staging, and planking, and do all hoisting required for the Work, or any part of the Work.
5. General Contractor shall furnish and maintain dumpsters as required to adequately control the disposal of all trash, construction debris, and waste materials resulting from the work of General Contractor and all filed sub-contractors.
6. Provide temporary protection of existing concrete tanks and other unheated concrete structures taken out of service for the General Contractor to complete the Work as indicated on the Contract Documents in that area.
7. General Contractor shall provide temporary ventilation during construction as required to ensure a safe working environment. The temporary ventilation systems shall address the following conditions, including but is not limited to: removal of hazardous fumes from explosion-proof rated spaces (Class 1, Division 1 rated spaces), removal of paint fumes and other potentially toxic conditions associated with the contractor's activities, and ventilation of confined spaces, in compliance with all OSHA and State safety requirements.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Obtain permits as required by local governmental authorities.
2. Obtain easements, when required, across private property other than that of the Owner for temporary power service.
3. Comply with the latest National Electrical Code.
4. Comply with all local, State and Federal codes, laws, and regulations.

B. All temporary utilities are subject to the approval of the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Electrical:

1. The General Contractor shall make necessary arrangements with the local power company for connection to the existing power supply and shall provide and pay for all temporary light and power requirements except as otherwise specified hereunder. In general, the temporary electrical service shall include all necessary switches, poles, wiring, cables, conduit, raceways, panelboards, fixtures, lamps and receptacles to supply construction power of adequate capacity for the project. Temporary transformers and meters shall be furnished and installed by the appropriate power authority, but paid for by the General Contractor, who shall be responsible for making all arrangements for their installation prior to using any existing power for temporary purposes.
2. Use new or used materials adequate in capacity for the purposes intended.
3. Materials must not create unsafe conditions or violate the requirements of applicable codes.
4. Conductors:
    a. Wire, cable or busses of appropriate type, sized in accordance with the latest National Electrical Code for the applied loads.
    b. Use only UL approved wire.
5. Conduit:
    a. Rigid steel, galvanized: ANSI C80.1.
    b. Electrical metallic tubing: ANSI C80.3.
    c. Other material approved by NEC.
6. Equipment: Provide appropriate enclosures for the environment in which used in compliance with NEMA Standards.
7. Temporary power shall be based upon the following minimum requirements:
8. Lighting - 300 watt per 1,000 square feet of floor area.
9. Receptacles - One 15 ampere duplex for 1,000 square feet of floor space.
10. Special Construction Equipment - Provide one 30-amp, 2-pole fused switch for equipment connection. The cost for cables and connection from switch to the special equipment will be borne by the Sub-Contractor requiring same.
11. The General Contractor will pay for the cost of energy consumed by all trades, including cost of lamp replacement. The General Contractor and Subcontractors of all trades shall furnish their own extension cords and such additional lamps as may be required for their work, shall pay for the cost of temporary wiring of a special nature for light and power required, other than that above mentioned.
12. All temporary work shall be furnished and installed in conformity with the National Electrical Code and in accordance with local ordinances and requirements of the municipal power authority. All temporary wiring and accessories shall be removed after it has served its purpose.

B. Heating and Ventilation:

1. The General Contractor shall furnish, install, and maintain a complete temporary heating and ventilation systems, including fuel therefore, which will provide heat and ventilation as required by the trades and for the protection of personnel in the work spaces, and stored and installed materials from injury as can be caused by dampness and cold. The General Contractor shall employ,

within the terms of the General Contract, a competent watchman who will maintain and operate the systems, as required. The General Contractor shall bear all costs incurred from the temporary heating and ventilation from the time the systems are first required until the date of Substantial Completion of the General Contract, as defined in the General Conditions and Supplementary Conditions.

2. Under no circumstance shall the permanent heating system be used for temporary heating purposes, until the building/buildings have been considered as satisfactorily enclosed by the Engineer, specified hereunder.
3. Temporary heating equipment must be smokeless and fumeless type, Underwriters Laboratories, Factory Mutual, Fire Marshal and Engineer approved, and will fulfill the heating requirements specified hereunder.
4. As soon as practicable, after the building/buildings have been considered satisfactorily enclosed by the Engineer, the General Contractor shall have the permanent heating and ventilation systems and apparatus put in operation. Electrical service, wiring, controls, and other essential parts of the permanent system must be installed prior to utilizing the heating system. The General Contractor shall pay for all power and fuel consumed in the temporary operation of the permanent systems until the time the building/buildings are partially or permanently occupied by the Owner, whichever comes first in accordance with the provisions specified herein for use and occupancy prior to acceptance by the Owner.
5. After enclosure of the building/buildings and before installation of wet work such as interior masonry and tile, maintain temperatures of 50 degrees minimum, except for a period commencing 10 days prior to the installation of interior woodwork, interior flooring, or interior painting, whichever occurs first, after which time the temperature shall be maintained at a minimum of 65 degrees F., until the project is either partially or permanently occupied by the Owner.

C. Water and Sanitary:

1. The General Contractor shall make necessary arrangements for connection to the municipal water supply and shall provide, at their own expense, any extensions as required for the operation of this project. The General Contractor shall bear all costs incurred for the temporary water services, including the costs of the water itself.
2. All lines, temporary or permanent, shall be protected and maintained by the General Contractor. Temporary lines shall be removed by the General Contractor when the temporary service is no longer required.
3. The General Contractor shall provide an adequate drinking water supply, satisfactorily cooled, for their employees.
4. See Site Plan for nearest water hook-up.
5. The General Contractor shall furnish, install, maintain and pay for adequate temporary chemical type toilet accommodations, for all persons employed on the work and located where approved by the Engineer. The accommodations shall be in proper enclosures and in accordance with Municipal Ordinances and shall be maintained in proper, safe and sanitary conditions and suitably heated when requested.

6. Relocate temporary toilet facilities as required to facilitate the construction.
7. Remove all temporary facilities at completion of work when directed by the Engineer.

D. Protection of Existing Concrete Tanks and other Unheated Concrete Structures taken out of Service:
1. The General Contractor shall provide protection as required to maintain the surface temperatures of the existing concrete above 40 degrees F during the months of November through March and other periods during which the ambient air temperature is below 32 degrees F. The General Contractor shall be responsible for all means and methods to maintain the specified temperature at no additional cost to the Owner.
2. The General Contractor shall furnish and monitor surface thermometers on the concrete surfaces.
3. The above listed requirement is a minimum required to prevent the structure from freezing. If the nature of the work within the structure requires a greater air temperature to perform the work (such as application of coatings), the requirements of Part 2.1.B shall apply.
4. If, in the opinion of the Engineer, the work required in the unheated structure is of a short duration or the anticipated ambient air temperatures will not drop below 40 degrees F, additional protection as required in Part E.1 may not be required. The General Contractor shall still be responsible for monitoring the temperature of the concrete surfaces and providing protection if they drop below 40 degrees F.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Electrical:
1. Provide electrical energy to:
a. All necessary points on the construction site so that power can be obtained at any desired point with extension cords no longer than 100 feet.
b. Construction site offices.
c. Lighting as required for safe working conditions at any location on the construction site.
d. Night security light.
e. When applicable, Owner's present facilities during the changeover of electrical equipment.
2. Maintain electrical energy throughout the entire construction period.
3. Capacity:
a. Provide and maintain adequate electrical service for construction use by all trades during the construction period at the locations necessary, as specified herein.
4. Installation:
a. Install all work with a neat and orderly appearance.
b. Have all installations performed by a qualified electrician.
c. Modify service as job progress requires.

d. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, traffic areas and other work.

B. Heating and Ventilation:
   1. Maintain a heated and ventilated environment for the work at the temperature and for the length of time specified or as directed by the Engineer, and as needed to protect all individuals on the construction site.
   2. Precaution:
      a. Operate temporary heating apparatus in such a manner that finished work will not be damaged.
      b. Repair all damage, caused by temporary heating operations, to the complete satisfaction of the Engineer.

C. Weather Protection
   1. The Contractor shall be entirely responsible for all weather protection during the Contract Time, and shall be liable for any damage to the Work, or any part thereof caused by the Contractor's failure to supply adequate and proper weather protection.
   2. Any work damaged by frost shall be promptly removed and replaced by the Contractor at no increase in Contract Price or Contract Time.

D. Water:
   1. Provide and maintain water for drinking and construction purposes as required for the proper execution of the Work.

E. Sanitary Accommodations:
      a. Provide and maintain sanitary accommodations for the use of the employees of the General Contractor, subcontractors, and Engineer.
      b. Sanitary accommodations shall meet the requirements of all local, State and Federal health codes, laws and regulations.

F. Protection of Existing Tanks and other Unheated Structures taken out of Service:
   1. The General Contractor shall provide protection and/or heat as required to maintain the specified temperature of the existing structure.
   2. The General Contractor shall document the condition of the structures immediately after they are taken out of service with either still photos or video.
   3. Precaution:
      a. If additional heat is required, operate temporary heating apparatus in such a manner that the existing structure will not be damaged.
      b. Repair all damage, caused by temporary heating operations, to the complete satisfaction of the Engineer.
   4. The General Contractor shall repair any concrete damaged as a result of the surface temperatures of the concrete dropping below 40 degrees F.

END OF SECTION

SECTION 01515

TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall design, furnish, install, test, operate, maintain and remove temporary bypass pumping system(s) in order to divert sewage flow around the work area. Temporary bypass pumping system(s) shall be fully automated and able to reliably convey the full range of wastewater flows, as scheduled herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. All system components specified herein shall be furnished by a Supplier who regularly engages in temporary bypass pumping systems. Supplier shall have a minimum of 15 years of experience with temporary bypass pumping systems. Supplier shall provide at least 5 references of project of a similar size and complexity as this project that have been performed within the past 5 years within New England.

B. Supplier shall have sufficient equipment and spare parts inventory to perform normal rentals, including this project, and maintain at least 100% reserve equipment for this project for immediate delivery. Supplier shall have sufficient service personnel to provide service calls within 4 hours, 24 hours per day, 7 days per week.

C. Temporary bypass pumping systems shall be:
   1. Rain For Rent, Charlton, MA;
   2. Xylem Dewatering Solutions, Bozrah, CT;
   3. Baker Corp, Oxford, Massachusetts;
   4. or equal.

D. A qualified representative of the Supplier shall inspect the installation and supervise the startup and testing of the temporary bypass pumping system.

E. The temporary bypass pumping system shall meet all applicable local, state and federal requirements.

F. The temporary bypass pumping system shall be designed by a Professional Engineer licensed to practice in the State of Maine. Compliance with this requirement shall be demonstrated via a signed and sealed submittal package, as specified herein.

1.4 SUBMITTALS

A. In accordance with the requirements of Section 01340.
   1. Qualifications information
   2. Proposed schedule, sequence of construction, duration of activities and description of sewer control methods to be utilized for each element of the project.

3. Coordination Drawings showing detailed layout of equipment, pumps, suction piping, discharge piping, fittings, valves, supports, materials, temporary enclosure and temporary odor control provided under this section.
4. List of duty equipment, pumps, piping, fittings, valves, and materials to be utilized by the Contactor for the temporary bypass pumping system.
5. List of standby equipment and spare parts available on-site and off-site in order to ensure uninterrupted operation of the bypass pumping system in the event of a utility power failure.
6. Fuel consumption rate at full speed duty and standby pumping.
7. Fuel storage tank and secondary containment provision, including Spill Prevention Control and Countermeasure (SPCC) Plan, if applicable.
8. Catalog cut sheets/ technical data for equipment and appurtenances.
9. Performance curves for wastewater bypass pumps and suction lift, static head, headloss, and total dynamic head (TDH) calculations.
10. Description of maintenance procedures to be utilized.
11. Description of controls and alarm equipment to be utilized. Sample alarm log.
12. Names of individuals responsible for on-call response, 24 hours per day, 7 days per week. Call list for alarm response.

B. No construction related activities requiring the need for bypass pumping operations shall begin until the related project submittals are reviewed and all provisions of the work have been fully coordinated with the Owner, Agency, Engineer and any other parties having jurisdiction for the proposed work activities.

PART 2 - PRODUCTS

2.1 WASTEWATER BYPASS PUMPING SYSTEM

A. Pumping Equipment:

1. Temporary bypass pumping system(s) shall designed to convey the full range of flows and head conditions as scheduled herein.

HARWARD STREET PUMP STATION	
Duty	Pump raw unscreened sewage
Duty Pumps	Electric or Diesel
Standby Pumps	Electric or Diesel
Variable Speed Required for Duty Pumps	Yes
Peak Instantaneous Flow	4,200 gpm
Average Flow	990 gpm
Minimum Flow	350 gpm

2. The temporary bypass pumping system shall be able to convey the peak instantaneous flow, as scheduled herein:
   a. with the largest available pump off-line; and
   b. without utility power.

3. Each pump shall be a skid-mounted unit. The pump system may utilize available on-site manholes, junction/splitter structures, and/or tankage for suction and discharge, as appropriate
4. The pumps shall be centrifugal trash pumps suitable for handling raw, unscreened sewage with solids up to 3 inches in diameter, and capable of running completely dry for extended periods of time without damage. Pumps shall be capable of static suction lifts to 28 vertical feet, at sea level.
5. The pump priming system shall be fully automatic, needing no form of adjustment or manual addition of water. The priming system shall be capable of priming the pump from a completely dry casing.
6. All pumps shall be critically silenced to less than 68 decibels at 25 feet.
7. Contractor shall provide appropriately sized portable spill guard containment dikes to contain leaks resulting from the pumping system, from the fuel storage tanks(s) and/or from the pumps and process piping within 5 feet of the system.

B. Piping
1. Suction piping and discharge piping shall be constructed of:
   a. Rigid galvanized steel pipe with ball and socket joints, Bauer HK Quick Coupling Piping or equal.
   b. Fused HDPE piping
   c. Connection to existing piping shall be made equivalent materials.
2. Aluminum "irrigation" type piping or glued PVC pipe shall not be allowed.

C. Controls and Alarms
1. The pump set shall be furnished with a weather-proof automatic control system consisting of floats and/or transducer level controls.
2. The controller shall start/stop the pumps based on signals from high and low level floats or a transducer. The controller shall be capable of automatically varying the pump speed to match varying flow conditions and maintain a constant suction level, if scheduled herein.
3. The controller shall annunciate and log all alarm conditions including but not limited to high upstream water level, duty pump failure, utility power loss and standby pump failure. The alarm log shall include the type of alarm, time of alarm, time alarm acknowledged, and time alarm condition cleared. Annunciation shall be via teledialer, two-way radio, cellular telephone, or equivalent.

PART 3 - EXECUTION

3.1 COORDINATION OF WORK

A. Provide all labor and equipment necessary to coordinate work of this section and maintain communications.

B. Notify all personnel, including but not limited to Owner, Engineer and Utility Companies, seven days in advance of any temporary bypass pumping work. The Owner will identify personnel to be notified in addition to those identified by the Contractor.

C. Contractor shall coordinate temporary bypass pumping operations with the Owner and Engineer on a daily basis.

3.2 PERFORMANCE:

A. General

1. The Contractor shall install and test all sewer flow control methods to the satisfaction of the Owner and Engineer prior to proceeding with the Work.
2. The Contractor shall be solely responsible for clean-up, repair, property damage costs and claims resulting from failure of the diversion system.
3. Any temporary pumps, piping, fuel storage, or other appurtenances associated with the temporary pumping system shall be either located above the 100-year flood elevation or protected against flotation or other damage which would be caused by a flood event.

B. The existing force main has a pig launching assembly that may be used for bypass pumping, as seen on the Drawings. If Contractor elects to use the pig launching assembly as part of the bypass pumping system, the following conditions shall be met:

1. The new gate valve on the forcemain in the yard must be installed on the forcemain where indicated on the Drawings prior to the pig launching assembly being used for bypass pumping.
2. The contractor shall have a pumper truck available on standby to handle flows while the pig launching assembly is being fitted with necessary fittings, including installation of upstream gate valve, to facilitate bypass pumping.
3. The contractor must utilize a pumper truck or otherwise adequately manage all flows while the station is offline during the retrofit of the pig launching assembly. The operating volume of the wet well is approximately 12,000 gallons and the average influent flow is approximately 990 gpm under dry weather conditions.

C. The temporary bypass pumping system shall be furnished, installed, tested, operated, maintained and removed as follows:

1. The Contractor shall furnish, install, and test temporary bypass pumping system and discharge pipelines.
2. The Contractor shall test and debug all systems and verify that all necessary equipment, materials, spare parts, and labor are available on-site prior to operation of the system and prior to the demolition of any part of the existing pumping station facilities.
3. The Contractor shall operate and maintain the system until the new Work is completed, demonstration tested and accepted by the Owner and Engineer. Contractor shall coordinate with the Owner on a daily basis.
4. Contractor shall be responsible for making regulatory reporting notifications for any release of wastewater or fuel to the environment. Contractor shall provide copies of notifications to the Owner and Engineer.
5. The Contractor shall anticipate that the Owner will require 7 calendar days of operation on the new, permanent Work following satisfactory completion of demonstration testing prior to beginning disassembly of the temporary bypass pumping system.

6. Upon receipt of approval by the Owner and Engineer, the Contractor shall disassemble and remove the temporary bypass pumping system, including all appurtenant piping. Contractor shall restore the area impacted by the temporary bypass pumping system to a like-new condition.

D. Contractor shall be responsible for cleanup, repairs, restoration and fines required to address spills or overflows from a failed bypass pumping system.

END OF SECTION

SECTION 01520

SITE SECURITY

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall:
   1. Protect work premises and Owner's operations from theft, vandalism, and unauthorized entry.
   2. Initiate program in coordination with Owner's existing security system at job mobilization.
   3. Maintain program throughout construction period.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 ENTRY CONTROL

A. The Contractor shall:
   1. Restrict entry of persons and vehicles into Project site and existing facilities.
   2. Allow entry only to authorized persons with proper identification.
   3. Maintain log of workmen, visitors and deliveries and make log available to Owner on request.
   4. Coordinate entrance of persons, vehicles (including deliveries) in such a manner to not interfere with Owner’s operations.

B. Owner will control entrance of persons and vehicles related to Owner's operations.

3.2 RESTRICTIONS

A. The Contractor shall not allow cameras on site or photographs taken except by written approval of Owner.

END OF SECTION

SECTION 01562

DUST CONTROL

PART 1 - GENERAL

1.1 DESCRIPTIONS

A. Work Included:

1. Furnish and apply water or calcium chloride on the road surfaces within the construction site, when required to control dust and when directed by the Engineer.
2. When dust control is not included as a separate item in the Contract, the work shall be considered incidental to the appropriate items of the Contract.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Water for Sprinkling:

1. Clean, free of salt, oil, and other injurious matter.

B. Calcium Chloride:

1. Meet the requirements of AASHTO M144.

PART 3 - EXECUTION

3.1 APPLICATION

A. Water:

1. Apply water by methods approved by the Engineer.
2. Use approved equipment including a tank with gauge equipped pump and spray bar.

B. Calcium Chloride:

1. Apply at a rate sufficient to maintain a damp surface but low enough to assure non-contamination of water courses.
2. Apply water prior to calcium chloride addition.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide all materials and perform all work necessary to completely regulate traffic in the area of Work.
   2. Perform all work in such a manner as to provide safe passage at all times for the public and with a minimum of obstruction to traffic.
   3. Do not close roads or streets to passage of the public without the permission of the proper authorities.
   4. Uniformed officers with vehicles and flaggers (including police officers when required by law, regulations, ordinances, or as a result of poor traffic control) shall be obtained and paid for by the Contractor.

B. The local police department and/or the appropriate state transportation authority who will decide if safe passage is being maintained and shall have the authority to require the Contractor to take any additional steps necessary to maintain safe passage. If the Authority furnishes an inspector on the job or requires additional traffic control as a result of poor traffic control by the Contractor, the Contractor shall be responsible for all costs assessed by the Authority and for additional traffic control at their own expense. Minimize the length of delays or traffic stoppage to the extent practicable. Maximum traffic stoppage time shall be 10 minutes.

C. Develop a project specific traffic control plan that meets the requirements of Manual of Uniform Traffic Control Devices (MUTCD) and any local and state requirements. Proposed Traffic Control Plan shall indicate signs/locations to be used. Traffic Control Plan submittal to the Engineer will be for general information only.

D. The Contractor's designated traffic control representative shall respond to all traffic safety complaints and be available to direct traffic control subcontractors the entire time work is occurring on site. If the designated representative is not on site for a period of time, another on site representative shall be designated by the Contractor for that period.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SCHEDULING WORK

A. During the Project Pre-Construction Meeting one Contractor representative will be designated as the coordinator between the Police Department and subcontracted traffic control.

B. Variable Message Signs notifying the public of pending road closure and/or construction must be in place seven days prior to road closure or as required by Maine Department of Transportation (MDOT).

C. Schedule all work so that two adjacent parallel streets are not closed to passage by the public at any one time, if at all possible.
D. Revise the plan of work if it will create a traffic hazard or an unreasonably long detour.
E. Do not start work in any new location without the permission of the Engineer.
F. Notify all police and fire departments of all scheduled detours and when streets are reopened.

1.4 SUBMITTALS

A. Submit a project specific traffic control plan that meets the requirements of the Manual of Uniform Traffic Control Devices (MUTCD) and any local and state requirements. The proposed Traffic Control Plan shall indicate signs/locations to be used.
B. The proposed Traffic Control Plan is provided "for information only" to inform the Owner, Engineer and Resident Project Representative of the project specific traffic control; however, if the Traffic Control Plan is incomplete (e.g., missing elements relevant to the project work), inadequate (e.g., outdated qualifications) or not project specific, it will be returned "revise and resubmit". Delays related to an incomplete Traffic Control Plan are the responsibility of the Contractor.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND BARRICADES

A. Traffic control (plans, methods and devices) shall be as outlined in the MUTCD as published by U. S. Department of Transportation, and any local and state requirements.
B. Provide adequate warning signs, barricades, signal lights, flaggers/uniformed police officers, and take other necessary precautions for the safety of the public.
C. Provide and illuminate suitable warning signs to show where construction, barricades or detours exist.
D. Provide digital message boards at appropriate locations as determined by the local police department and/or the MDOT to maintain safe passage of traffic and work zone.
E. Provide barricades of substantial construction and painted with a finish that increases visibility at night, as outlined in the MUTCD.
F. Keep signal lights illuminated at all barricades and obstructions from sunset to sunrise.
G. Maintain all necessary signs, barricades, lights, flaggers, crew and other safety precautions during authorized suspension of the Work, weekends, holidays or other times when the Work is not in progress.
H. Contractor shall make periodic inspection throughout the day of the traffic control patterns, methods, signs and other devices to ensure that they are properly placed.

2.2 UNIFORMED POLICE OFFICER

A. A uniformed police officer is a police officer (local, county or state) on regular or special duty dressed in uniform with the necessary high visibility vest and apparel needed for traffic control.

B. Arrange the police detail with the local Chief of Police.

2.3 FLAG PERSON

A. A flag person is a trained and certified individual assigned specifically to the task of directing traffic and is outfitted in the necessary high visibility vest and apparel needed for traffic control.
B. Flag persons shall be provided by the Contractor.

PART 3 - EXECUTION

3.1 DETOURS

A. Provide, identify and maintain suitable detours when the project, or any part thereof, is closed to public travel.
B. When the closed part of the project is reopened, restore the detour area and any other disturbed areas to the original condition.

3.2 INCONVENIENCE TO RESIDENTS OF VICINITY

A. Whenever a traveled way is closed, perform the Work in such a manner that local travel, residents and businesses in the vicinity of the Work will be inconvenienced as little as possible.
B. Allow access to residents and abutting land owners along the project to driveways and other normal outlets from their property.

3.3 TRAFFIC CONTROL OFFICERS

A. Where required by the local police departments and/or when specified, traffic control officer shall be Uniformed Police Officers.
B. Where the local police departments do not wish to or are unable to furnish traffic control officers and/or when specified, the traffic control officers shall be flag person.

END OF SECTION

SECTION 01572

MAINE CONSTRUCTION GENERAL PERMIT (MCGP)

Construction activities to be performed under of this Project have been determined to require coverage under the Maine Construction General Permit (MCGP). The MCGP is based on the Federal National Pollutant Discharge Elimination System (NPDES) Stormwater program that applies nationwide. The Environmental Protection Agency (EPA) has delegated its authority to administer this program to the Maine Department of Environmental Protection (MEDEP). The program provides that certain discharges are not allowed unless they are licensed, and the MCGP authorizes the direct discharge of stormwater associated with construction activities to waters of the State.

Activity Under the MCGP, construction activities are defined as:
Construction involving one acre or more of disturbed area;

- Construction activity less than one acre that is part of a common plan of development (i.e. subdivision) of which is larger than one acre; or
- Any construction activity designated by the MEDEP based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to waters of the State.

Maine Regulations requires the Owner (or their authorized Applicant) to submit a Notice of Intent (NOI) and a Notice of Termination (NOT) to the appropriate MEDEP regional office listed on Section page 00830-2. For all Projects (other than Owner constructed projects) the Owner will authorize the Contractor, as Applicant, to submit the NOI, pay the NOI submittal fee and submit the NOT. The Authorized Representative for the Owner must be someone appointed by the Selectmen, Council or Trustees to sign and authorize the Applicant to submit the NOI.

1.1 NOTIFICATION PHASE:

A. Submit a Notice of Intent (NOI)

1. The Notice of Intent (NOI) for the MCGP is a one page form that is filed with the MEDEP. All construction activities, as defined in the General Permit, are required to submit an NOI (except for common plan of development projects that do not require a Site Law, Stormwater, or Land Use Regulation Commission (LURC) permit which instead are required to meet the Maine Erosion and Sedimentation Control Law).
2. The NOI must be filed and approved by MEDEP prior to any soil disturbance or construction. The NOI form provides information including, but not limited to:
    a. Name, address, telephone number of the Owner and Applicant
    b. Project location and detailed directions
    c. Size of the proposed disturbed area
    d. Brief description of the project and its purpose.
    e. Name of the waterbodies to which the disturbed area drains or the name of the municipality, if it drains to an MS4.

By signing the NOI, the Applicant certifies that the information is true and agrees to meeting the requirements of the MCGP, including the Basic Standards for erosion and sedimentation control; inspection and maintenance of any stormwater control practices; and housekeeping (ex. preventing fuel spills and controlling dust on the construction site). The Basic Standards are found in the Appendices of the MCGP.

Note that Maine's water quality laws 38 M.R.S.A. § 349 and Section 309 of the Clean Water Act provides for significant penalties where information is false or the permittee violates, either knowingly or negligently, permit requirements. Refer to the Maine Construction General Permit requirements for further definition on submittal requirements.

3. All NOI forms must be accompanied by a fee and the following documentation:
   a. A location map
      i. The location must be a copy of a portion of a 7.5 minute USGS topographic map or a Delorme Atlas map showing the site location and approximate boundaries.
   b. A site plan of the Project
      i. The site plan must show the locations of structures and roads, the extent of the disturbed area(s), pre-construction site topography, post-construction site topography, on-site adjacent surface waterbodies, and all erosion and sedimentation control measures to be used on site. The site plan must identify the location of downgradient vegetated buffers. Vegetated buffers are to be preserved wherever possible; however, if buffers cannot be retained, a written narrative explaining why must be included. In addition, all protected natural resources, such as wetlands, streams, or high water line ponds or coastal wetlands must be identified on the site plan. The site plan does not need to be prepared by a professional; however it must be legible and drawn to scale.
   c. An erosion and sedimentation (ESC) plan
      i. The ESC plan must contain permanent stabilization measures, installation details of proposed erosion control measures, seeding and mulching rates, and a construction schedule. The ESC plan must be designed by a professional. This plan and its details may be included on the site plan instead of as a separate submission.
   d. Photographs of the area to be developed
      i. Photographs must show the existing character and topography of the area proposed for development.
   e. Written approval from the Department of Inland Fisheries & Wildlife (IF&W), if the Project is located in an essential habitat area.
4. MEDEP has developed the attached form to be used by Applicant (Owner or Contractor) of construction activities when submitting an NOI. The form indicates all the information required and must be used in order for the NOI to be processed correctly. The Applicant (Owner and/or Contractor) of

construction activities must submit the completed NOI by certified mail or hand delivery to the MEDEP regional office serving the area where the project is located. The MEDEP regional office addresses are listed below:

Maine Department of Environmental Protection
Southern Maine Regional Office
312 Canco Road
Portland, ME 04103

Maine Department of Environmental Protection
Central Maine Regional Office
17 State House Station
Augusta, ME 04333-1107

Maine Department of Environmental Protection
Eastern Maine Regional Office
106 Hogan Road
Bangor, ME 04401

Maine Department of Environmental Protection
Northern Maine Regional Office
1235 Central Drive
Skyway Park
Presque Isle, ME 04769

5. The Application Fee required by the NOI shall be paid by the Applicant.
6. The NOI is deemed approved 14 calendar days after MEDEP receives the NOI and the Applicant can proceed unless notified by MEDEP to the contrary.

1.2 PERFORMANCE PHASE:

A. The Applicant (Owner or Contractor) must continue to comply with the Basic Performance Standards stated in Appendix A through C of the MCGP conditions and the ESC Plan until: (1) they no longer meet the definition of the Applicant (Owner or Contractor) of a construction activity or (2) the construction activity is complete, all disturbed soils have been finally stabilized, and temporary erosion and sediment controls have been removed. The Applicant (Owner or Contractor) then needs to submit a Notice of Termination (NOT) to inform MEDEP that permanent erosion control measures have been installed and are functioning properly.

1.3 PERMANENT STABILIZATION AND TERMINATION PHASE:

A. Submit Notice of Termination (NOT) - MEDEP has developed the attached form to be used by Applicant (Owner or Contractor) of construction activities when they submit a NOT. The NOT must be completed and submitted to MEDEP within 20 days of the completion of permanent stabilization. The NOT form provides information including, but not limited to:
   1. Name, address, telephone number of the Owner and Applicant
   2. Name, location, and description of project
   3. Permit number

4. Photographs of the completed site
5. Signed certification statement

B. The Applicant (Owner and/or Contractor) of construction activities must submit the completed NOT by certified mail or hand delivery to the MEDEP regional office serving the area where the project is located. The MEDEP regional office addresses are listed below:

Maine Department of Environmental Protection
Southern Maine Regional Office
312 Canco Road
Portland, ME 04103

Maine Department of Environmental Protection
Central Maine Regional Office
17 State House Station
Augusta, ME 04333-1107

Maine Department of Environmental Protection
Eastern Maine Regional Office
106 Hogan Road
Bangor, ME 04401

Maine Department of Environmental Protection
Northern Maine Regional Office
1235 Central Drive
Skyway Park
Presque Isle, ME 04769

C. The Applicant's authorization to discharge under the MCGP terminates at midnight on the day the NOT is signed.

D. Retention of Records - Following the termination of construction activities the Applicant (Owner or Contractor) must keep a copy of the Erosion and Sedimentation Control (ESC) Plan and any forms, submissions, reports or other materials required by the MCGP for a period of at least three years following permanent stabilization. The record retention period may be extended by request of the MEDEP.

E. Accessibility - Employees and agents of the MEDEP may enter any property at reasonable hours to determine compliance. The permittee must retain a copy of the ESC and the General Permit at the construction site and make it accessible to the MEDEP other government officials for the duration of the project. In addition, the ESC and General Permit must be made available for use by any contractors on site undertaking work regulated in the General Permit.

END OF SECTION

SECTION 01600

DELIVERY, STORAGE AND HANDLING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies the general requirements for the delivery, handling, storage and protection for all items required in the construction of the work. An updated delivery and storage log is required with the monthly payment requisition prior to approval. An example log is included in this section.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

B. Coordinate with Owner regarding 36-inch sewer pipe pre-purchased and stored by the Owner. Contractor shall be responsible for moving the sewer from the City's storage facility at the Public Works Garage to the jobsite.

1.3 TRANSPORTATION AND DELIVERY

A. Transport and handle items in accordance with manufacturer's instructions.

B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than 120 days prior to installation without written authorization from the Engineer.

C. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for the protection of components.

D. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended, including cross reference of the applicable contract specification section.

E. Deliver spare parts at the same time as pertaining equipment. Deliver spare parts to the Owner after completion of work.

F. Deliver products to the site in manufacturer's original sealed containers or other packing system, complete with instructions for handling, storing, unpacking, protecting and installing.

G. Instructions for handling, storing, unpacking, protecting and installing equipment shall be included in the Equipment O&M Manuals, which shall be submitted prior to the equipment being shipped to the site. This information shall be filed in a dedicated three ring binder(s) on-site, in the Contractor trailers, accessible to the Owner and Engineer. The binder(s) shall be clearly labeled, and include dividers for each specification section. The manufacturer-provided instructions for each equipment item shall be labeled with the specification number, equipment name, and equipment number. The instructions shall also be submitted to the Engineer.

H. Assume responsibility for equipment material and spare parts just before unloading from carrier at site.

I. All items delivered to site shall be unloaded and placed in a manner which will not hamper the Contractors normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

J. Provide equipment and personnel to unload all items delivered to the site.

K. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged. For items furnished by others (i.e. Owner, other Contractors), perform inspection in the presence of the Engineer. Notify the Engineer in writing of any problems.

L. Pay all demurrage charges if failed to promptly unload items.

1.4 STORAGE AND PROTECTION

A. Store and protect products and equipment in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instructions shall be studied by the Contractor and reviewed with the Engineer by them. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and pieces of equipment.

B. Arrange storage of products and equipment to permit access for inspection. Periodically inspect to make sure products and equipment are undamaged and are maintained under specified conditions.

1. For outdoor storage of pipe, valves and fittings
   a. All plastic piping shall be covered with tarps or similar and adequately strapped down to eliminate UV exposure.
   b. All valves and fittings shall be covered adequately to protect from weather (rain, sleet, snow) and sun (UV) exposure.
   c. The materials shall be inspected by the Contractor at a minimum, weekly, to ensure that the material storage measures have met the requirements of this section and manufacturer recommendations.

C. Provide protective maintenance during storage consisting of manually exercising equipment, inspecting mechanical surfaces for signs of corrosion or other damage, lubricating, applying any coatings as recommended by the equipment manufacturer necessary for its protection and all other precautions to assure proper protection of all equipment stored and for compliance with manufactures requirements related to warranties.

D. Store loose granular materials on a solid flat surface in a well-drained area. Prevent mixing with foreign matter.

E. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulation of dirt or grease, and in a position to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.

F. All mechanical and electrical equipment and instruments shall be covered with canvas and stored in a weather tight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it shall be satisfactory to the Engineer.

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by manufacturer.
2. Moving parts shall be rotated at a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Log all rotation maintenance for each piece of equipment in the written record noted above.

3. Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use. Log all startup for each piece of equipment in the written record noted above.
4. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
5. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

G. The weather tight building shall be provided with adequate heating/cooling and ventilation as required by the manufacturer to prevent condensation. Maintain temperature and humidity within range required by manufacturer and to prevent condensation on the equipment being stored.

H. Temporary heating and cooling is acceptable. Equipment shall be protected from environmental effects as required by the manufacturer and dependent on the season. Equipment that arrives on site without coating shall be protected from environmental impacts through coating or protection at the Contractor's expense. Any equipment that displays defects or corrosion from environmental impacts will not be accepted for installation.

I. The location of all stored material and equipment shall be reviewed with the Owner and Engineer. The Owner and Engineer may request that equipment and material be moved to an alternate location to accommodate plant maintenance and operation, or if the location is deemed unacceptable or unsuitable.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING MONTHLY LOG

A. An updated storage and delivery log is required with the monthly payment requisition prior to approval.

B. The monthly log shall include the specification section, equipment description, equipment tagging, submittal approval date, date of equipment delivery, date of O&M submittal, contractor start-up sign-off, certified equipment testing date, operator training date, spare parts turnover date, required maintenance (activity and date), and equipment turnover (Owner's witness and date).

3.2 STORAGE AND PROTECTION

A. Equipment requires acceptance and verification of the storage from the Owner, Engineer, Manufacturer and Contractor at the Engineer's discretion.

B. Following delivery, the equipment warranty from the Manufacturer is the responsibility of the Contractor.
C. All storage and maintenance will be the responsibility of the Contractor, conducted at the Contractor's expenses and verified by the Engineer.
D. It is the Contractor's responsibility to coordinate all storage requirements on site as required by the Manufacturer to achieve acceptance.

Section 01600 Delivery, Storage and Handling

Specification Section	Equipment Description	Equipment Tags	Submittal Approved	Date of Equipment Delivery[1]	Date of O&M Submittal	Equipment Start-Up[2]		Certified Equipment Testing	Operator Training	Spare Parts Turnover	Required Maintenance by Contractor (activity & date)	Equipment Turnover	
						Date	Witness	Date	Date	Date		Owner's Witness	Date

1. If equipment is delivered and placed in storage, all steps for Stored Equipment shall be followed and tracked separately
2. Log weekly start-ups of installed equipment, performed by Contractor, until Equipment Turnover

END OF SECTION

SECTION 01710

PROJECT CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
2. At completion of work, remove waste materials, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces. Leave project clean and ready for use.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: Conduct cleaning and disposal operations in accordance with all applicable local and state laws, ordinances, and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturers.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Cleaning During Construction:

1. Execute cleaning operations to ensure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.
2. Entirely remove and dispose of material or debris during the progress of the work that has washed into or has been placed in watercourses, ditches, gutters, drains, catch basins, or elsewhere as a result of the Contractor's operations.
3. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
4. At reasonable intervals during the progress of work, clean the site and dispose of waste materials, debris, and rubbish.
5. Clean interiors of buildings, when applicable, prior to finish painting, and continue to clean on an as-needed basis until buildings are ready for occupancy.
6. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw material from heights.

7. When applicable, schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.

B. Control of Hazards:
   1. Store volatile wastes in covered metal containers, and remove from premises daily.
   2. Prevent accumulation of wastes which may create hazardous conditions.
   3. Provide adequate ventilation during use of volatile or noxious substances.

C. Disposal:
   1. Do not burn or bury rubbish and waste materials on project site.
   2. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
   3. Do not dispose of wastes into streams or waterways.

D. Final Cleaning:
   1. Employ experienced workers, or professional cleaners, for final cleaning.
   2. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials, from all sight-exposed interior and exterior finished surfaces.
   3. Repair, patch and touch up marred surfaces to specified finishes.
   4. Broom clean paved surfaces.
   5. Rake clean non-paved surfaces of the project site.
   6. Restore to their original condition those portions of the site not designated for alterations by the Contract Documents.

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Keep accurate record documents for all additions, demolition, changes of material or equipment (from that shown on the Drawings), variations in work, and any other additions or revisions to the Contract (via Change Order, Work Change Directive, Field Order or Clarification).

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 MAINTENANCE OF DOCUMENTS

A. Maintain at job site, one copy of:

1. Contract Drawings
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Change Orders
6. Any other modifications to the Contract
7. Field Test Reports

B. Store documents in files and racks specifically identified for Record Drawing use, that are apart from documents used for construction.

C. File documents in a logical manner indexed for easy reference.

D. Maintain documents in clean, dry, legible condition.

E. Do not use record documents for construction purposes.

F. Make documents available at all times for inspection by the Engineer and Owner, and by the end of the project, transmit these documents to the Engineer.

G. Failure to maintain current records, as specified herein, shall be grounds for withholding additional retainage from monthly partial payment requests.

1.4 RECORDING

A. Label each document "PROJECT RECORD" in large high printed letters.

B. Keep record documents current and do not permanently conceal any work until required information has been recorded.

C. General Field Recording Issues:

1. All swing ties shall be taken from existing, permanent features such as utility poles, corners of buildings and hydrants. Porches, sheds or other house additions shall be avoided as they could be torn down. A minimum of two swing ties shall be taken. Survey grade GPS coordinates are also acceptable.
2. Stations shall be recorded to the nearest foot.
3. Inverts shall be recorded to the nearest hundredth of a foot.
4. Elevations shall be recorded to the nearest hundredth of a foot.

5. Building dimensions shall be recorded to the nearest 1/4".
6. Equipment and Piping shall be recorded to the nearest tenth of a foot, and the overall dimensions and layout of the equipment shall be adjusted to reflect the equipment provided.

D. Project Record Drawings - Legibly mark Contract Drawings to record existing utilities and actual construction of all work, including but not limited to the following (where applicable):

1. Existing Utilities
   a. Water mains and services, water main gate valves, sewer mains and services, storm drains, culverts, steam lines, gas lines, tanks and other existing utilities encountered during construction must be accurately located and shown on the Drawings. In congested areas supplemental drawings or enlargements may be required.
   b. Show any existing utilities encountered in plan and profile and properly labeled showing size, material and type of utility. Ties shall be shown on plan. Utility shall be drawn to scale in section (horizontally and vertically) and an elevation shall be called out to the nearest hundredth of a foot.
   c. When existing utility lines are broken and repaired, ties shall be taken to these locations.
   d. If existing water lines are replaced or relocated, document the area involved and pipe materials, size, etc. in a note, and with ties.
2. Manholes, Catch Basins, Valve Pits and other structures.
   a. Renumber structure stationing to reflect changes.
   b. Show ties to center of structure covers or hatches.
   c. In general, show inverts at center of structures. However, for manholes with drop structures, or steep channels (greater than 0.2' change on slope), show inverts at face of manhole.
   d. Show inverts for other structures at the face of the structure.
   e. Draw any new structures that are added on plan and profile.
   f. Show any field or office redesigns.
   g. Redraw plan if the structure's location is moved more than 5 feet in any direction. Note: It is important to show existing utilities, as outlined in Paragraph 1 above, especially if they were one reason for relocating the sewer, manholes and other structures.
   h. Redraw profile if inverts changed by more than 6 inches.
3. Gravity Sewer Line
   a. Change sewer line slopes indicated on Drawings if inverts are changed.
   b. Draw any new gravity lines that are added on plan and profile.
   c. Show any field or office redesigns.
   d. Redraw the sewer line profile if manhole inverts are redrawn.
   e. Redraw the sewer line on plan corresponding to relocated manholes.
4. Water Mains and Force Mains
   a. Show ties to the location of all valves, bends (horizontal and vertical), tees and other fittings. The use of thrust blocks shall be recorded.
   b. Revise elevations indicated on the Drawings to reflect actual construction.
5. House Services
   a. Draw all house services (even to empty lots) on plan, and show ties.
   b. Show ties or distances to wyes from manhole.

c. The Wright-Pierce "Sanitary Sewer Service Location" forms and “Water Service Location” forms shall be used to record sewer and water service information. A copy of these forms shall be provided to the Owner, along with the Record Drawing Set.

6. Ledge
   a. Ledge profiles shall be shown. Note whether the plotted ledge profile reflects undisturbed or expanded conditions.
7. Yard Piping and Buried Electrical Conduit
   a. Site piping and utilities shall be drawn to reflect the installed locations, with ties and elevation of all bends (horizontal and vertical).
   b. Show routing for electrical conduits and pull boxes, especially in close proximity to buildings and when the conduits change direction or cross process piping.
8. Roads
   a. Show centerline road profile and level spot elevations.
   b. Show pavement widths.
   c. On road cross sections, show the pavement cross slope.
   d. Show any deviations from the design plans.
9. Buildings
   a. In general, small changes to structures shall not be redrawn. If any dimensional changes were made in the field, the numerical change shall be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings.
   b. Show finished concrete elevations (top of slab, top of wall, top of footing, etc.). Redraw any foundation, frost wall, etc. that was modified, deepened, or altered during construction.
   c. Adjust finished concrete horizontal dimensions that are shown on the Drawings.
   d. Adjust structural steel elevations and horizontal dimensions that are shown on the Drawings.
   e. Show location of anchors, construction and control joints, and waterstops, when they are different from those shown on Drawings.
   f. Any additions or major changes shall be shown in both plan and elevation (i.e. relocated doors, opposite door swings, change in wall location, relocation of floor drains).
   g. Show approximate location and routing of electrical conduits in walls, slabs and ceilings. Most conduits are run in groups, therefore, use range of measurements to define location for entire section of conduits.
   h. Special circuits for computers, alarms and instrumentation shall be shown.
   i. Show any changes in location and elevation of ductwork and devices, fuel piping and equipment, and heat piping and equipment.
   j. Location of gravity sewer system below slabs in buildings shall be shown, if changes are made in the configuration.
   k. If wall mounted electrical switches, control boxes, thermostats, etc. have been relocated significantly, (other side of door, or to a wall other than indicated diagrammatically on electrical plans) make the revision accordingly.

10. Utilities
    a. When encountered, additional utilities (e.g., gas, cable, telephone, fiber optic, etc.) shall be indicated on the Record Drawings.
11. Equipment Systems and Piping
    a. Show any changes to equipment systems, whether interior or exterior, for process, HVAC, plumbing, instrumentation or electrical. If any dimensional changes were made in the field, the numerical change shall be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings. Record Drawings must reflect any equipment configuration and layout changes differing from that shown on the Drawings.
    b. Show any changes to piping systems, whether interior or exterior, for process, HVAC, plumbing and instrumentation. If any dimensional changes were made in the field, the numerical change shall be made on the Drawing and be properly labeled. Update dimensions and elevations on Drawings.

E. Specifications and Addenda - Legibly mark up each section to record:
1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
2. Changes made by Change Order, Field Order, or other method.

1.5 SUBMITTALS

A. At the completion of the project, and prior to the release of retainage, deliver record documents to the Engineer.
1. Record drawings shall be provided as an electronic file (pdf format).
2. If the Contractor provides alternate or substitute equipment that requires revised arrangements from the Bidding Documents, the Contractor shall provide supplemental record drawings of these items in AutoCAD format.

B. Accompany submittal with transmittal letter, in duplicate, containing:
1. Date, project title and number.
2. Contractor's name and address.
3. Title and number of each record document with certification that each document is completed and accurate.
4. Signature of Contractor, or their authorized representative.

C. Failure to supply all information on the Project Record Drawings as specified in Part 1.3 may result in withholding final completion and in non-approval of final payments of the Contract. If Contract Time has elapsed, this shall be grounds for imposing liquidated damages.

1.6 QUALITY ASSURANCE

A. All horizontal and vertical dimensions, swing-ties, and elevations shall be accurate to within one-tenth of a foot, unless greater accuracy is specified elsewhere in the Specifications (e.g., concrete elevations, weir elevations, etc.).

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.1 MAINTAINING AND PROVIDING RECORDS

A. Records shall be kept current as the work progresses.

B. Records shall be made available for review by the Owner, Engineer, Resident Project Representative and/or Funding Agency(s) upon request.

C. Failure to maintain current records, as specified herein, shall be grounds for withholding additional retainage from monthly partial payment requests. Failure to provide records shall also be grounds for withholding of final payment and, if beyond contract time, shall be grounds for imposing liquidated damages.

3.2 AS-BUILT SURVEY PERFORMANCE

A. From established survey control, and construction baseline as shown on the drawings, conduct surveys of the project area during construction as needed to obtain information of buried and above ground items. Surveys shall include information outlined in Section 1.4.

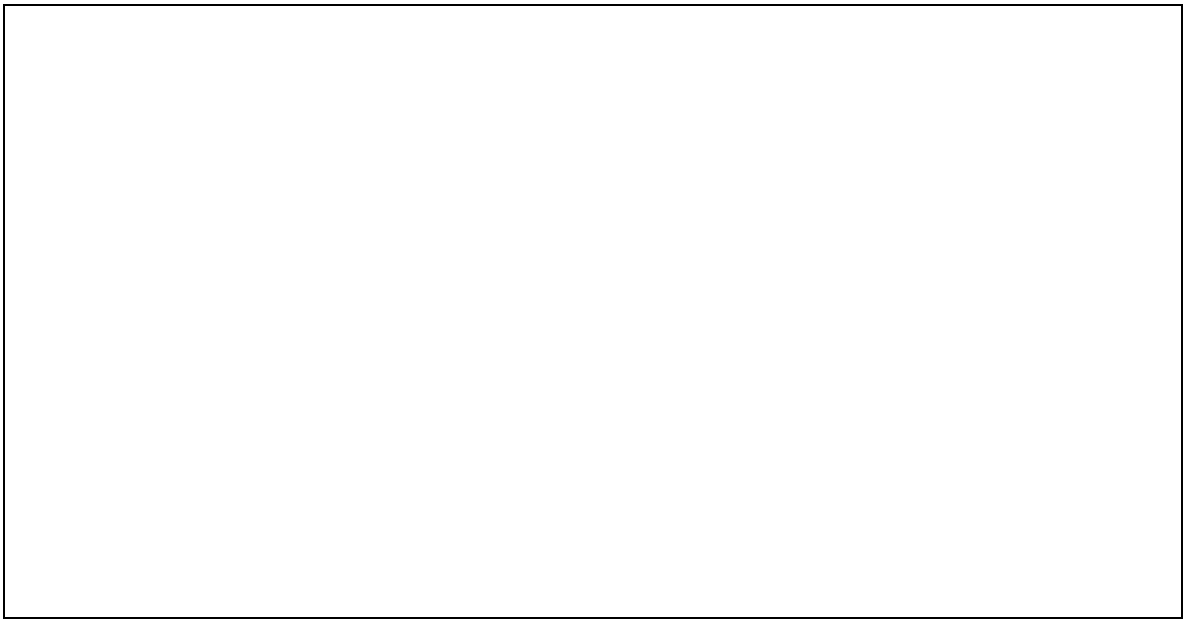
B. Actual road alignments; walls; fence and guardrail; existing, new and relocated utility poles; traffic and warning sign locations; crosswalks, parking space and stop bar locations; retaining walls and foundations drains; all underground and overhead utility poles and lines within the project limits, including those installed on private property; all other new features and appurtenances and those existing features and appurtenances changed as a result of this project shall be included in the survey.

WRIGHT-PIERCE
Engineering a Better Environment

SANITARY SEWER SERVICE LOCATION

Project: _____ Date: _____
Date Installed: _____ Town, City of: _____

Type, Size of Service Pipe	_____	Street	_____
Connection at Sewer Main	_____	Dwelling No.	_____
Depth, End of Service	_____	Occupant	_____
Length of Service Pipe Laid	_____	Owner	_____
Measured, Located By	_____	House No.	_____
Project Contractor	_____	Complete	_____
		Incomplete	_____



N.T.S.

Comments: _____

_____

_____

_____

_____

Observed By:

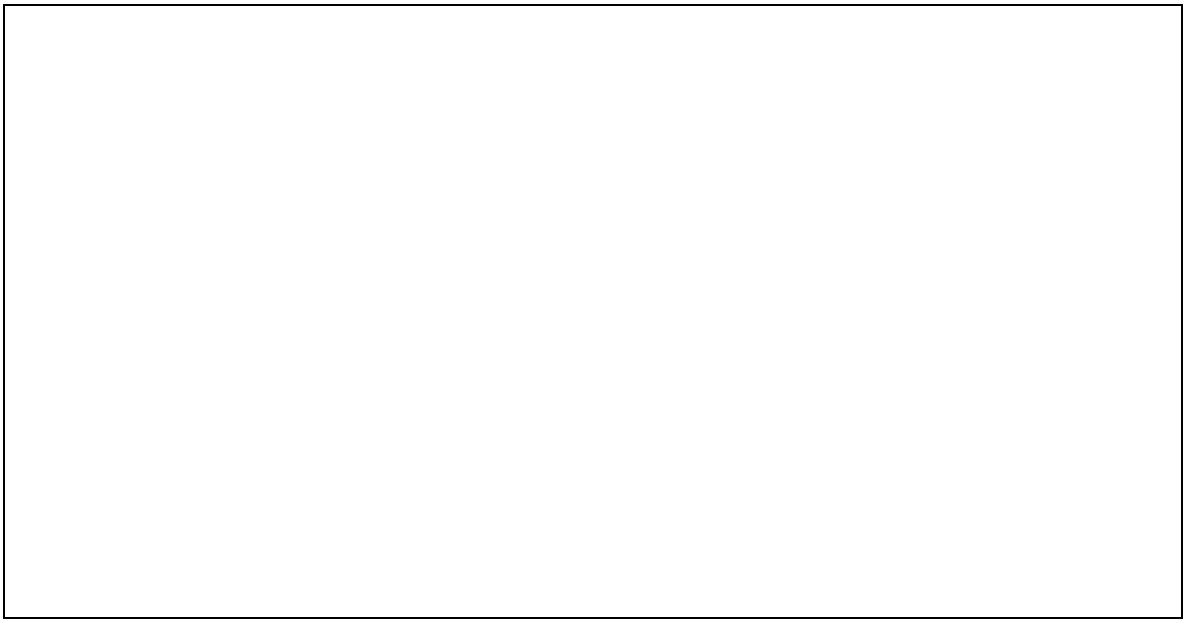
_____ _____
Contractor (Date)

_____ _____
(Date)

WRIGHT-PIERCE
Engineering a Better Environment

WATER SERVICE LOCATION

Project: _____ Date: _____
Date Installed: _____ Town, City of: _____
Type, Size of Service Pipe _____ Street _____
Connection at Water Main (STA) _____ Occupant _____
Depth to Cap _____ Owner _____
Elevation of Cap _____ House No. _____
Length of Service Pipe Laid _____ Complete _____
Measured, Located By _____ Incomplete _____
Project Contractor _____



N.T.S.

Comments: _____

_____

_____

_____

Observed By:

_____ _____
Contractor (Date)

_____ _____
Wright-Pierce (Date)

Location of Stub approved _____
(Owner)

END OF SECTION

SECTION 01800

EQUIPMENT STARTUP, TESTING AND OPERATOR TRAINING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. General: The work of this Section includes the startup, testing and operator training of equipment and control systems sufficient for a fully functional project as determined by the Engineer.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1. The following items are integral to this process, in general order of activity:
   a. Submittals, as specified in Section 01340.
   b. Operations and Maintenance Manuals, as specified in Section 01340.
   c. Summary of Work as specified in Section 01010.
   d. Temporary Facilities and Controls as specified in Section 01500.
   e. Temporary Bypass Pumping Systems as specified in Section 01515.
   f. Pre-Startup Meeting, as specified herein.
   g. Factory Acceptance Testing, as specified herein and in Division 13.
   h. Procedures Prior to Startup, as specified herein.
   i. Equipment Startup, as specified herein.
   j. Operator Training, as specified herein.
   k. Equipment Demonstration Testing, as specified herein.
   l. Site Acceptance Testing, as specified herein and in Division 13.
   m. Electrical system testing as specified herein and in Division 16.

1.3 GENERAL DEFINITIONS:

A. Equipment Startup shall be generally defined as the initial placing into service of the equipment by representatives of the Contractor, the equipment manufacturer, and any subcontractors directly responsible work related to the equipment provided. This shall include verification of all equipment protection and safety control features (e.g., motor high temperature, seal fail, hardwire interlocks, estops, etc.) and include configuration of the VFD (if applicable) prior to equipment startup.

B. Equipment Demonstration Testing shall generally be defined as the formal and scheduled demonstration of equipment/system operations in accordance with the requirements of the Contract Documents, including all required performance or acceptance testing using the process fluid (e.g., mixed liquor, sludge, chemical, etc.). This formal demonstration shall be performed in the presence of the Engineer by representatives of the General Contractor, the equipment manufacturer, and any subcontractors directly responsible work related to the equipment provided.

C. Operator Training shall generally be defined as the formal and scheduled instruction of the Owner's designated representatives in the proper operations and maintenance of the provided equipment. This formal training shall be performed in the presence of the Engineer, by representatives of the Contractor, the equipment manufacturer,

and any subcontractors directly responsible work related to the equipment provided. Operator Training shall also include remote assistance to plant personnel by Manufacturer representatives during the initial operations of the equipment.

1.4 SUBMITTALS:

A. In accordance with the requirements of Section 01340 and as outlined below.

B. Before the Pre-Startup Meeting:

1. Startup Plan: Contractor shall coordinate with subcontractors and Manufacturers and provide a proposed start-up, testing and training plan for each piece of equipment including detailed plans for temporary bypass pumping or temporary facilities, when required. The Manufacturer(s) shall provide the Contractor with a start-up, testing and training schedule and plan.
    a. The startup, testing and training plan shall include a written outline description of the means and methods to be employed during the equipment test of each piece of equipment as well as the anticipated sequence and duration of activities.
    b. The startup, testing and training plan shall include the name(s) and resume(s) of the duly authorized Manufacturer's Representatives proposed for the project. The qualifications of duly authorized representatives of the Manufacturer are specified below.
    c. The startup, testing and training plan shall include proof of calibration of decibel meter(s) and flow meter(s) to be used in Equipment Startup(s).
    d. The startup, testing and training plan shall comply with the sequencing and scheduling requirements outlined in Section 01010.
    e. The startup, testing and training plan shall identify the method to separately track the electrical power costs associated with all testing. Provide documentation from the local power company indicating that peak power demands incurred during testing and startup procedures will not become a part of the permanent record for determining future power demand charges for the Owner.
    f. The startup, testing and training plan shall identify the source of water used for testing as well as the disposal location of water used for testing.
    g. The startup, testing and training plan shall identify the location and type of temporary flow meters to be utilized, where required herein.
    h. No startup activities shall be scheduled for Fridays without prior agreement by the Owner and Engineer.
    i. Contractor shall assume a maximum of 3 days per week of availability by the Engineer for equipment startup, training and demonstration testing. Availability beyond this will be considered on a case-by-case basis with prior agreement by the Owner and Engineer.
2. Contractor shall submit manufacturer Operations and Maintenance Manuals, along with updated control system drawings, at least 2 months prior to Equipment Startup.

C. Prior to Equipment Startup:

1. Revised Startup Plan based on discussions at Pre-Startup Meeting and subsequent coordination with Manufacturers, RPR and Owner (e.g., process availability, equipment status, valving, lockout/tagout, etc.).
2. Completed Short circuit coordination and arc flash study

3. Completed Megger and Grounding Testing forms
4. Completed communication cable testing, testing reports have been submitted.
5. Completed Factory Acceptance Tests documentation for relevant equipment and control panels. Refer to 13444 for witnessed requirements.
6. Confirmation from the Systems Integrator that all relevant instruments and floats are installed, properly scaled and calibrated.
7. Confirmation from the Electrical subcontractor that the scaling of wiring interface between MCC, VFD and equipment has been checked.
8. SCADA / OIT screens and PLC programs.
9. Confirmation from the General Contractor that temporary heating, cooling and ventilation system necessary to protect the installed work.

D. Following successful Equipment Startup and prior to placing the equipment into service, submit:
   1. Completed Equipment Startup Certification forms
   2. Completed VFD Parameter Setup Checklist and VFD Parameter Setup Verification forms.
   3. Completed Operator Training forms (videos may follow separately)

E. Prior to Equipment Demonstration Testing, submit:
   1. Manufacturer start-up field testing report.
   2. Generator load bank test form.

F. Following Equipment Demonstration Testing, submit:
   1. Completed Equipment Demonstration Testing Certification form

G. Prior to the equipment is accepted, submit:
   1. Manufacturer demonstration field testing report
   2. Completed Operating Training videos.

H. Refer to Division 13 and 16 for other startup submittal requirements.

I. Refer to below for O&M submittal requirements.

1.5 PRE-STARTUP MEETING

A. Contractor shall request a Pre-Startup Meeting a minimum of 45 days prior to any startup activities. Engineer will set the meeting date and establish the agenda for the meeting. Contractor shall submit a proposed startup, testing and training plan a minimum of 14 days prior to the Pre-Startup Meeting. If the proposed startup, testing and training plan is insufficient, the Engineer may postpone the Pre-Startup Meeting until the submitted plan is sufficient. The purpose of the Pre-Startup Meeting is to discuss the general startup procedure and details of the Contractor's submitted startup, testing and training plan. If the project startups are phased, the Contractor shall plan on multiple Pre-Startup Meetings based on proposed schedule.

B. The Pre-Startup Meeting will be held at the Project Site or Virtually through a web-based video conference software (Teams, Zoom, etc.).

C. Contractor shall make arrangements for appropriate individuals from the Electrical subcontractor, Systems Integrator, HVAC subcontractor and relevant Manufacturer(s) to attend. Manufacturer(s) may attend in person or via telephone/video conference.

D. Engineer will distribute a meeting summary to all attendees.

1.6 SCHEDULES AND NOTIFICATIONS:

A. Contractor shall provide Engineer with at least a 14 calendar day notice prior to initiating startup activities to allow necessary coordination with Engineer and Owner representatives. If startups are conducted in groups of activities, the notification shall be provided for each grouping. The actual date and time for testing and/or training will be the first mutually acceptable date and time available to all parties subsequent to receipt of the request.

B. Contractor shall be responsible for any and all coordination necessary with the daily operations of the facility to accommodate the testing schedule.

C. Operator Training shall follow successful Equipment Startup and must be completed prior to the equipment being put on-line for uninterrupted service. Contractor may formally request that Operator Training be conducted concurrently with the Equipment Demonstration Testing; however, this determination will be made on a case-by-case basis by the Engineer and Owner. Under no circumstances will conditions of the testing interfere with the ability of Owner's representatives to observe necessary features, to hear and understand instructions, or to ask questions. If such conditions occur, then Operator Training will not be allowed to run concurrently with Equipment Demonstration Testing.

D. Contractor shall maintain a shared calendar for the Owner, Engineer and Contractor to document the agreed upon dates for individual Equipment Startup, Operator Training, and Equipment Demonstration Testing.

1.7 QUALITY ASSURANCE

A. Duly authorized Manufacturer's Representatives shall meet the following criteria:

1. A direct employee of the Manufacturer;
2. Fluent in the English language;
3. Has a minimum of 5 years of experience in the proper installation, adjustment, operation, testing, and startup of the specified model, including, but not limited to, equipment calibration, and other mechanical or electrical components of the equipment.
4. Sales personnel, marketing personnel or local representatives will not be accepted as a duly authorized representative of the Manufacturer unless the Manufacturer has certified them accordingly.

PART 2 - PRODUCTS- NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL

A. Equipment startup and testing is a multi-disciplinary activity that requires numerous subcontractors, suppliers and vendors to present at key milestones. The General Contractor, Systems Integrator and Electrical contractor shall ensure that the appropriate representatives are present and available for each milestone activity.

3.2 PROCEDURES PRIOR TO STARTUP

A. General: Perform preliminary process, electrical, and control coordination and work necessary for Equipment Startup, Demonstration Testing, and Site Acceptance Testing. Refer to Division 11, Division 13, and Division 16 for specific requirements.

B. Startup plan shall have been submitted and reviewed/discussed with the Owner and Engineer.
C. Perform and document Factory Acceptance Testing (FAT) of all System Integrator furnished control panels. Refer to Section 13444.
D. Perform grounding and megger testing to equipment and feeders as specified in Section 16000.
E. Install, terminate, label, and test wiring between the process, electrical, and control systems as specified in Section 16000 and 13410.
F. Test and coordinate scaling of wiring interface between MCC, VFD, and process control systems as specified in Section 13410.
G. Coordinate and configure VFDs as specified in Section 16000.
H. Install, configure, and coordinate scaling of instruments. Instrument configuration and calibration to be witnessed by Engineer. Refer to Section 13410 for additional requirements. Refer to the contract Process drawings, Electrical drawings, and Section 13440 for installation details.
I. Install, configure, and program all control system interfaces (SCADA, OITs, etc.) as described in Section 13442 and 13444.
J. Provide temporary or permanent heating, cooling, and ventilation (HVAC) to protect workers, stored materials and installed work. Equipment or processes damaged from inadequate HVAC shall be repaired by the Contractor at no additional cost to the Owner. Refer to 01500 for additional information.

3.3 EQUIPMENT STARTUP

A. Equipment startup shall be performed by the authorized representative(s) of the Manufacturer as identified in the Submittals.
B. The Equipment Startup shall be performed prior to Operator Training and prior to Equipment Demonstration Testing.
C. No form of energy shall be applied to any part of the system prior to receipt by the Engineer of a certified statement of approval of the installation from the Contractor. This certification shall contain a statement by an authorized representative of the equipment Manufacturer that the equipment is ready for testing, as outlined below.
D. As part of the Equipment Startup, the Contractor and Manufacturer shall:
    1. Verify that the equipment is installed properly and in accordance with Manufacturer's requirements and instructions, and as such, it is appropriate to apply power to the units in question.
    2. Verify that all manual and all automatic equipment protection and safety control features of the equipment function properly, including all alarms, and all activation and deactivation sequences.
    3. Verify that the equipment can operate without excessive noise, vibration, overheating, overloading, jamming, etc. during specified conditions.
    4. Verify and document equipment capacity and amperage draws (on all power feeds) with equipment running under specified conditions.
    5. Verify and document the noise level of equipment, drives and motors, unless otherwise noted, shall not exceed 90 dBA, as measured 3 feet from the unit under free field conditions.
        a. Each unit shall be monitored for compliance running under specified conditions with other area equipment deactivated.

b. Contractor shall provide certified proof of calibration for instrument utilized to measure noise level.

E. Each piece of equipment shall be tested sufficiently to ensure that all features required to be demonstrated and/or verified during the equipment testing are within acceptable limits. The startup shall not be considered complete until the unit is fully capable of passing the equipment testing.

F. Where multiple units are provided, each unit shall undergo startup procedures.

G. The duly authorized representative of the Manufacturer shall provide all specialty tools, specialty testing equipment and labor necessary for the start-up of the equipment.

H. The Contractor shall provide all power, chemical, tools, equipment, labor, water and fuel as required for Equipment Startup. All waste materials shall be disposed of by the Contractor in an environmentally acceptable manner at no additional cost to the Owner.

I. In the event of an unsuccessful equipment start-up, Manufacturer and Contractor shall make necessary alternations, adjustments, repairs and replacements and the equipment start-up shall be repeated.

J. If the Engineer has arrived on-site for the scheduled Equipment Startup Testing and the Contractor has not sufficiently completed the Procedures Prior to Startup (Preliminary SAT) or if the Manufacturer's representative is not present, the Contractor shall be responsible for reimbursing the Owner for the Engineer's labor and travel costs associated with failed testing.

K. The Manufacturer Representative's and Contractor shall fill out the Equipment Start-Up Certification form included at the end of this Section. Startup will not be considered complete until this form has been provided to the Engineer along with the Manufacturer Representative's field report.

3.4 EQUIPMENT DEMONSTRATION TESTING

A. Equipment Demonstration Testing shall be performed after the Equipment Startup is completed and it has been verified that equipment functions in accordance with the requirements of the Contract Documents in all aspects. Equipment Demonstration Testing shall be performed by the authorized representative(s) of the Manufacturer.

B. Equipment Demonstration Testing shall not be scheduled concurrently with Equipment Startup without the prior approval of the Engineer.

C. At a minimum during the Equipment Demonstration Testing, the Contractor shall complete the following to the satisfaction of the Engineer:

1. Demonstrate that the equipment can operate without excessive noise, vibration, overheating, overloading, jamming, etc. during normal operating conditions.
2. Demonstrate the full specified range of equipment operation when controlled remotely by the controls system.
3. Other specific requirements as outlined within the individual specification sections.

D. Each piece of equipment shall be tested sufficiently to ensure that all features required to be demonstrated and/or verified are within acceptable limits.

E. Where multiple units are provided, each unit shall undergo equipment testing procedures individually and then with multiple units on-line to verify the total systems output capacity and performance.

F. The duly authorized representative of the Manufacturer shall provide all specialty tools, specialty testing equipment and labor necessary for the start-up and testing of the equipment.

G. The Contractor shall provide all power, chemical, equipment, labor, water and fuel as required for demonstration testing.

H. All equipment provided on the project shall be demonstrated to function properly. Demonstration as a component of an overall system shall not relieve the Contractor of their responsibilities to demonstrate proper operation or verify specific requirements for each individual component.

I. Minimum Testing Requirements for Pumps:
   1. If sufficient sewage or water is not available for tests, Contractor will provide water at their expense for testing, if so directed.
   2. During tests, Manufacturer shall observe and record head, output, rpm, motor input and amperage. Sufficient test points shall be obtained to develop accurate pump system curve. If multiple operational points are specified, compliance with all points must be sufficiently demonstrated.
   3. If permanent and calibrated flow meters are not available, provide temporary and calibrated flow metering.
   4. Fully demonstrate ability to operate at specified conditions without motor overload.
   5. For mechanical seals, after a run-in period of 30 minutes, the seal area shall be wiped dry. The pump shall be operated for a 10-minute period. No measurable leakage shall be detected from the mechanical seal.
   6. Refer to Section 11000, 11310 and 15400, as applicable, for additional details.

J. Minimum Testing Requirements for HVAC Systems.
   1. Refer to Section 15604.

K. Minimum Testing Requirements for Electrical Systems.
   1. Generator resistive load bank test form.
   2. Refer to Section 16000 and 16620.

L. In the event of unsuccessful Equipment Demonstration Testing, Manufacturer and Contractor shall make necessary alternations, adjustments, repairs and replacements and the equipment testing shall be repeated.

M. If the Engineer has arrived on-site for the scheduled Equipment Demonstration Testing and the equipment is not capable of demonstrating complete compliance with the Contract Documents, or if the Manufacturer's representative is not present, the Contractor shall be responsible for reimbursing the Owner for the Engineer's labor and travel costs associated with failed testing.

N. The Manufacturer Representative's shall fill out the Equipment Demonstration Testing Certification form included at the end of this Section. Equipment Demonstration Testing will not be considered complete until this form has been provided to the Engineer along with the Manufacturer representative field report and accepted by the Engineer.

3.5 SITE ACCEPTANCE TESTING (SAT)

A. General: Test and tune the industrial control system (ICS) and other Division 13 supplied systems. Testing on the ICS shall include the field equipment to the user interfaces at SCADA and/or the operator interface terminals (OITs) and alarm dialers. Refer to Section 13410 for additional information.

B. The Contractor shall provide all power, chemical, equipment, labor, water and fuel as required for SAT.
C. Demonstrate all PLC, OIT, and SCADA functions specified in Section 13441.
D. Demonstrate all SCADA features specified in Section 13441.
E. Demonstrate all network functionality described on the network drawings.
F. Demonstrate all building monitoring systems. Permanent HVAC, Fire Alarm, or other system must be fully functional to support testing.
G. Adjust all instrument and VFD parameters as necessary based on the control system tuning and document. Coordinate with equipment manufacturers as necessary.
H. Demonstrate all cellular network functionality.
I. Demonstrate all security functions identified in Section 13441.
J. Refer to Division 13 for additional requirements.
K. Site Acceptance Testing shall be started at least 2 weeks prior to substantial completion.
L. The Contractor shall not schedule more than 3 days of site acceptance testing, control system training, or control system punch list activities during any week without agreement from the Engineer and Owner
M. In the event of unsuccessful SAT, Systems Integrator and Contractor shall make necessary alternations, adjustments, repairs and replacements and the equipment testing shall be repeated.
N. Minimum Testing Requirements for Electrical Systems.
   1. Generator building load test form.
   2. Refer to Section 16000 and 16620.
O. If the Engineer has arrived on-site for the scheduled SAT and the Contractor has not sufficiently completed the Procedures Prior to Startup (Preliminary SAT) or if the proper personnel aren't present, the Contractor shall be responsible for reimbursing the Owner for the Engineer's labor and travel costs associated with failed testing.

3.6 OPERATOR TRAINING

A. Operator Training shall be performed by the authorized representative(s) of the Manufacturer as identified in the Submittals.
B. Operator Training shall not be scheduled concurrently with Equipment Startup or Demonstration Testing without the prior approval of the Owner and Engineer.
C. Unless otherwise noted within the specific specification sections, provide minimum of one day (8-hour days, not including travel time) of combined training and operational assistance for plant operators for each piece of equipment in the proper operations of provided equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
D. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance and warranty conditions. Should manufacturer require time in addition to the minimums indicated herein, or within the individual specification sections, to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner. Under absolutely no circumstances shall warrantees become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described to Owner's representatives during these sessions.

E. Refer to individual equipment specification sections for further requirements.
F. The manufacturer representative shall fill out the Operator Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

EQUIPMENT START-UP CERTIFICATION

Owner: _____ Date: _____

Project _____

Contractor: _____

Equipment Manufacturer: _____

Specification Number/Equipment: _____

As an authorized representative of the equipment manufacturer, the undersigned certifies that the equipment listed above conforms to the requirements of the Contract Documents. The undersigned authorized representative of the equipment manufacturer further certifies that the equipment has been installed in accordance with the manufacturer's written instructions, that it is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void. Any items that must be completed prior to Equipment Demonstration Testing are listed below.

_____ _____
(Manufacturer's Authorized Representative/ Signature & Printed Name) (Date)

_____ _____
(Contractor/ Signature & Printed Name) (Date)

_____ _____
(Witnessed by Engineer/ Signature & Printed Name) (Date)

** Manufacturer's Representative to provide a copy of Field Report via separate transmittal **

OPERATOR TRAINING CERTIFICATION

Owner: _____ Date: _____

Project _____

Contractor: _____

Equipment Manufacturer: _____

Specification Number/Equipment: _____

I, the undersigned Manufacturer's Authorized Representative, have trained the Owner's personnel listed below in the proper operation and maintenance of the above listed equipment.

_____

_____

_____

_____

_____

_____ _____
(Manufacturer's Authorized Representative/ Signature & Printed Name) (Date)

_____ _____
(Owner's Representative/ Signature & Printed Name) (Date)

_____ _____
(Witnessed by Engineer/ Signature & Printed Name) (Date)

EQUIPMENT DEMONSTRATION TESTING CERTIFICATION

Owner: _____ Date: _____

Project _____

Contractor: _____

Equipment Manufacturer: _____

Specification Number/Equipment: _____

This certifies that the entire equipment/system has met the requirements of Section 01800, 16950 and all other applicable requirements of the contract documents.

_____ _____
(Manufacturer's Authorized Representative/ Signature & Printed Name) (Date)

_____ _____
(Contractor/ Signature & Printed Name) (Date)

_____ _____
(Witnessed by Engineer/ Signature & Printed Name) (Date)

END OF SECTION

SECTION 02050A

DEMOLITION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. The Contractor shall furnish all labor, materials, tools, equipment and apparatus necessary and shall do all work required to complete the demolition, removal, and alterations of existing facilities as indicated on the Drawings, as herein specified, and/or as directed by the Engineer.
2. Demolition and alteration work within occupied areas shall be accomplished with minimum interference to the occupants and to the plant which shall be in continuous operation during construction.
3. All equipment, piping, and other materials that are not to be relocated or to be returned to the Owner shall become the property of the Contractor and shall be disposed of by him, away from the site of the work and at his own expense.
4. All demolition or removal of existing structures, utilities, equipment, and appurtenances shall be accomplished without damaging the integrity of existing structures, equipment, and appurtenances to remain, to be salvaged for relocation or stored for future use.
    a. All debris generated by cutting, coring, or grinding shall be completely cleaned and removed from the equipment area prior to installation of new equipment.
5. Such items that are damaged shall be either repaired or replaced at the Contractor's expense to a condition at least equal to that which existed prior to the start of his work.
6. Unless otherwise indicated, all items labeled to be "removed", "demolished" or "remove/demolish" shall be removed and disposed of off site in accordance with all Local, State and Federal Regulations.
7. The Contractor shall not collect any samples of either Building Materials, Wastes, Soils, or any other site/project related materials, nor have the samples analyzed for any reason without prior written approval from the Owner or Engineer. Furthermore, the Contractor shall not hire or contract with another party or Consultant to conduct sampling of either Building Materials, Wastes, Soils, or any other site/project related materials or to conduct analytical analysis.
    a. All sampling requests are to be directed in written format to the Owner and Engineer.
    b. By collecting unauthorized samples, the Contractor shall assume any and all financial burden of the required corrective action.
    c. If a sample is collected and analyzed without prior written approval from the Owner or Engineer, the Contractor shall be responsible for any and all remediation required by any applicable regulatory authority arising from or related to the samples collected and analyzed, as the validity of the materials sampled, sample locations and sampling protocols utilized

cannot be confirmed by the Owner's or Engineer's independent Consultant.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 JOB CONDITIONS

A. Condition of Structures:
   1. The Owner assumes no responsibility for the actual condition of structures to be demolished.
   2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner as far as practicable. However, variations within the structures may occur due to Owner's removal and salvage operations prior to the start of demolition work (where applicable).

1.4 UTILITIES

A. Utility Locations:
   1. Utility locations shown on the plans are approximate only, based on information supplied by the utility companies.

B. Coordination with Utilities:
   1. The Contractor shall make all necessary arrangements and perform any necessary work to the satisfaction of affected utility companies and governmental divisions involved with the discontinuance or interruption of affected public utilities and services.

1.5 SUBMITTALS

A. Schedule - Demolition:
   1. Submit two (2) copies of proposed methods and operations of demolition to the Engineer for review prior to the start of work. Include in the schedule the coordination for shut-off, capping and continuation of utility services as required.
   2. Provide a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations.

1.6 PROTECTIONS

A. Ensure the safe passage of persons around the area of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and persons. Erect temporary, covered passageways as required by authorities having jurisdiction.

B. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

1.7 DAMAGES

A. The Contractor shall promptly repair damages caused by demolition operations to adjacent facilities at no cost to the Owner.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Remove and dispose of non-salvageable material in accordance with all applicable local and state laws, ordinances and code requirements.
B. Dispose of material daily as it accumulates.
C. Carefully remove, store and protect from damage all materials to be salvaged.
D. Buildings and Adjacent Property:
   1. Protect all buildings and property adjacent to equipment to be removed from damage by erecting suitable barriers or by other suitable means.
   2. Leave such buildings in a permanently safe and satisfactory condition.
E. Maintaining Traffic:
   1. Ensure minimum interference with roads, streets, driveways, sidewalks and adjacent facilities.
   2. Do not close or obstruct streets, sidewalks, alleys or passageways without permission from authorities having jurisdiction.
F. Architectural, structural, mechanical, process and electrical demolition, removal and alteration are indicated in the corresponding sections.
G. Mechanical/Process Demolition:
   1. Mechanical/Process demolition in general shall consist of the dismantling and removal of existing piping, tanks, pumps, motors, equipment and other appurtenances as specified, and indicated on the Drawings.
   2. It shall also include, where necessary, the cutting of existing piping for the purpose of making connections thereto.
   3. Piping not indicated to be removed but which may interfere with construction shall be removed to the nearest solid support, capped and left in place. Where piping that is to be removed passes through the wall of existing structures, it shall be cut off and properly capped on each side of the wall.
   4. When piping is to be altered or removed underground, the remaining piping shall be properly capped or plugged.
   5. Abandoned underground piping shall be left in place unless it interferes with new structures or unless otherwise noted on the Drawings.
H. Salvage:
   1. Salvaged items shall be removed from the project site and delivered to the City of Bath Public Works (450 Oak Grove Avenue, Bath, ME) for the Owner in an acceptable location and manner.
   2. The following items shall be salvaged:
      a. Generator
      b. Pump station sump pump
      c. Existing CSO-008 slide gate and operator, complete
      d. VFDs
      e. Harward Pump Station Pump No. 3 parts – specific parts to be coordinated with Owner at time of demolition.

I. Pump Station Structure Cleaning: (unless indicated otherwise on the Drawings):
   1. Contractor shall give Owner 14 days minimum notice prior to beginning work in structures requiring draining and cleaning; which are to be renovated or cleaned as part of this project. The Owner will be responsible for removal and disposal of the liquid contents of the existing structures.
   2. When the existing pump station structures are empty of liquid (drained by the Owner), any solids and/or debris remaining that are not easily drained by the Owner as part of normal facility operations shall be the responsibility of the Contractor. Contractor shall remove and dispose of all grit, sludge, rags, solids and/or debris within the pump station structures at the unit cost identified in the Bid Form. The Contractor shall then clean the structure walls, floor and ceiling using a high-pressure steam cleaning device. The cleaning once debris is removed from the structure is not included in the unit cost item.
   3. If the demolition work does not commence within the Contractor's approved project schedule, the structures may be placed back in operation by the Owner. It will then be the Contractor's responsibility to drain and clean the structures.

J. Maintain Transport of Wastewater:
   1. During demolition, maintain transport of wastewater as outlined in Section 01010, Summary of Work.

K. Demolition Sequence:
   1. The demolition sequence is to conform the reviewed and approved project schedule, and restrictions outlined in Section 01310, Construction Schedules.

L. Pest Control:
   1. Provide pest control when needed or when directed by the Engineer.
   2. Exterminate and prevent migration of rodents to adjoining buildings in accordance with the requirements of the state or local health department.

END OF SECTION

SECTION 02076

ASBESTOS-CEMENT (TRANSITE) PIPE REMOVAL AND DISPOSAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Remove and dispose of Asbestos-Cement (AC) sewer main according to all applicable Federal, State, and local laws, regulations, and ordinances.

B. The Contractor may dispose of AC pipe at the City of Bath Landfill. Should the contractor elect to use the City's landfill, disposal costs will be waived for AC pipe material disposed of.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SCHEDULING

A. Prior to initiating AC pipe removal, the Contractor shall prepare an abatement plan and provide a copy for record purposes to the Engineer. Refer to Paragraph 1.5 SUBMITTALS for more information.

B. The Contractor shall update the abatement schedule as requested by the Engineer.

C. The Contractor shall notify the City of Bath landfill in advance of AC pipe disposal so that the City can prepare adequate space for the AC pipe.

1.4 CODES, REGULATIONS, AND STANDARDS

A. General Applicability

1. Contractor shall perform all work in accordance with these specifications: U.S. Environmental Protection Agency (U.S. EPA) and Occupational Safety & Health Administration (OSHA) regulations, NIOSH recommendations, Maine Department of Environmental Protection (Maine DEP) rules and regulations, and any other applicable Federal, State and local government regulations and guidelines

2. The most recent edition of any relevant regulation, standard, document, code or policy statement shall be in effect. Where conflict among the requirements or with these specifications exists, the most stringent requirement(s) shall be utilized.

B. Contractor Responsibility

1. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State and local regulations related to all aspects of the abatement project. The Contractor is responsible for providing and maintaining training, accreditation, medical exams, medical records, and personal protective equipment as required by applicable Federal, State and local regulations. The Contractor shall hold the Owner and Owner's Representative harmless for any failure to comply with any applicable work, packaging, transporting, disposal, safety, health, or environmental requirement on the part of the Contractor, Contractor's employees, or subcontractors of the Contractor.

C. The publications listed below form a part of this specification to the extent referenced. The publications listed below are not intended to be a comprehensive list of all regulations, applicable to this work.
   1. Environmental Protection Agency (EPA):
      a. National Emission Standards for Hazardous Air Pollutants (NESHAP) Title 40, Part 61).
      b. A Guide to Respiratory Protection for the Asbestos Abatement Industry.
   2. Occupational Safety and Health Administration (OSHA):
      a. Asbestos Construction Standard 29 CFR Part 1926.1101
      b. Asbestos General Industry Standard 29 CFR 1910.1001
      c. Respiratory Protection, 29 CFR 1910.134
      d. Construction Industry Standards, 29 CFR 1926
   3. U.S. Department of Transportation
      a. 49 CFR 100 - 185, Transportation
   4. National Institute for Occupational Safety and Health (NIOSH):
      a. "Respiratory Protection A Guide for the Employee."
   5. American National Standards Institute (ANSI):
      a. Z86.1-1973 - Commodity Specification for Air
      b. Z9.2 - HEPA Filter Specifications
      c. Z88.2-1980-Respiratory Protective Equipment
   6. Maine Department of Environmental Protection (Maine DEP):
      a. Chapter 425 - Asbestos Management Regulations
      b. Chapter 401 - Landfill Siting, Design, and Operation
      c. Chapter 411 - Non-Hazardous Waste Transporter Licenses

1.5 PERSONNEL QUALIFICATIONS

A. All personnel of the Contractor or any approved subcontractors involved with asbestos abatement work shall meet the following minimum qualifications:
   1. Medical examination within the past year in accordance with OSHA 1926.134 with a physician’s written opinion that the worker has no condition that would preclude him/her from working with asbestos or wearing a respirator.

B. The Contractor shall employ a competent person to oversee all aspects of AC pipe removal.

C. There shall be a sufficient number of trained and qualified workers, foremen and superintendents to accomplish the work within the required schedule. No untrained or unqualified person shall be employed to speed up completion of the abatement work.

1.6 SUBMITTALS

A. Submittals shall be in accordance with Specification Section 01300 - Submittals.

B. At a minimum, the following submittals shall be submitted to the Engineer.
   1. Certification of compliance with OSHA requirements including but not limited to medical surveillance, record keeping and personnel exposure monitoring.
   2. Respiratory Protection Program. Include site specific exposure assessment for respirator selection.
   3. A written project schedule. The schedule shall be date specific and include all phases of the project.
   4. Emergency Action Plan.

5. Copies of training certificates for all personnel involved in the removing of asbestos cement pipe.
6. Copy of current license of the asbestos abatement contractor if utilized.
7. Proposed waste disposal site and waste transporter. Include name, address, telephone number and operating permits, etc.
8. Safety data sheets (SDS) for all materials and products to be used by the Contractor on this project.
9. A work plan outlining the methods to be used during the removal of AC pipe. The work plan shall include the use of the Best Management Practices pertaining to the qualifications of field personnel and methods for dust control, packaging, transportation, and decontamination of equipment.

C. During Abatement
1. Results of personnel exposure monitoring.
2. Project schedule.

D. Post Abatement Submittals
1. Disposal receipts (within timeframes regulated by EPA) signed by the landfill operator demonstrating that the AC pipe removed from the project has been packaged, transported and disposed of properly.
2. Provide the Engineer with copies of on-site job logs, notifications, permits, accident reports, personnel exposure air monitoring results, waivers of lien.
3. Copies of any notices of non-compliance issued by governmental authorities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Polyethylene sheeting: shall be at least 6-mil thickness. Sheeting, labels and tape shal comply with OSHA standard 29 CFR 1926.

B. Disposable bags and/or drums: shall be of 6-mil polyethylene, on which labels are directly printed, as required by EPA, OSHA and DOT regulations.

C. Surfactant (wetting agent): shall be a 50/50 mixture of polyoxyethylene ether and polyoxyethylene ester, or equivalent, mixed in a proportion of 1 fluid ounce to 5 gallons of water or as specified by manufacturer.

2.2 PERSONNEL PROTECTION

A. The Contractor is required to provide all required personnel protective equipment.

PART 3 - EXECUTION

3.1 TOOLS AND EQUIPMENT

A. Transportation Equipment: Transportation equipment, as required, shall be suitable for loading, temporary storage, transport, and unloading of contaminated waste without exposure to persons or property. The equipment shall be secured at all times and access limited to authorized personnel only.

B. The Contractor shall provide approved respirators and protective clothing to all Contractor personnel. The Contractor shall also provide approved protective clothing to representatives of the Owner, and to representatives of the State or other governmental entity who may inspect the job site.

C. Protective clothing requirements must include, but may not be limited to:
   1. One-time use, disposable, full-body coveralls made by Tyvek®, 3M,or approved equal.
   2. Hard Hats
   3. Eye protection
   4. Gloves
   5. Respiratory protective equipment as required by State law
   6. Other as appropriate for site conditions

D. The Contractor shall have sufficient equipment to mix and spray wetting agents.

E. The Contractor shall have a sufficient quantity of, ladders, hand tools and materials to conduct the abatement project in an efficient and workmanlike manner.

3.2 INSPECTION AND PREPARATION

A. Before any work commences, post danger signs in and around the work area to comply with Federal, State, and local law.

3.3 WORK AREA PREPARATION:

A. Regulated area access is to be restricted to authorized trained/accredited and protected personnel. The Contractor shall control site security during abatement operations in order to isolate work in progress and protect adjacent personnel.

B. Prior to any asbestos related work in an area, restrict access to all persons other than trained personnel and authorized visitors. The Contractor shall erect signs around the perimeter in accordance with EPA, OSHA and this specification. Maintain a log of all people entering and exiting the workplace during abatement work.

C. The Contractor shall be responsible for taking whatever steps are necessary to prevent a release to the environment and additional contamination of the areas beneath the AC pipe.

3.4 AC PIPE CONNECTION AND REMOVAL PROCEDURES

A. Cutting of existing AC pipe shall be minimized. Cutting of AC pipe shall be performed in accordance with all applicable OSHA standards and shall minimize release of AC fibers.

B. AC pipe shall be secured, wrapped, and disposed of in a timely manner. Stockpiling of removed pipe in an unsecured area shall not be allowed.

C. AC pipe shall be transported to a licensed facility for proper disposal.

D. Crushing of pipe in-place shall not be allowed.

3.5 GENERAL PROCEDURES

A. Install polyethylene sheeting beneath the AC pipe to minimize contamination of adjacent soil.

B. All surfaces shall be wetted during removal activities.

C. If AC pipe is found to be friable or will be rendered friable, abatement shall be conducted in containment.

D. AC pipe shall be removed from the trench in an “intact” condition in sizes such that the piping may be handled without breakage.

E. If AC pipe sections can be separated without cutting, the removal may be conducted without containment.

F. Separated non-friable AC pipe sections may be removed without containment.

G. If AC pipe sections require breaking/cutting to separate, all breaking/cutting activities shall be conducted within a glove bag or negative pressure regulated work area (containment).

H. In the event of breakage of AC pipe during removal which results in pieces contacting soil, then the Contractor shall remove all debris and soil located adjacent to and beneath the debris as well as six inches of soil from beneath and surrounding the debris. All resultant debris and soils shall be properly handled, packaged and disposed of as friable, regulated asbestos waste.

I. The Engineer and Owner shall be notified immediately in the event of breakage.

J. AC pipe shall be double wrapped in 6-mil polyethylene sheeting and labeled prior to transport as required.

3.6 DISPOSAL ACTIVITIES

A. It is the responsibility of the Contractor to determine current waste handling, transportation, and disposal regulations and or requirements for AC pipe and for each waste disposal facility. The Contractor must comply fully with these regulations and all U. S. Department of Transportation and EPA requirements.

B. The Contractor will document actual disposal of the waste at the designated landfill by completing a Waste Shipment Record and forwarding a copy of it along with a copy of the Bill of Lading to the Engineer.

C. All waste load-out and disposal activities shall be the responsibility of the Contractor.

D. Contractor shall insure that transport vehicles do not leak water or other material while being loaded, transported or while on site partially loaded. At minimum, transport vehicles shall be lined with two layers of 6-mil thick polyethylene sheeting installed to form a watertight barrier within the vehicle. If water is observed leaking from any transport or storage container, contractor shall immediately stop work, unload the container (including dumpsters and semi-trailers) find and correct the source of the leak, and place waste material back into the container. This process will be repeated each time any water is observed leaking from a storage or transport vehicle that contains asbestos waste. Contractor shall also take all steps necessary, to decontaminate the ground or other surfaces that became wet due to water leaking from a container that holds asbestos waste.

3.7 CLEANING AND FINAL DECONTAMINATION

A. After the removal of the AC pipe has been completed and before removal of barriers (as applicable), the entire area shall be thoroughly cleaned. All plastic barriers, tapes and disposable contaminated equipment shall also be disposed of as asbestos waste. All reusable contaminated equipment such as masks, hard hats, etc., shall be thoroughly decontaminated through wet cleaning or sealed within 6-mil polyethylene bags before removal from the work area.

END OF SECTION

SECTION 02080A
CONTAMINATED SOIL AND WATER MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the segregation, removal and disposal of contaminated soils including soil handling, testing, reuse, temporary stockpiling/storage, transportation, and disposal, and the removal, testing, treatment and disposal of contaminated water from excavation dewatering.

B. This section also includes the procurement of an Environmental Professional to conduct monitoring of excavation in areas as identified herein with potential for contaminated soils and groundwater.

C. Should the monitoring indicate contaminated soil and/or groundwater are present, the contaminated soil and/or groundwater must be managed in accordance with the procedures outlined in this specification. Unit Price items are included in the Bid Form for handling contaminated soil and handling contaminated groundwater. Refer to Section 00410 and Section 01150 Measurement and Payment for a description of the pay items.

D. Environmental Professional shall be responsible for the on-site monitoring of excavation and dewatering, classification of soils, directing Contractor in segregation of materials, soil and dewatering discharge water sampling, procurement and analytical testing of soils for off-site disposal, procurement and analytical testing of dewatering discharge water, record keeping, preparing summary of excavation report for Owner and Engineer and complying with all applicable Maine DEP screening, sampling, testing and notification requirements.

E. The intent of this Section is for the Contractor to provide the complete services required for the excavation, segregation, and safe removal and disposal of contaminated soils and for the removal, treatment and disposal of contaminated dewatering discharge water in accordance with all local, state and federal regulations, the Contractor's submitted Work Plan and this specification within the project work area.

F. The Contractor and their Environmental Professional shall provide the Owner and Engineer site access to the work area, soil storage area(s) and dewatering discharge water treatment area. Contractor shall also provide site access to all Maine DEP personnel, as required.

G. The Contractor shall notify their workers and subcontractors of all available background information on the site including Contaminated Soil Information in Appendix C and potential for contamination to be present. All work involving the potential for contaminated soils and groundwater shall be conducted in accordance with federal, state and local regulations, including but not limited to OSHA regulations. At a minimum, all individuals involved in excavation and removal of potentially contaminated materials shall be trained in accordance with the requirements of 40 CFR 1910.120. This will include, but not be limited to, the Contractor's excavation employees and Environmental Professional.

H. Project Description and Background Information

1. According to historical records of 1090 High Street, the site was developed and operated as a bulk fuel facility from approximately 1910 to 2012. Former infrastructure associated with the property included several garage/sheds buildings and storage trailers, and numerous aboveground and underground petroleum storage tanks. These facilities have all been removed with the exception of two small wooden sheds outside of the project area.
2. The following previous environmental reports for the subject property have been completed and are available for review upon request:
    a. "Phase I Environmental Site Assessment, M.W. Sewall & Co. Bulk Plant, 1110 High Street, Bath Maine" dated March 31, 2010.
    b. "Phase II Environmental Site Assessment, M.W. Sewall & Co. Bulk Plant, 1110 High Street, Bath Maine" dated August 17, 2010.
    c. "Analysis of Brownfields Cleanup Alternatives & Conceptual Remedial Action Plan" M.W. Sewall Bulk Plant Site, 1110 High Street, Bath, Maine dated January 27, 2011.
    d. "Phase I Environmental Site Assessment, M.W. Sewall & Co. Bulk Plant, 1110 High Street, Bath Maine" dated October 5, 2015.
    e. "Supplemental Phase II Investigation, M.W. Sewall & Co. Bulk Plant, 1110 High Street, Bath Maine" dated April 4, 2016.
    f. "Phase 1 Environmental Site Assessment, Former M.W. Sewall & Co. Bulk Plant 1090 High Street, Bath Maine", dated July 3, 2024.
3. Relevant Findings
    a. The 2010 Phase II Environmental Site Assessment identified petroleum contamination on the southwestern portion of the site in the approximate location where the new sewer line is to be installed. The report determined that the concentration of petroleum contamination in surface and subsurface soils throughout the historical fill area, Area of Concentration 1 (AOC 1) were above the Permissible Concentration Level (PCL) for the "residential" exposure scenario, but below the below the PCL for the "outdoor worker" and "excavation/construction worker" exposure scenarios. The work is not anticipated to disturb any other Areas of Contamination.

1.2 RELATED SECTIONS

A. Section 01320 – Health and Safety Plan
B. Section 01340 - Submittals
C. Section 01562 - Dust Control
D. Section 02200 - Earthwork

1.3 REFERENCES

A. Maine Department of Environmental Protection Remedial Action Guidelines for Contaminated Sites (RAGs), Table 4: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario
B. Appendix C – Contaminated Soil Information

1.4 SUBMITTALS

A. Qualifications of the Environmental Professional to be on-site to monitor excavation and dewatering in areas with potential for contamination, conduct testing and coordinate with licensed disposal facility. Environmental Professional shall have a minimum of 5-years' experience in soil and groundwater management and contaminated soil and groundwater assessment in the State of Maine.

B. The following submittals are to be provided at the completion of the excavation work:

1. Letter summary of on-site monitoring and analytical results. Summary shall include details of daily activities, soils encountered, PID readings, soil and water samples taken, analytical testing completed and results, disposal summary and all manifest documentation or additional analytical requirements.
2. Daily field reports and documentation of soil excavation and dewatering activities.
3. Weight slips from a licensed disposal facility.

1.5 COORDINATION

A. Contractor shall notify Owner, Engineer, and Environmental Professional 3 days in advance of work within the potentially contaminated area of the project. The Contractor's Environmental Professional shall be on-site during all excavation activities in areas identified as having the potential for contamination, and as needed if other areas of suspected contamination are identified by the Contractor during construction.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall maintain all records on site that are required by local, state and federal regulations.

B. Environmental Professional shall be on-site to monitor excavation and dewatering, screen soils, sample soils and dewatering discharge water as needed, and help direct the segregation of potentially impacted materials during work in the following areas:

1. 1090 High Street from STA 2+00 to STA 6+00.
2. The contractor shall not remove soil or conduct sampling beyond the work area necessary to install the sewer pipe without prior written authorization from the Engineer and Owner. Failure to adhere to this and any subsequent cost of remediation due to testing outside of the necessary work area will be borne by the Contractor at no additional cost to the Owner.

3.2 MATERIAL CLASSIFICATION AND SCREENING OF SOILS

A. Excavated soils shall be classified by the Environmental Professional based on photo-ionization detector (PID) field screening measurements. Field Screening with a PID and Field Sampling shall be performed in accordance with the Maine DEP Standard Operating Procedures "*Compendium of Field Testing of Soil Samples for Gasoline and Fuel Oil*", latest revision.

B. Soil remediation is required if the average PID field test sample result is at or above the values listed in Table 1 "*Approved PID Field Cleanup and Notification Guidelines*" of the Maine DEP Standard Operating Procedures "*Compendium of Field Testing of Soil Samples for Gasoline and Fuel Oil*" (reproduced below) for the site's cleanup scenario.

TABLE-1
APPROVED PID FIELD CLEANUP AND NOTIFICATION GUIDELINES*

Cleanup Scenario	Soil size (grams)	Ion	Thermo	Passport	Foxboro	MiniRAE	Photon
Outdoor Commercial Worker/ Excavation-Construction Worker	5	1200	500	850	375	1500	400

Note: No adjustment is made for set points; the response factor should be 1.0 for all instruments.

Instrument Descriptions
Ion: Ion Science PhoCheck Series
Thermo: Thermo Environmental OVM 580 Series
Passport: MSA Passport PID II OVM
Foxboro PID: Foxboro TVA-1000 PID mode
MiniRAE: RAE Systems MiniRAE 2000 and MiniRAE 3000
Photon: MSA Photon Gas Detector

* Reproduction from Maine DEP Standard Operating Procedures "*Compendium of Field Testing of Soil Samples for Gasoline and Fuel Oil*"

C. Soils shall be classified as follows for the purposes of handling, storage and disposal:
   1. Class 1 Soil: Average PID field test sample results for soil is below the threshold value listed in Table 1 for the applicable PID instrument.
   2. Class 2 Soil: Average PID field test sample result is at or above the value listed in Table 1 for the applicable PID instrument.

3.3 HANDLING OF SOIL MATERIALS

A. Soils classified as Class 1 based on the Material Classification and Screening of Soils section of this specification are not considered contaminated and will not require special handling. Soils may be reused on site, as allowed, or reused off-site.

B. Soils classified as Class 2 soils are considered contaminated and when excavated shall be transported to the licensed disposal facility at the end of each working day. Materials which cannot be transported shall be temporarily stockpiled in a secured stockpile area and shall be transported to the disposal facility within 72 hours.

3.4 SOIL DISPOSAL

A. The Contractor shall be responsible for disposal of impacted soils in accordance with all local, state and federal laws and for coordination with the licensed disposal facility for disposal of impacted soils.

B. Contractor is also responsible for properly notifying Maine DEP if contaminated soils are encountered and to cooperate with any special Maine DEP notification, testing and documentation requirements. The Contractor shall be responsible for the cost of any additional analytical testing or grain size analysis, as required by Maine DEP or the licensed disposal facility for acceptance.

C. Contractor and their Environmental Professional shall be responsible for signing any manifests or bill of lading required for the transport and disposal of contaminated soils. A copy of the manifest documentation shall be retained on-site during construction and a copy shall be provided to the Resident Project Representative (RPR) for each truck load of material transported and disposed of off-site.

3.5 TREATMENT AND DISPOSAL OF WATER

A. Treatment / Disposal of Water

1. The Contractor shall submit a written plan for sampling, treating and/or disposal of water from the site that meets all local, state, and federal requirements.
2. Infiltration to the Groundwater
    a. The Contractor may dispose of removed groundwater via an infiltration basin provided the following conditions are met.
        i. A Temporary Groundwater Discharge Permit is obtained by the Contractor from Maine DEP.
        ii. All dewatering discharge water within the areas listed in this specification is tested and meets the Contractor's Temporary Groundwater Discharge Permit requirements prior to re-infiltration.
        iii. Infiltration basin is designed to meet all Maine DEP requirements by a professional engineer licensed in the State of Maine.
3. Off-site treatment and/or disposal
    a. Contractor may remove dewatering discharge water within the areas listed in this specification as having the potential for contamination off-site for treatment and/or disposal, provided the methods of treatment and/or disposal meet Maine DEP wastewater discharge requirements.
    b. Contractor shall provide the name and contact information for the off-site treatment and/or disposal facility used to treat and/or dispose of the removed dewatering discharge water to the Owner and Engineer.
    c. Contractor shall minimize the amount of dewatering discharge water removed to the greatest extent possible while still meeting the requirements of these specifications.

3.6 EQUIPMENT DECONTAMINATION

A. No equipment, supplies, or materials (except properly containerized waste material) shall be removed from the work area unless such equipment, supplies and materials have been thoroughly decontaminated and cleaned free of visible debris.

B. Decontamination wastewater and debris shall be properly handled and disposed of in accordance with all local, state, and federal laws.

3.7 SECURED STOCKPILE AREA

A. A separate secure stockpile area should be created for the temporary staging of contaminated soils excavated. This secured stockpile area shall be separate from any other stockpiled material excavated from or brought on-site for construction.

B. Soil stockpiles shall be staged on 20-mil polyethylene sheets overlapping minimum 4-feet and secured at the end of each working day with a minimum 12-mil reinforced polyethylene sheet anchored at the base. The edge of the stockpile shall be bermed a minimum of 12-inches around the outside edge of the stockpile.

3.8 DUST CONTROL

A. Contractor shall be responsible for taking actions required to minimize the generation of dust during soil excavation, loading, stockpiling and soil handling. The Contractor shall have materials and equipment available to immediately address dust issues should conditions warrant in accordance with Section 01562 Dust Control.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Clearing and grubbing includes, but is not limited to, removal of trees, brush, stumps, wooded growth, grass, shrubs, poles, posts, signs, fences, culverts and other vegetation and minor structures; the protection of designated wooded growth; the storage and protection of minor structures and materials which are to be replaced; and the disposal of non-salvageable structures and materials, and necessary preliminary grading.

B. Limits of Work:
   1. Perform clearing and grubbing work within the areas required for construction, or as shown on the Drawings, to a depth of l2 inches below the existing grade.
   2. Perform additional clearing and grubbing work within areas and to depths which, in the opinion of the Engineer, interfere with excavation and/or construction, or are otherwise objectionable.

C. Work Not Included:
   1. Clearing and grubbing work performed for the convenience of the Contractor will not be considered for payment.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. Dispose of combustible material by burning only when permitted by and in accordance with all applicable local and state laws, ordinances and code requirements.

B. Remove and dispose of non-salvageable structures and material in accordance with all applicable local and state laws, ordinances and code requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide all materials required to complete the work.

B. All timber and wood shall become the property of the Contractor unless other agreements are made between the Owner and the Contractor.

C. Repair any damage to structures to the complete satisfaction of the Owner and Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Carefully preserve and protect from injury all trees and/or shrubs not to be removed.

B. Right-of-way:

1. Where excavation is required on public or private rights-of-way containing trees, shrubs, other growth, or any structure or construction, obtain the Engineer's direction concerning the extent to which such obstacles can be cleared or stripped prior to performing the Work.
2. In all rights-of-way, remove only those particular growths or structures which are, in the opinion of the Engineer, essential for construction operations.
3. All other removals or damage shall be replaced or restored at the Contractor's expense.

3.2 PERFORMANCE

A. Clearing:

1. Remove and dispose of all trees, brush, slash, stubs, bushes, shrubs, plants, debris and obstructions within the area to be cleared, except any areas that may be designated as "Selective Clearing", and except as otherwise shown on the Drawings or as directed by the Engineer.
2. Remove all stumps unless otherwise directed by the Engineer.
3. Dispose of material to be removed daily as it accumulates.
4. Take special care to completely dispose of all elm trees and branches immediately after cutting either by burial in approved locations or, when permitted, by burning in areas well removed from standing elm growth.

B. Protection of Wooded Growth:

1. Fell trees toward the center of the area being cleared to protect trees and shrubs to be left standing.
2. Cut up, remove and dispose of trees unavoidably falling outside the area to be cleared.
3. Employ skilled workmen or tree surgeons to trim and repair all trees that are damaged but are to be left standing.

C. Selective Clearing:

1. When shown on the Drawings and when directed by the Engineer, perform selective clearing work to preserve natural tree cover.
2. Perform selective clearing work only under the direction and supervision of the Engineer.
3. Remove all dead and uprooted trees, brush, roots and other material which, in the opinion of the Engineer, are objectionable.
4. Cut flush with the ground and remove only those trees indicated by the Engineer.
5. Employ skilled workmen or tree surgeons to carefully trim all branches requiring cutting on trees to be left standing. Wood exposed as the result of removal of branches is to be left exposed to air and sunlight.
6. Bituminous paint shall not be used on wood exposed as a result of branch removal, excavation around roots, or damage to tree bark.

D. Grubbing:
   1. Perform grubbing work beneath new roads, driveways, walks, seeded areas and other areas and as directed by the Engineer.
   2. Grub out all sod, vegetation and other objectionable material to a minimum depth of l2 inches below the existing grade.
   3. Completely remove all stumps, including major root systems.

E. Disposal:
   1. Remove from the site and dispose of material not being burned.
   2. Provide an approved disposal area unless otherwise specified.

F. Burning:
   1. Dispose of combustible materials by burning, only if approved by local and state officials.
   2. Employ competent workmen to perform burning work in such a manner and at such locations that adjacent properties, trees and growth to remain, overhead cables, wires and utilities will not be jeopardized.
   3. Do not leave fires unguarded.
   4. Do not burn poison oak, poison ivy or other plants of similar nature.
   5. Do not use tires or other combustible waste material to augment burning.
   6. Burn combustible materials daily as the work progresses.
   7. The Contractor shall be responsible for all damage caused by burning and shall be responsible for obtaining all necessary permits for burning.

3.3 REPLACEMENT OF MATERIALS

A. Paving, Curbing and Miscellaneous Material:
   1. Remove all paving, subpaving, curbing, gutters, brick, paving block, granite curbing, flagging and minor structures that are over the area to be filled or excavated.
   2. Remove and replace bituminous asphaltic and portland cement concrete in accordance with the appropriate sections of these Specifications.
   3. Properly store and preserve all material to be replaced in a location approved by the Engineer.

B. Shrubs and Bushes:
   1. Remove, store, and replace ornamental shrubs and bushes to be preserved in accordance with accepted horticultural practices.

C. Topsoil:
   1. When applicable, carefully remove, store, and protect topsoil in accordance with the appropriate section of this division.

D. Responsibility:
   1. Replace, at no additional cost to the Owner, materials lost or damaged because of careless removal or neglectful or wasteful storage, disposal or use of these materials.

END OF SECTION

SECTION 02115

STRIPPING AND STOCKPILING TOPSOIL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Segregate topsoil approved by the Engineer prior to excavation, trenching and grading operations and stockpile it for use in the work.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil shall consist of friable loam of at least two percent decayed organic matter (humus), free of subsoil, and reasonably free of clay lumps, brush, roots, weeds, and other objectionable vegetation, stones and similar objects larger than one (1) inch in any dimension, litter and other materials unsuitable or harmful to plant growth. It shall contain no toxic materials.

B. The quality of the topsoil material to be used shall be subject to approval by the Engineer.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Remove topsoil from the areas that are likely to be disturbed as a result of construction operations to a depth based on the soil profile, as approved by the Engineer.

B. Remove topsoil from all designated areas prior to the performance of normal excavation.

3.2 STORAGE

A. Transport topsoil and deposit in storage piles convenient to the areas which are subsequently to receive the application of topsoil.

B. Stockpile topsoil separate from other excavated materials in areas approved by the Engineer.

C. Take all necessary precautions to prevent other excavated material and objectionable material from becoming intermixed with the topsoil before, during and after stripping and stockpiling operations.

D. Neatly trim and grade stockpiles to provide drainage from surfaces and to prevent depressions where water may become impounded.

E. Construct temporary erosion control devices for all stockpiled material, subject to the Engineer's approval.

F. All loam stripped and stockpiled shall be immediately seeded with 70% Domestic/30% Perennial Rye Grass.

END OF SECTION

SECTION 02140

TEMPORARY CONSTRUCTION DEWATERING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish, operate, maintain, and remove temporary dewatering system to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry; collect and dispose of ground and surface water where necessary to complete the work.
2. Design, furnish, operate, maintain, and remove temporary treatment system for temporary dewatering system effluent prior to discharge.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 DESIGN REQUIREMENTS

A. The Temporary Construction Dewatering System shall be of sufficient size and capacity necessary to lower and maintain the ground water table to an elevation at least two feet below the lowest foundation subgrade, or bottom of pipe trench, to allow material to be excavated in a dry condition, including depressurizing the soil stratum beneath the excavation subgrade. Materials to be removed shall be sufficiently dry to permit excavation to grades shown on the Contract Drawings and to stabilize the excavation slopes where temporary excavation support systems are not required. Operate the dewatering system continuously until backfill work has been completed.

B. Control of surface and subsurface water is part of the Temporary Construction Dewatering System requirements. Maintain adequate control so that:

1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering the prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
2. Erosion is controlled.
3. Flooding of excavations or damage to structures does not occur.
4. Surface water drains away from excavations.
5. Excavations are protected from becoming wet from surface water and ensure excavations are dry before additional work is undertaken.
6. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.
7. The stability of the sides and bottom of excavations are sustained during excavations. Construction operations shall be performed to dry and stable soils.
8. Any existing dewatering wells that can affect dewatering and excavation shall be sealed below the excavation subgrade.

C. The design shall include an assessment of how the dewatering operations will affect the stability of all adjacent structures.
D. Contractor is responsible to perform additional geotechnical investigations as deemed necessary to facilitate the design of the Temporary Construction Dewatering System and prevent damage to adjacent buildings, roads, structures, utilities and other facilities.

1.4 SUBMITTALS

A. Provide submittals in accordance with Specification Section 01340.
B. Provide a Temporary Construction Dewatering System Plan at least 30 days prior to beginning operations. This submittal shall include:
   1. Detailed written description of dewatering methods to be employed to convey the water from site to adequate disposal, including operations, maintenance and control requirements.
   2. Estimated average, minimum and maximum pumping rates (total).
   3. Capacity and number of standby pumping equipment.
   4. Capacity and number of standby power equipment.
   5. Treatment tankage and discharge locations.
   6. Technical data on the well screens, filter materials and gradations to demonstrate adequacy of the proposed systems to prevent migration of fines.
   7. Structure Monitoring Plan, if required.
   8. Effluent monitoring provisions and laboratory testing methods, including sample monitoring log (flow, TSS, etc.).
   9. System removal requirements.
C. The Temporary Construction Dewatering System submittal shall be provided concurrently with and coordinated with the submittals required by Section 02156 (Temporary Excavation Support Systems).
D. Submit water monitoring results at the frequency required by the permitting authority.
E. Submittal review of the Temporary Construction Dewatering System Plan shall not in any way relieve the Contractor from full responsibility for the complete and adequate design, installation and performance of the dewatering system and shall not relieve the Contractor of sole responsibility for the dewatering system as necessary to prevent damage and settlement to adjacent buildings, roads, structures, utilities and other facilities adjacent to the excavations and for the safety of people working within the excavated areas.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment used in the Temporary Construction Dewatering System shall adhere to accepted industry standards.
B. Backup equipment for the Temporary Construction Dewatering System shall be identical to the primary equipment, shall be immediately available and in operating condition at all times.
C. Pipes and Well Screens: Schedule 40 PVC or stronger.
D. Sand: Clean, single-size filter sand having an effective size (D10) of 0.3 to 0.5 mm with a fineness modulus of less than 4 and with no more than 4% passing a 100 sieve.

E. Grout: Cement-bentonite grout of adequate mix proportion and consistency. Seals shall consist of bentonite pellets.
F. Pumps, meters, hoses and controls shall be suitable for the intended purpose and application.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:
   1. Keep work areas dewatered until all construction of new structures, pipes, and appurtenances have been substantially completed to the extent that they will not be damaged by water.
   2. Thoroughly brace, or otherwise protect against flotation, all pipelines and structures which are not stable until final grades and ground cover is established.
   3. Maintain standby, or backup, equipment and power supply throughout the duration of the dewatering operations.
   4. Prevent soil particles from entering the discharge points.
   5. Ground water level shall be maintained at least one foot below the bottom of the excavation.

B. Disposal of Water:
   1. Dispose of water pumped or drained from the construction site in a suitable manner to avoid siltation of adjacent drainage structures and piping, wetlands or water bodies, injury to public health, damage to public and private property, and damage to the work completed or in progress.
   2. Provide suitable temporary channels for water that may flow along or across the construction site.
   3. Provide treatment as necessary to prevent discharge of contaminated ground water caused by Contractor's operations or any contaminated ground water that may pass through the Temporary Construction Dewatering System.
   4. Contractor must obtain all necessary regulatory approvals for the disposal of dewatering flows. These may include, among others, approval by the USEPA under the National Pollutant Discharge Elimination System (NPDES) program for construction activities.

C. Temporary Underdrains:
   1. When necessary, temporary underdrains may be placed in excavations.
   2. Underdrain pipe shall be perforated corrugated metal, polyethylene or P.V.C. pipe.
   3. Surround the underdrain completely and fill the space between the underdrain and the pipe or structure with free draining material.

D. Excavation Sump Pumping:
   1. When necessary, and where appropriate to the geotechnical conditions encountered, excavations may be over excavated 12 to 24-inches and filled with screened stone to allow sump pumping of groundwater. Immediately cease operations if boils, loss of fines, quick conditions, softening of the ground or instability of slopes occur.

2. The system shall be installed with suitable screens and filters so that pumping of fines does not occur.

E. Well and Wellpoint System:
   1. If necessary, dewater the excavations and trenches with an efficient well or wellpoint system to drain the soil and prevent saturated soil from flowing into the excavated wells and area.
   2. Wellpoint and well systems shall be of the type designed for dewatering work and shall be installed with suitable screens and filters so that pumping of fines does not occur.
   3. Pumping units shall be capable of maintaining sufficient suction to handle large volumes of air and water at the same time.

F. Removal
   1. Remove all equipment after the permanent installations are complete.

3.2 MONITORING

A. General:
   1. Contractor shall monitor the performance of the dewatering system and the groundwater level achieved throughout construction.
   2. Contractor shall monitor the effluent quality from the treatment system as required by the permitting authority.

3.3 CORRECTIVE ACTION

A. No movement of or damage to adjacent buildings, roads, structures, utilities and other facilities shall be allowed.

B. If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), the Contractor shall stop work and resubmit a revised Temporary Construction Dewatering System design submittal. The revised plan shall indicate why the system revisions are needed and indicated what change will be made to address the issues. Contractor shall perform work necessary for reinstatement of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to the Owner.

C. Damage to existing structures shall be repaired at no additional cost to the Owner.

END OF SECTION

SECTION 02156

TEMPORARY EXCAVATION SUPPORT SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Design, furnish, install, maintain, and remove temporary excavation support system as required to comply with all applicable State and Federal regulations including the Occupational Safety and Health Act. Excavation support system shall consist of trench boxes, steel sheeting, pile and lagging bracing or other systems designed by the Contractor.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 DESIGN REQUIREMENTS

A. The Contractor shall be responsible for the design and construction of the excavation support structures. The excavation support structures (sheeting systems or other special excavation techniques) shall be properly designed by a Professional Engineer registered in the State in which the project is located, who practices in a discipline applicable to excavation work and has more than 5 years of experience in the design of excavation support systems. The excavation support system shall be designed to accommodate an additional 2 feet of excavation below the bottom of excavation shown on the Contract Drawings.

B. The excavation support system shall be designed and installed to limit the upward hydraulic gradient into the bottom of the excavation and to sustain all existing and expected loads and utilities, to prevent migration of fine-grained materials into the excavation, to prevent all movement to earth which could in any way cause injury to workmen, delay the work or endanger adjacent structures. If detrimental effects result from construction activities, the Contractor shall modify the design, revise construction procedures and/or take measures to mitigate and abate further movement at no cost to the Owner.

C. The excavation support system shall be installed to prevent impact to nearby existing structures and utilities.

D. The internal lateral bracing shall be located so that the braces shall not pass through walls and/or slabs of existing or proposed structures.

E. The support system shall provide adequate room to properly perform the installation and to allow for inspection of the installation.

F. Prior to the installation of any portion of the temporary lateral support system, the Contractor shall furnish to the Owner precondition surveys documenting the existing conditions of the adjacent structures.

G. The use of existing structures to support the sheeting bracing or structural framing shall be prohibited.

1.4 SUBMITTALS

A. Provide submittals in accordance with Specification Section 01340.

B. Submit qualifications of temporary excavation support system design engineer.
C. Submit attached certificate of design and complete scaled and dimensioned layout drawings of the proposed excavation system, stamped and sealed by a Professional Engineer registered in the State in which the project is located.
D. The Contractor shall have sole responsibility for design, construction, monitoring and removal of the excavation support system as necessary to prevent damage to adjacent structures, utilities, streets adjacent to excavations and for safety of persons working within the excavated areas. The submittals will be reviewed for consistency with the design intent.
E. Submittals under this Section shall be provided concurrently with and coordinated with the submittals under Section 02140 (Temporary Construction Dewatering System).

PART 2 - PRODUCTS

2.1 MATERIAL

A. All materials shall conform to all applicable State and Federal regulations including the Occupational Safety and Health Act.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform preparatory work to discover, protect, maintain and restore utilities, foundations or other facilities located in close proximity of the proposed excavation lateral support system.
B. Conduct pre-excavation to remove obstructions along the alignment of the excavation lateral support system which will interfere with installation of the excavation lateral support system.
C. Install the excavation support system, including the installed wall and bracing system, outside the limits of the permanent structure. Construction tolerances (e.g., wall verticality) and lateral wall deflections as a result of excavation and other activities shall be considered in determining the plan location.
D. Excavation shall not proceed more than 2 ft. below the bracing level, anywhere within the excavation support limits, until the entire level of bracing is completely installed.
E. The first level of bracing shall be installed within 5 ft. of the ground surface prior to any excavation below this level.
F. If the excavation support system is inadequate or fails (i.e. settlement of adjacent grade, settlement of structures, cracking of structures, etc.), immediately stop work and perform repairs necessary for reinstatement of a functional system, as well as restoration of foundation soil and damaged structure resulting from such inadequacy or failure by Contractor, at no additional cost to Owner.

3.2 INSTALLATION

A. Install excavation support system in accordance with all applicable State and Federal regulations including the Occupational Safety and Health Act. The excavation support system design engineer shall visit the site during excavation support system installation.

3.3 INTERNAL LATERAL WALL BRACING (RAKERS, WALES AND STRUTS)

A. Rakers are only allowed for the temporary lateral brace that is installed within 5 ft. of the ground surface.

B. Use wales, struts, corner braces to provide support of the excavation lateral support walls as required. Include web stiffeners, plates, brackets, or angles as required to prevent rotation, crippling or buckling of connections and points of bearing between structural steel members. Allow for eccentricities due to fabrication and assembly. Consider effects of temperature changes.

C. Install and maintain all support members in continuous tight contact with each other and with the wall being supported.

D. Preload all bracing members (including rakers, corner braces, and struts) in accordance with methods, procedures and sequence as described on the reviewed shop drawings. Coordinate excavation work with installation of bracing and preloading. Use steel shims and steel wedges, welded or bolted in place, to maintain the preloading force in the bracing after release of the jacking equipment pressure. Wood shims or wedges shall not be used. Braces shall be preloaded to 50 percent of the maximum design load. Provide means to control the fluctuation of loading due to temperature variations.

E. Accomplish preloading by jacking struts, rakers, etc. in place against the excavation lateral support system walls, or by other methods acceptable to the Owner or Owner's Representative.

3.4 MONITORING

A. Contractor shall implement the excavation support system monitoring plan intended to monitor the performance of the excavation support system, as well as adjacent grade and adjacent structures, throughout construction. Monitoring shall include the following at a minimum:

1. Pre-Installation Structure Elevation Survey. Survey prior to excavation support system installation.
2. Vibration Monitoring. Full-time vibration monitoring during excavation support system installation.
3. Installation Structure and Support System Surveys.
    a. After excavation support system installation but prior to first brace installation;
    b. When at mid-point of excavation;
    c. When at bottom of excavation;
    d. At weekly intervals during structure construction.
    e. Prior to excavation support system removal.
    f. Each survey shall assess the support system deformation and key structures.
4. Vibration monitoring. Full-time during excavation support system removal.
5. Post-Installation Structure Survey. Survey after removal of excavation support system.
6. No movement of or damage to structures shall be allowed.

B. The excavation support system design engineer shall visit the site during the monitoring program at periodic intervals.

3.5 REMOVAL OF SHEETING

A. Remove all sheeting and bracing unless the removal may cause injury to adjacent structures and/or property.

B. The General Contractor shall be responsible for repairing all damage to existing structures caused by the removal of sheeting. The excavation support system design engineer shall visit the site during excavation support system removal.

C. All backfill disturbed by the removal of the sheeting shall be re-compacted to its in-situ density.

D. Proceed with backfilling as specified in these Specifications. When the level of compacted backfill reaches the location of bracing and wales, remove these items from the trench or other excavation. When the level of the backfill reaches a point three feet below the existing ground grade, remove the sheeting by approved methods and equipment.

E. After removing the sheeting, complete backfilling in the usual manner.

F. If the Contractor elects to leave the sheeting or any component of the temporary support system in place, the Contractor shall cut the sheeting or such component at least 4 feet below the ground surface, or as directed by the Engineer.

CERTIFICATE OF DESIGN

RE: Contract between
OWNER: _____
(Name)
and
CONTRACTOR: _____
(Name)
on
CONTRACT: _____
(Title)
_____
(Number) (Date)

The undersigned hereby certify that the engineer listed below:

1. Is licensed or registered to perform professional engineering work in the state of _____(location of Project);

2. Is qualified by education and training to design the _____ _____ specified in Section _____ of subject contract;

3. Has previously designed comparable excavation support systems;

4. Has prepared the design in full compliance with the requirements of subject contract, including all applicable laws, regulations, rules, and codes – including review and coordination with the Dewatering System design; and

5. Will inspect and supervise installation of the excavation support system, will monitor the in-place system to confirm that the system is installed and functions in accordance with the design and will inspect and supervise the removal of the excavation support system.

CONTRACTOR	ENGINEER
By: _____ (Signature)	By: _____ (Signature)
_____ (Name)	_____ (Name)
_____ (Title)	_____ (Engineering Discipline)
_____ (Date)	_____ (Date)

END OF SECTION

SECTION 02170

USE OF EXPLOSIVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Drilling, blasting, and removal of all ledge within the limits of excavation as indicated on the Contract Drawings.
   2. Pre-blast and post-blast surveys of existing structures and utilities.
   3. Seismic monitoring and documentation of all blasting.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. NFPA 495 (2010) - Explosive Material Code
B. US Department of Interior Bureau of Mines – Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting (RI 8507)
C. Occupational Safety and Health Administration (OSHA) 29 CFR 1910.109 Explosives and Blasting Agents
D. State Blasting Regulations: 2020 MEDOT Standard Specifications Subsection 203.042

1.4 QUALITY ASSURANCE

A. Perform all blasting operations, including, but not limited to transportation, storage, handling, use and disposal, in accordance with all applicable Local, State and Federal laws, ordinances and code requirements, including NFPA 495 and 29 CFR 1910.109, unless otherwise specified herein.
B. All blasting operations shall be performed by a single firm.
C. Qualifications:
   1. Blasting Subcontractor:
      a. Shall possess a current blasting license issued by the appropriate regulatory authority within the project state.
      b. Shall have a minimum 5-years' experience on similar blasting projects.
   2. Seismic Monitoring Subcontractor:
      a. Shall be experienced in the use of seismographs and interpreting the information recorded.
      b. Shall have a minimum 5 years' experience on similar blasting projects.
      c. Shall be selected and employed by the General Contractor.
      d. May be the Blasting Subcontractor, upon approval of the Engineer.
   3. Pre-Blast and Post-Blast Survey Subcontractor:
      a. Shall be experienced in conducting pre-blast and post-blast surveys and documenting existing conditions of structures, buildings, utilities and monuments.

b. Shall have a minimum 5 years' experience on similar projects.
c. Shall be selected and employed by the General Contractor**.**

D. The Blasting Subcontractor shall secure and pay for all necessary blasting permits, and furnish proof of permitting by all Local and State departments having jurisdiction.

E. A Pre-Blast Meeting shall be conducted, at the discretion of the Owner and Engineer, by the Blasting Subcontractor to discuss blasting procedures prior to the commencement of blasting operations. The meeting shall be attended by the Engineer, Owner, Blasting Subcontractor, Seismic Monitoring Subcontractor, pre-blast and post-blast Survey Subcontractor, and local utility companies (Bath Water District, Central Maine Power).

1.5 SUBMITTALS

A. Submit qualifications of the Blasting Subcontractor, Seismic Monitoring Subcontractor and Pre-Blast/Post-Blast Subcontractor, including the names and qualifications of the individuals who will be directly responsible for the work.

B. Blasting Subcontractor – proof of liability insurance and permitting shall be submitted prior to mobilization of blasting materials.

C. Submit blasting plan prior to the commencement of the blasting operations. The blasting plan shall include the following:
1. All equipment that will be used in the blasting operations.
2. Methods of matting or covering the blast area in open excavations to prevent flyrock and excessive air overpressure (airblast), and dust and fume mitigation.
3. Diameter, spacing, depth and bottom of blast hole elevation. Amount of explosive used per hole, on each delay and the total for the blast.
4. Calculations of ground vibration at adjacent structures and/or monitoring locations based on the proposed blasting plan and distances to adjacent structures and/or monitoring locations.
5. Name and qualifications of individual responsible for the design of the blasting program.
6. Description of audible warning system to be used.
7. Description of the notifications program required to property owners and utilities, including demonstration of how it complies with the relevant state, local and utility blasting requirements.

D. Submit a monitoring plan prepared by the Seismic Monitoring Subcontractor with the coordination of the Blasting Subcontractor. The monitoring plan shall include the following:
1. Specifications of proposed instruments used to monitor ground vibrations and air overpressure. Submit calibration documents from within the past year.
2. Plan indicating Blasting and Seismic Monitoring locations relative to existing buildings and/or other structures.

E. Submit copy of blasting permits prior to beginning blasting operations.

F. Submit pre-blast survey documentation/report.

G. Submit post-blast survey documentation/report.

H. All shop drawings shall submitted for information only.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Explosive charges and detonation devices shall be of a type suitable for the intended use. The use of blasting materials shall meet the manufacturer's specifications and safety requirements.

PART 3 - EXECUTION

3.1 PRE-BLAST SURVEY

A. Prior to commencing blasting operations and prior to installing excavation support systems, a pre-blast survey shall be conducted, and may be attended by the General Contractor, Blasting Subcontractor, Engineer, and Owner.

B. The structures to be surveyed shall be within 250 feet in all directions from the edge of each blasting locale as shown on the seismic monitoring plan. Structures to be surveyed, and their distance from the blast site may be influenced by the blast design, predicted vibration level and site-specific public relations requirements.

C. The pre-blast survey shall include color photographs and/or high-definition videos of all structures, buildings (including items such as bridges, dams, etc.) and water supply wells within the pre-blast survey zone. The photos and videos shall include both the exterior of each building and structure and all accessible interior rooms of each building, at the discretion of the property owner. All photos shall have the date permanently imprinted on the image.

1. A minimum of 2 attempts shall be made to request access and entry to all applicable properties. Maintain written documentation of request denials for interior and exterior inspections.

D. Prior to blasting, all wells shall be documented and tested as follows:

1. Flow test to measure the yield.
2. Water quality tests by a State certified laboratory for nitrate, nitrite and turbidity.

E. The Owner will coordinate access for survey work on adjacent properties.

F. The Pre-Blast Survey Subcontractor shall submit a final report, which shall include the following:

1. Dated photographs with written identification of each, and/or high-definition video of all buildings and other structures surveyed.
2. A written report shall be submitted a minimum of one week prior to commencement of blasting operations or excavation support system installation. The report will be made available to property owners on an as needed basis, with the cost borne by the Owner. The report shall include the following for each building, other structure, and wells:
    a. Location and description.
    b. Description of the overall condition.
    c. Noted physical deficiencies, cracks, pertinent elevations and other physical conditions that could be potentially affected by blasting operations.
    d. Yield and water quality test results of each water supply well.

e. Written documentation of attempts made to gain access and entry to any properties where access was denied and/or where only exterior inspection was conducted from the property line.

3.2 PERFORMANCE - GENERAL

A. Drilling and blasting materials and methods shall be those necessary to accomplish ledge excavation required for completion of the work indicated on the Contract Drawings.

B. Blasting shall not commence until the pre-blast survey has been completed and submitted.

C. All explosives shall be stored and handled in a secure manner, in compliance with all Local, State and Federal laws, ordinances, and code requirements. Storage locations shall be legibly marked (vehicles placarded), and daily-use quantities limited to such quantities as may be needed for the current workday, including those necessary for changing site conditions. Explosives shall not be stored on site during non-working hours.

D. All blasting shall be performed in accordance with all Local, State and Federal laws, ordinances and code requirements.

E. All blasting areas shall be properly identified with appropriate signs or identification markers as required by law. Blasting signs notifying those approaching the blast site shall be placed at each entrance to the site or blasting area. Blasting notification signs shall be left in place while the above conditions prevail. Immediately remove signs after blasting operations have been completed.

F. All blasting shall be conducted within the hours of 8:00 a.m.– 5:00 p.m. from Monday through Friday. Any and all blasting outside of these time limits shall be subject to approval from the Owner, and shall be in compliance with all Local, State and Federal laws, ordinances and code requirements.

G. All safety precautions shall be taken to protect individuals in the direct vicinity of the blasting operations. Blasting mats or other means to prevent flying rock shall be utilized.

H. Conduct blasting operations such that damage is prevented to adjacent buildings, other structures, water supply wells, public domain, natural resources and habitat. Acceptable peak particle velocity limits and peak air overpressure limits shall not be exceeded.

I. General Contractor shall notify each property owner and public utility company with buildings or other structures within a minimum 500-foot radius of the site work at least 10 days prior to initiating pre-blast surveys to enable the owners to take such steps as they may deem necessary to protect their property. The actual blasting program to be implemented may require notification beyond the 500-foot radius. .

J. General Contractor shall notify the Engineer at least 72 hours prior to commencing blasting operations.

K. An audible warning system shall be employed to warn all persons on site of blasting operations. Do not perform blasting work until the area is cleared and secure. Take appropriate precautions to prevent individuals from entering the blasting area. Provide sufficient flagmen outside the danger zone to stop all approaching traffic and pedestrians. The audible system shall include a warning that blasting is to commence, and notification that blasting is complete. Signs explaining the audible warning system shall be posted prior to blasting.

L. When blasting in areas where rock removal is required adjacent to and below existing structures, care shall be taken at the excavation limits to minimize over-blasting (back break or side break) and fracturing of remaining rock. Hydraulic hammer line drilling, presplit, or other means may be required to minimize the impact to the remaining rock relative to the site-specific conditions and geologic structure.

M. Perform at least one controlled test blast prior to commencement of production blasting in order to substantiate, or if necessary adjust, the proposed blast design to ensure vibration and overpressure limits are not exceeded. Coordinate scheduling of test blast/s with Engineer.

3.3 VIBRATION CONTROL

A. All blasting operations shall be conducted to limit ground vibrations to acceptable limits to help ensure that adjacent structures and buildings are not damaged.

B. Acceptable ground vibration limits shall be:

1. The following vibration limits (Peak Particle Velocity in inch/sec) shall be adhered to based upon the USBM Alternative Blasting Level Criteria (adopted from RI 8507, 1980) relative to vibration frequency of blasts:
   a. Greater than 40 Hz - Maximum PPV = 2.0 in/s
   b. Greater than 30 Hz but not more than 40 Hz - Maximum PPV = 1.5 in/s
   c. Greater than 20 Hz but not more than 30 Hz - Maximum PPV = 1.0 in/s
   d. Not more than 20 Hz - Maximum PPV = 0.5 in/s

C. The peak air overpressures measured at the nearest above grade occupied structure shall not exceed 133 dB (0.014 psi).

D. Blasting shall not be permitted less than 72 hours after completion of any and all concrete placements within 250 feet. Blasting shall not be permitted less within 100 feet of freshly placed concrete until such concrete has cured for a minimum of 72 hours and has attained 33% of its 28-day design strength.

E. Adherence to the above listed limits shall not relieve the Contractor of the responsibility to protect existing structures.

F. If these values are exceeded, Contractor shall stop blasting and submit a revised blasting plan. The revised blasting plan shall indicate why the limits were exceeded and indicate what changes will be made to prevent future exceedances.

3.4 BLASTING DOCUMENTATION (BLAST LOGS)

A. The Blasting Subcontractor shall prepare and maintain copies of all blasting logs which shall include, but not be limited to, the following information:

1. Date, time and location of blast.
2. Diagram of blast pattern showing the number, diameter, depth, subdrill, distribution, and powder factor for the explosives used per hole and per blast.
3. Sequence and schedule of blasting rounds and delay pattern.
4. Blast evaluations.
5. Weather and temperature conditions.

B. For each blast at all blast sites, the Seismic Monitoring Subcontractor shall monitor the blasting vibrations and overpressures at a minimum of two buildings or other structures within 250 feet of each blast. This may be adjusted dependent upon the blast design and site-specific conditions as deemed necessary. One monitoring location shall be the nearest structure. Monitoring locations shall preferably be in different directions from the blast. The buildings or other structures to be monitored

shall be mutually agreed upon by the Engineer, General Contractor, and Blasting Subcontractor. Blast monitoring shall commence just before the blasts are set off. Record vibration and overpressure measurements, which shall include, but not be limited to:

1. Identification of monitoring instrument, and serial number.
2. Calibration certificate dated within the past year.
3. Name of instrument operator.
4. Building or other structure at which the monitoring instrument is located, and distance from such structure.
5. Distance and direction of monitoring instrument from blast site.
6. Date and time of reading.
7. Type of ground at recording station.
8. Peak particle velocity and frequency for all components (vertical, radial and perpendicular).
9. Values of air overpressure.
10. Printed copies of measurement readings.
11. Blast vibration and air overpressure measurement records shall be made available to Owner and Engineer on a weekly basis as deemed necessary, or as requested.

C. Crack Monitors:

1. Where required, crack monitors shall be installed by the Seismic Monitoring Subcontractor. They may be required on structures that are within the zone of displacement or heave of the blast (within 20 feet), and/or at cracks in concrete and/or masonry that are greater than 1/16 inches (1.6 mm) wide and within 250 feet of the blast area. Crack monitor locations shall be as determined by the Engineer, Contractor, Blasting Subcontractor, or Seismic Monitoring Subcontractor. All crack monitors shall be documented on plans of the buildings or structures with reference numbers for each monitor.
2. All cracks shall be measured and documented prior to commencement of blasting. Crack widths shall be measured to the nearest 0.10 millimeters.

3.5 POST-BLAST SURVEY

A. After conclusion of all blasting work, perform a post-blast survey shall be conducted at all building, structures and water supply wells that were part of the pre-blast survey. The survey may be attended by the General Contractor, Blasting Subcontractor, Engineer, and Owner. A report comparing the pre and post-blast conditions shall be provided.

3.6 DAMAGE TO STRUCTURES AND BUILDINGS

A. The General Contractor shall be responsible for all damages caused by blasting operations regardless of the adherence to specified vibration limits.

B. Such damage shall be repaired by the General Contractor at no additional cost to the Owner. The General Contractor shall submit proposed repairs, which shall be reviewed by the Engineer with no exceptions taken. Damages shall be defined as:

1. Physical damage to the structure or building.
2. Newly formed cracks in concrete or masonry.
3. Substantial increase in width and/or length of existing cracks in concrete or masonry.

4. Structure or building movement.
5. Reduction in water supply well yield or water quality.

C. The extent of damages caused by blasting operations shall be determined by the Engineer. The Engineer will notify the General Contractor in writing of all damages caused by blasting operations. Disputes shall be resolved based on review of the pre-blast and post-blast surveys, seismic readings, etc.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Work described by this Section consists of all earthwork encountered and necessary for construction of the project as indicated in the Contract Documents, and includes but is not limited to the following:
   1. Excavation
   2. Backfilling and Filling
   3. Compaction
   4. Embankment Construction
   5. Grading
   6. Providing soil material as necessary
   7. Disposal of unsuitable materials
   8. Disposal of excess suitable material

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
   1. All work shall be performed and completed in accordance with all local, state and federal regulations.
   2. The General Contractor shall secure all other necessary permits unless otherwise indicated from, and furnish proof of acceptance by, the municipal and state departments having jurisdiction and shall pay for all such permits, except as specifically stated elsewhere in the Contract Documents.

B. Line and Grade:
   1. The Contractor shall establish the lines and grades in conformity with the Drawings and maintain same to properly perform the work.

C. Testing Methods:
   1. Gradation Analysis: Where a gradation is specified the testing shall be in accordance with ASTM C117 and ASTM C136 (or latest revision).
   2. Compaction Control:
      a. Unless otherwise indicated, wherever a percentage of compaction for backfill is indicated or specified, it shall be the in-place density divided by the maximum density and multiplied by 100. The maximum density shall be the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using 10-lb. Hammer and 18-in. Drop, Designation D1557 (Modified Proctor), or latest revision, unless otherwise indicated.

b. The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in Place by the Sand Cone method, Designation D1556, (or latest revision) or Nuclear method Designation D6938.
c. Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D6938 (Standard Proctor).
d. An Independent Testing Laboratory will be retained by the Owner to conduct all laboratory and field soil sampling and testing, and to observe earth work and foundation construction activities. Laboratory testing will consist of sieve analyses, natural water content determinations, and compaction tests. Field testing will consist of in-place field density tests and determination of water contents.

1.4 SUBMITTALS

A. Collection of samples and testing of all materials for submittals shall be performed by the Independent Testing Laboratory and paid for by the Contractor until the materials are approved by the Owner or Engineer.
B. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
C. Submit test results (including gradation analysis) and source location for all borrow material to be used at least 10 working days prior to its use on the site. Contractor shall identify and provide access to borrow sites.
D. Submit moisture density curve for each type of soil (on site or borrow material) to be used for embankment construction or fill beneath structures or pavement.

1.5 TESTS

A. The Independent Testing Laboratory shall conform to the procedures and standards listed below. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
B. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the Engineer and Contractor at the Owner's expense unless otherwise indicated (see Section 01400 - Quality Control).
C. Field density tests on embankment materials shall be as follows:
D. Tests shall be taken on every 200 cubic yards of embankment material.
E. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.
F. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.
G. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the Engineer.
H. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the Engineer.
I. Additional density testing will be required by the Engineer if the Engineer is not satisfied with the apparent results of the Contractor's compaction operation.

1. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary, at no additional cost to the Owner, to obtain the required compaction. No allowance will be considered for delays in the performance of the work.
2. Reconciliation of re-testing costs are specified in Section 01400.

1.6 JOB CONDITIONS

A. Site Information:
   1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner and Engineer will not be responsible for interpretations or conclusions drawn there from by the Contractor. Data are made available for the convenience of Contractor.
   2. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.

B. Existing Utilities and Structures:
   1. The locations of utilities and structures shown on the Drawings are approximate as determined from physical evidence on or above the surface of the ground and from information supplied by the utilities. The Engineer in no way warranties that these locations are correct. It shall be the responsibility of the Contractor to determine the actual locations of any utilities or structures within the project area.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

A. Aggregate Subbase (MDOT 703.06 Type D): Shall be screened or crushed gravel of hard durable particles free from vegetable matter, lumps or balls of clay and other deleterious substances. Type B Aggregate for base shall not contain particles of rock that will not pass the 3 inch square mesh sieve. The gradation of the part that passes a 3-inch sieve shall meet the following grading requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1/2 inch	35-80
1/4 inch	25-65
No. 40	0-30
No. 200	0-7.0

B. Aggregate Base (MDOT 703.06 Type A): Shall be screened or crushed gravel consisting of hard durable particles which are free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the material shall meet the grading requirements of the following table:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
1/2 inch	45-70
1/4 inch	30-55
No. 40	0-20
No. 200	0-6.0

C. Underdrain Backfill Material (MDOT 703.22 Type B): Shall be stone material consisting of hard durable particles which are free from vegetable matter, lumps or balls of clay and other deleterious substances. The gradation of the material shall meet the grading requirements of the following table:

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
1 inch	95-100
1/2 inch	75-100
No. 4	50-100
No. 20	15-80
No. 50	0-15
No. 200	0-5.0

D. Common Borrow: Shall consist of approved material required for the construction of the work where designated. Common borrow shall be free from frozen material, perishable rubbish, peat, organic, and other unsuitable material.

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
6-inch	100
No. 200	0-5

Common borrow may be used for embankments unless otherwise indicated and provided that the material is at a moisture content suitable for compaction to the specified density. No rocks shall exceed 3/4 of the depth of the specified lift thickness.

E. Crushed Stone: Shall be a uniform material consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, containing angular pieces, as are those which come from a mechanical crusher. Gradation requirements shall be as follows:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 4	0-10

F. Screened Stone: Shall be a well graded stone consisting of clean, hard, and durable particles or fragments, free from vegetable or other objectionable matter, meeting the following gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
1 inch	100
3/4 inch	90-100
3/8 inch	20-55
No. 4	0-10
No. 8	0-5

G. Select Fill (Structural Fill): Shall consist of well graded granular material free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and having no rocks with a maximum dimension of over 4 inches and meeting the following gradation requirements, except where it is used for pipe bedding in which case the maximum size shall be 2 inches.

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
4 inch	100
3 inch	90-100
¼ inch	25-90
No. 40	0-30
No. 200	0-5

H. Sand: Shall be well graded durable material free of organic matter and conform to the following gradation requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieve
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No.100	2-10
No.200	0-5

Sand conforming to the requirement for fine aggregate in ASTM Standard Specifications for Concrete Aggregate, Designation C-33, will meet the above requirement.

2.2 FILTER FABRIC

A. If filter fabric is required, refer to Section 02260.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which excavating, backfilling, filling, compaction and grading are to be performed 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 EXCAVATION

A. General:
   1. Excavation consists of removal and disposal of all material encountered when establishing line and grade elevations required for execution of the work.
   2. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all cofferdamming, pumping, and draining; and shall render the bottom of the excavations firm, dry and acceptable in all respects.
   3. All excavation shall be classified as either earth or ledge.
      a. Earth Excavation shall consist of the removal, hauling and disposal of all earth materials encountered during excavation including but not limited to native soil or fill, pavement (bituminous or concrete), existing sewers and manholes, ashes, loam, clay, swamp muck, debris, soft or disintegrated rock or hard pan which can be removed with a backhoe, or a combination of such materials, and boulders that do not meet the definition of "Ledge" below.
      b. Ledge Excavation: Shall consist of the removal, hauling, and disposal of all ledge or rock encountered during excavation. "Ledge" and "rock" shall be defined as any natural compound, natural mixture that in the opinion

of the Engineer can be removed from its existing position and state only by drilling and blasting, wedging, sledging, boring or breaking up with power operated tools. No boulder, ledge, slab, or other single piece of excavated material less than two cubic yards in total volume shall be considered to be rock unless, in the opinion of the Engineer it must be removed from its existing position by one of the methods mentioned above.

4. The Contractor shall not have any right of property in any materials taken from any excavation. Do not remove any such materials from the construction site without the approval of the Engineer. This provision shall in no way relieve the Contractor of his obligations to remove and dispose of any material determined by the Engineer to be unsuitable for backfilling. The Contractor shall dispose of unsuitable and excess material in accordance with the applicable sections of the Contract Documents.

B. Additional Excavation: When excavation has reached required subgrade elevations, notify the Engineer and Resident Project Representative who will observe the conditions.
   1. If material unsuitable for the structure or paved area or pipeline (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, screened stone, crushed stone, or concrete as directed by the Engineer.
   2. All excavated materials designated by the Engineer as unsuitable shall become the property of the Contractor and disposed of at locations in accordance with all State and local laws and the provisions of the Contract Documents.

C. Unauthorized Excavation: Shall consist of removal of materials beyond indicated subgrade elevations or dimensions without specific authorization of Engineer. Unauthorized excavation, as well as remedial work required by the Engineer shall be at the Contractor's expense. Remedial work required is as follows:
   1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with select fill or screened stone compacted to 95%. Provide 12" minimum select fill or screened stone directly under footings. Concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
   2. If the bottom of a trench is excavated beyond the limits indicated, backfill the resulting void with thoroughly compacted screened stone, unless otherwise indicated.
   3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

D. Structural Excavation:
   1. Shall consist of the removal, hauling, disposal, of all material encountered in the excavation to permit proper installation of structures.
   2. Excavations for structures shall be carried to the lines and subgrades shown on the Drawings.

3. Excavate areas large enough to provide suitable room for building the structures.
4. The extent of open excavation shall be controlled by prevailing conditions subject to any limits designated by the Engineer.
5. Provide, install, and maintain sheeting and bracing as necessary to support the sides of the excavation and to prevent any movement of earth which could diminish the width of the excavation or otherwise injure the work, adjacent structures, or persons and property in accordance with all state and OSHA safety standards.
6. Erect suitable fences around structure excavation and other dangerous locations created by the work, at no additional cost to the Owner.
7. Exposed subgrade surfaces shall remain undisturbed, protected, and maintained as uniform, plane areas and shape to receive the foundation components of the structure.
    a. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
    b. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade and trim bottoms to required lines and grades to leave solid base to receive the structure.
    c. If a structure is to be constructed within the embankment, the fill shall first be brought to a minimum of 3 feet above the base of the footing. A suitable excavation shall then be made as though the fill were undisturbed earth.

E. Trench Excavation: Shall consist of removal, hauling and disposal of all material encountered in the excavation to the widths and depths shown on the Drawings to permit proper installation of underground utilities.
1. Excavate trenches to the uniform width shown on the Drawings sufficiently wide to provide sufficient space for installation, backfilling, and compaction. Every effort should be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.
3. Grade bottoms of trenches as indicated for pipe and bedding to establish the indicated slopes and invert elevations, notching under pipe joints to provide solid bearing for the entire body of the pipe, where applicable.
4. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least two feet above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.
5. Unless otherwise specifically directed or permitted by the Engineer, begin excavation at the low end of sewer and storm lines and proceed upgrade.
6. Perform excavation for force mains and water mains in a logical sequence.

7. The extent of open excavation shall be controlled by prevailing conditions subject to any limits prescribed by the Engineer.
8. As the excavation progresses, install such shoring and bracing necessary to prevent caving and sliding and to meet the requirements of the state and OSHA safety standards, as outlined in the appropriate section of this Specification.

F. Protection of Persons, Property and Utilities:
1. Barricade open excavations occurring as part of this work and post with warning lights in compliance with local and State regulations.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations. Exercise extreme caution and utilize sheeting, bracing, and whatever other precautionary measures that may be required.
3. Rules and regulations governing the respective utilities shall be observed in execution of all work. Active utilities and structures shall be adequately protected from damage, and removed or relocated only as indicated or specified. Inactive and abandoned utilities encountered in excavation and grading operations shall be removed, plugged or capped only with written authorization of the utility owner. Report in writing to the Engineer, the locations of such abandoned utilities. Extreme care shall be taken when performing work in the vicinity of existing utility lines, utilizing hand excavation in such areas, as far as practicable.
4. Repair, or have repaired, all damage to existing utilities, structures, lawns, other public and private property which results from construction operations, at no additional expense to the Owner, to the complete satisfaction of the Engineer, the utility, the property owner, and the Owner.

G. Use of Explosives:
1. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction and the Owner. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.
2. All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.

H. Stability of Excavations:
1. Slope sides of excavations to comply with all codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

I. Shoring and Bracing:
1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
2. Provide trench shoring and bracing to comply with local codes and authorities having jurisdiction. Refer to Specification Section 02156.

3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Install shoring and bracing as excavation progresses.

J. Material Storage:
   1. Stockpile excavated materials which are satisfactory for use on the work until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and protect with temporary seeding or other acceptable methods to control erosion.
   2. Locate and retain soil materials away from edge of excavations.
   3. Dispose of excess soil material and waste materials as herein specified.

K. Dewatering:
   1. To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavations (including surface and subsurface waters).
   2. Excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged. Refer to Specification Section 02140.

L. Cold Weather Protection:
   1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
   2. No frozen material shall be used as backfill or fill and no backfill shall be placed on frozen material.

M. Separation of Surface Material:
   1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work.
   2. Prior to excavation, existing pavement shall be cut where in the opinion of the Engineer it is necessary to prevent damage to the remaining road surface.
   3. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
   4. From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.

N. Dust Control:
   1. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. Refer to Specification Section 01562.
   2. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the contractor shall furnish and spread the material, as directed.

3.3 BACKFILL AND FILL

A. General:
   1. Backfilling shall consist of replacing material removed to permit installation of structures or utilities, as indicated in the Contract Documents.

2. Filling shall consist of placing material in areas to bring them up to grades indicated on the Drawings.
3. The Contractor shall provide and place all necessary backfill and fill material, in layers to the required grade elevations.
4. Backfill excavations as promptly as work permits, but not until completion of the following:

    a. Acceptance by Engineer of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
    b. Inspection, approval, and recording locations of underground utilities.
    c. Removal of concrete formwork.
    d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
    e. Removal of trash and debris.
    f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
    g. Density testing having results meeting requirements specified herein.
5. In general, and unless otherwise indicated, material used for backfill of trenches and excavations around structures shall be suitable excavated material which was removed in the course of making the construction excavation. Unless otherwise specified or allowed by the Engineer the backfill and fill shall be placed in layers not to exceed 8 inches in thickness.
6. All fill and backfill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on the Drawings. The fill and backfill materials shall be placed in layers not exceeding 8 inches in thickness.
7. All structures (including manholes) shall be placed on a 6-inch mat of screened stone unless otherwise indicated.
8. Suitable excavated material shall meet the following requirements:
    a. Free from large clods, silt lumps or balls of clay.
    b. Free from stones and rock fragments with larger than 12 inch max. dimension.
    c. Free from organics, peat, etc.
    d. Free from frozen material.
9. If sufficient suitable excavated material is not available from the excavations, and where indicated on the Drawings, the backfill material shall be select fill or common borrow, unless otherwise indicated, as required and as directed by the Engineer.
10. Do not backfill with, or on, frozen materials.
11. Remove, or otherwise treat as necessary, previously placed material that has frozen prior to placing backfill.
12. Do not mechanically or hand compact material that is, in the opinion of the Engineer, too wet.

13. Do not continue backfilling until the previously placed and new materials have dried sufficiently to permit proper compaction.
14. The nature of the backfill materials will govern the methods best suited for their placement and compaction. Compaction methods and required percent compaction is covered in Compaction section.
15. Before compaction, moisten or aerate each layer as necessary to provide a water content necessary to meet the required percentage of maximum dry density for each area classification specified.
16. Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.
17. Place material in a manner that will prevent stones and lumps from becoming nested.
18. Completely fill all voids between stones with fine material.
19. Do not place backfill on or against new concrete until it has attained sufficient strength to support loads without distortion, cracking, and other damage.
20. Deposit backfill and fill material evenly on all sides of structures to avoid unequal soil pressures.
21. Keep stones or rock fragments with a dimension greater than two inches at least one foot away from the pipe or structure during backfilling.
22. Leave sheeting in place when damage is likely to result from its withdrawal.
23. Completely fill voids left by the removal of sheeting with screened stone which is compacted thoroughly.

B. Pipe Bedding, Initial Backfill and Trench Backfill:
1. Place bedding and backfill in layers of uniform thickness specified herein, and as shown on the Drawings.
2. Thoroughly compact each layer by means of a suitable vibrator or mechanical tamper.
3. Install pipe bedding and initial backfill in layers of uniform thickness not greater than eight (8) inches.
4. Deposit the remainder of the backfill in uniform layers not greater than eight inches.
5. Provide underground utility marking tape for new utility trenches as shown on the Drawings. Refer to Section 02650 – Buried Utility Markings.
6. Where soft silt and clay soils are encountered the trench shall be excavated six inches below the normal bedding and backfilled with 6-inches of compacted sand.
7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footings.
8. The following schedule lists the bedding materials for various types of pipe. Refer to the pipe trench detail for dimensional requirements.

BEDDING REQUIREMENTS

DI or Concrete Pipe	Screened stone
PVC or PE Pipe	Screened stone

9. The following schedule lists the initial backfill requirements for various types of pipes. Refer to the pipe trench detail for dimensional requirements.

INITIAL BACKFILL REQUIREMENTS

DI or Concrete, Pipe	Screened stone
PVC or PE Pipe	Screened stone

10. Special bedding and backfill requirements shown on the Drawings supersede requirements of this section.
11. Where pipes or structures pass through or under the impervious core of the lagoon embankments, bedding and backfill material shall consist of the impervious embankment material. Extra care should be given to properly and thoroughly compact the bedding material around the pipe.

C. Improper Backfill:
1. When excavation and trenches have been improperly backfilled, and when settlement occurs, reopen the excavation to the depth required, as directed by the Engineer.
2. Refill and compact the excavation or trench with suitable material and restore the surface to the required grade and condition.
3. Excavation, backfilling, and compacting work performed to correct improper backfilling shall be performed at no additional cost to the Owner.

D. Ground Surface Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, scarify or break-up sloped surface steeper than 1 vertical to 4 horizontal.
2. When existing ground surface has a density less than that specified under "compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.4 COMPACTION

A. General:
1. Control soil compaction during construction to provide not less than the minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D1557 as indicated.
    a. Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).
    b. Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D1557).
    c. Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density (ASTM D1557).
    d. Roadways, Drives and Paved Areas: Compact each layer of fill, subbase material, and base material to at least 95% of maximum dry density (ASTM D1557).
    e. Pipes: Compact bedding material and each layer of backfill to at least 90% maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.
    f. Embankments: Compact each layer of embankment material to at least 95% of maximum dry density (ASTM D1557).

C. Moisture Control:
1. Where subgrade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, in quantities controlled to prevent free water appearing on surface during or subsequent to compaction operations.
2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory level.

D. Compaction Methods: The Contractor may select any method of compaction that is suitable to compact the material to the required density.
1. General: Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.
2. Tamping or Rolling: If the material is to be compacted by tamping or rolling, the material shall be deposited and spread in uniform, parallel layers not exceeding the uncompacted thicknesses specified. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the excavation side slopes, as well as in all other portions of the fill area, is thoroughly compacted. When the excavation width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe or structure, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping or rolling, the rate at which

backfilling material is deposited shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor.

E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5 GRADING:

A. General:
   1. Grading shall consist of that work necessary to bring all areas to the final grades.
   2. Uniformly grade areas within limits of work requiring grading, including adjacent transition areas.
   3. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:
   1. Grade areas adjacent to building to drain away from structures and to prevent ponding.
   2. Grade surfaces to be free from irregular surface changes, and as follows:
      a. Lawn or Unpaved Areas: Finish grade areas to receive topsoil to within not more than 1" above or below the required subgrade elevations.
      b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1/2" above or below the required subgrade elevation.
      c. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 3/8" above or below the required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs:
   1. Grade surface to be smooth and even, free of voids, and compacted as specified, to the required elevation.
   2. Provide final grades within a tolerance of 1/2" when tested with a 10' straight edge.

D. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

E. Protection of Graded Areas:
   1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
   2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

3.6 BASE COURSE AND LEVELING COURSE

A. General:
   1. Base course consists of placing the specified materials in layers to support a leveling course or paved surface, as indicated in the Drawings.

B. Grade Control:
   1. During construction, maintain lines and grades including crown and cross-slope of base course and leveling course.

C. Placing:
   1. Place base course on prepared subbase conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base materials.
   2. Place leveling course on prepared base course, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compaction.

D. Shaping and Compacting:
   1. All layers of aggregate base course and leveling course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed.
   2. The Contractor shall bear full responsibility for and make all necessary repairs to the base leveling courses and the subgrade until the full depth of the base leveling courses is placed and compacted. Repairs shall be made at no additional cost to the Owner.
   3. If the top of any layer of the aggregate base or leveling course becomes contaminated by degradation of the aggregate or addition of foreign materials, the contaminated material shall be removed and replaced with the specified material at the Contractor's expense.

END OF SECTION

SECTION 02225

FLOWABLE FILL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install flowable fill material in authorized excavation(s) as shown on the Drawings and/or as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with ACI 229, Controlled Low-Strength Materials, or as specified here-in.

1.4 SUBMITTALS

A. Submit Mix designs for each mixture to be provided at least 15 days prior to production.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Materials shall meet the following requirements:
   1. Portland Cement, Type I or II - ASTM C150.
   2. Fly Ash (LOI limits do not apply) - ASTM C618.
   3. Fine Aggregate/Mineral Filler – ASTM C 33, ASTM or non-ASTM sands or mineral fillers with 100% passing the 1/2" sieve may be considered which produce an acceptable flow and desired performance characteristic. Soils with fine clays will not be considered. All other than ASTM C 33 materials must receive prior approval from the Engineer.
   4. Air Entraining Admixtures - As Per Manufacturer's Specifications.
   5. Light Weight Cellular Admixture - As Per Manufacturer's Specifications.
   6. Water – Potable or ASTM C 94.
   7. Preformed Foam – Procedures for evaluation ASTM C 796 and ASTM C 869.

B. Standard Flowable Fill:
   1. Compressive strength at 28 days less than 1200 psi

C. Excavatable Flowable Fill:
   1. Compressive strength at 28 days between 100-200 psi.
   2. Mix:
      a. Portland Cement: 50-100 lb/yd3
      b. Fly Ash: up to 350 lb/yd3, lime content not to exceed 10% by weight.
      c. Fine Aggregate/Mineral Filler: 2000-3000 lb/yd3
      d. Water: 325-600 lb/yd3, for Class F fly ash and cement-only mixtures up to 1000 lb/yd3 may be acceptable.

D. Low Density Flowable Fill:
   1. The preformed foam shall produce stable air cells capable of resisting the chemical and physical forces imposed during mixing, placing and setting.
   2. Submit the foaming agent Manufacturer's recommended mixing procedures and approved mixing equipment to the Engineer.
   3. Methods of placement must not cause a change in density due to loss of air content beyond predictable ranges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Flowable fill shall be produced and delivered using standard concrete construction equipment and practices.
B. Placing flowable fill shall be by chute, pumping, or other method approved by the Engineer.
C. The flowable fill shall be discharged directly from the mixer truck into the space to be filled.
D. No flowable fill shall be placed on frozen ground.
E. At the time of placement the flowable fill shall have a temperature of at least 40 degrees F.
F. When flowable fill is placed in freezing temperatures, the material should be covered with blankets and protected from freezing until hardening.
G. The Contractor shall provide all necessary means to confine the material within a designated space.
H. Formed walls or other bulkheads shall be constructed to withstand hydrostatic pressure exerted by flowable fill where necessary and as determined by the Engineer.
I. The Contractor is responsible to ensure underground utilities, including but not limited to pipes, tanks, structures, cables, etc. are secured to prevent floating.
J. No compaction or vibration of the material is required.
K. Where flowable fill is being used as pipe bedding it shall be placed in lifts to ensure lateral support of the pipe develops along the side of the pipe before continuing with the backfilling.
L. When paving over flowable fill in cold weather, any frozen material on the surface shall be scraped off and removed prior to paving.
M. The flowable fill shall be left undisturbed until the material obtains sufficient strength. Sufficient strength for paving is achieved when the flowable fill can support the weight of foot traffic without apparent deformation. Sufficient strength for supporting vehicular traffic is 2.5 tons per square foot as measured by a pocket penetrometer.
N. Trenches shall be covered and barricaded until hardening occurs.

END OF SECTION

SECTION 02260

FILTER FABRIC

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish all materials and install filter fabric of the types, dimensions and in the location(s) shown on the Drawings and specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. A competent laboratory must be maintained by the manufacturer of the fabric at the point of manufacture to ensure quality control.

B. During all periods of shipment and storage, the fabric shall be wrapped in a heavy duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140°F, mud, dirt, dust and debris.

1.4 SUBMITTALS

A. Manufacturer shall furnish certified test reports with each shipment of material attesting that the fabric meets the requirements of this Specification

PART 2 - PRODUCTS

2.1 MATERIALS

A. Filter fabric for use in stabilization, drainage, underdrains, landscaping and beneath structures shall be formed in widths of not less than six (6) feet and shall meet the requirements of Table 1. Both woven and non-woven geotextiles are acceptable; however no "slit-tape" woven fabrics will be permitted for drainage, underdrain, and erosion control applications.

TABLE 1

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength	ASTM D4632	120 pounds
Grab Elongation	ASTM D4632	50 percent
CBR Puncture Strength	ASTM D6241	310 pounds
Trapezoid Tear Strength	ASTM D4533	50 pounds
Water Flow Rate	ASTM D4491	120 gal/min/sf
Equivalent Opening Size (EOS)	ASTM D4751	U.S. Std. Sieve #80
Coefficient of Permeability	ASTM D4491	0.2 cm/sec

The geotextile shall have property values expressed in "typical" values that meet or exceed the values stated above as determined by the most recent test methods specified above.

B. Filter fabric for use in reinforcement shall meet the requirements of Table 2. Woven and non-woven geotextiles are acceptable.

TABLE 2

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Wide Width Tensile Strength	ASTM 4595	195 pounds
Grab Tensile Strength	ASTM 4632	195 pounds
Grab Elongation	ASTM D4632	20 percent
CBR Puncture Strength	ASTM D6241	700 pounds
Trapezoid Tear Strength	ASTM D4533	85 pounds
Equivalent Opening Size (EOS)	ASTM D4751	U.S. Std. Sieve number(s) between #20 and #100

The geotextile shall meet or exceed the "typical" values stated above as determined by the most recent test methods specified above.

C. Filter Fabric for use under riprap shall meet the requirements as specified in Section 02271 - Riprap and Stone Ditch Protection.

D. For Silt Fence, refer to Section 02270 - Temporary Erosion Control Execution

PART 3 - EXECUTION

3.1 Install filter fabric as shown on the drawings or as directed in appropriate specifications in this division or in accordance with manufacturer's instructions or as directed by the engineer.

END OF SECTION

SECTION 02270

TEMPORARY EROSION CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices, as specified herein, as shown on the Drawings and as directed by the Engineer.
   2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices, or as required to control erosion that occurs during normal construction operations.
   3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.
   4. After awarding of or after being awarded the Contract, prior to commencement of construction activities, the Contractor will meet with the Engineer to discuss erosion control requirements and develop a mutual understanding relative to details of erosion control.

B. Design Criteria:
   1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
   2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices, as may be necessary, until such time as adequate soil stabilization has been achieved.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material, before beginning construction in accordance with Section 01572. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of his responsibility for completion of the work as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Baled Hay:
   1. At least 14" by 18" by 30" securely tied to form a firm bale, with at least two stakes to hold the bale in place.

B. Sand Bags:
   1. Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

C. Mulches:
   1. Loose hay, straw, peat moss, wood chips, bark mulch, crushed stone, wood excelsior, or wood fiber cellulose.
   2. Type and use shall be as specified by the "Maine Erosion and Sedimentation Control Best Management Practices" prepared by the Maine DEP, herein after referred to as the BMP.

D. Mats and Nettings:
   1. Twisted Craft paper, yarn, jute, excelsior wood fiber mats, glass fiber and plastic film.
   2. Type and use shall be as specified in the BMP.

E. Permanent Seed:
   1. Conservation mix appropriate to the predominant soil conditions as specified in the BMP and subject to approval by the Engineer.

F. Temporary Seeding:
   1. Use species appropriate for soil conditions and season as specified in the BMP and subject to approval by the Engineer.

G. Water:
   1. The Contractor shall provide water and equipment to control dust, as directed by the Engineer.

H. Silt Fence:
   1. Silt Fence shall be one of the commercially available brands, meeting the following requirements:

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength (both directions)	ASTM D-4632	124 pounds
Puncture Strength	ASTM D-4833	60 pounds
Apparent Opening Size	ASTM D-4751	#30
Flow Rate	ASTM D-4491	8 gal/min/ft^2

I. Erosion Control Mix Berm:
   1. Minimum 12” high and 24” wide berm, meeting the following requirements and as specified by the "Maine Erosion and Sedimentation Control Best Management Practices" prepared by the Maine DEP:
      a. Organic matter content between 80-100%, dry weight
      b. Particle size by weight shall be 100% passing a 6” screen and 70-85% passing a 3/4” screen
      c. Organic portion must be fibrous and elongated.
      d. Soluble salts content shall be less than 4.0 mmhos/cm.
      e. pH should be between 5.0-8.0.
      f. Free from refuse, physical contaminants, and material toxic to plant growth such as fly ash or yard scraping.

g. No large portions of silts, clays, or fine sands.
h. Well-graded and may contain rocks less than 4” in diameter.

J. Filter Sock
1. Minimum diameter of 12” woven or non-woven geosynthetic fabric filled with erosion control mix meeting the following requirements and as specified by the "Maine Erosion and Sedimentation Control Best Management Practices" prepared by the Maine DEP:
a. Organic matter content between 80-100%, dry weight
b. Particle size by weight shall be 100% passing a 6” screen and 70-85% passing a 3/4” screen
c. Organic portion must be fibrous and elongated.
d. Soluble salts content shall be less than 4.0 mmhos/cm.
e. pH should be between 5.0-8.0.
f. Free from refuse, physical contaminants, and material toxic to plant growth such as fly ash or yard scraping.
g. No large portions of silts, clays, or fine sands.
h. Well-graded and may contain rocks less than 4” in diameter.

K. Catch Basin Inlet Protection
1. Inserts/Filter Sacks
a. Catch basin inserts/filter sacks made of woven geotextile with rebar lifting handles.
b. Seam strength that meets the following requirements (ASTM D-4884):

Parameter	MARV	Units
Maximum Load	852	Lbs
Maximum Strength	1280	Lb/ft

c. Fabric strength that meets the following requirements (ASTM D-4884):

Property	Test Method	Units	MARV
Grab Tensile	ASTM D-4632	Lbs	281 x 170
Grab Elongation	ASTM D-4632	%	16 x 7
CBR Puncture	ASTM D-6241	Lbs	1005
Trapezoid Tear Strength	ASTM D-4533	Lbs	85 x 61
UV Resistance @ 500 Hours	ASTM D-4355	%	96
AOS	ASTM D-4751	U.S. Sieve	40
Flow Rate	ASTM D-4491	GPM/ft	38.5
Permittivity	ASTM D-4491	Sec. $^{-1}$	0.51

2. Strawbales
a. Surround perimeter of catch basin inlet with straw bales.
b. Stake and embed strawbales 4 inches in ground.
c. Not applicable for use on impervious surfaces.
3. Concrete Blocks
a. 8-inch standard cement blocks placed on their side around the inlet and wrapped in geotextile fabric.

b. Blocks shall be surrounded by ¾-inch minimum and 2-inch maximum clean crushed stone.
c. Not applicable on slopes of more than 5%.

4. Silt Fence with Gravel
   a. Silt fence may be placed around the perimeter of a catch basin and surrounded by ¾-inch minimum and 2-inch maximum clean crushed stone.
5. Sand-Filled Bags
   a. Sand-filled bags butted together around the perimeter of the catch basin inlet.
   b. Bags should be staggered and create a berm with a height no less than 12 inches.

2.2 CONSTRUCTION REQUIREMENTS

A. Temporary Erosion Checks:
   1. Temporary erosion checks shall be constructed in ditches and other locations as necessary.
   2. Baled hay, sand bags or siltation fence may be used in an arrangement to fit local conditions.

B. Temporary Berms:
   1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.

C. Temporary Seeding:
   1. Areas to remain exposed for a time exceeding 3 weeks shall receive temporary seeding as indicated below:

Season	Seed	Rate
Summer (5/15 - 8/15)	Sudangrass	40 lbs/acre
Late Summer/Early Fall	Oats	80 lbs/acre
(8/15 - 9/15)	Annual Ryegrass	40 lbs/acre
Fall (9/15 - 10/1)	Winter Rye	112 lbs/acre
Winter (10/1 - 4/1	Mulch w/Dormant Seed	80 lbs/acre*
Spring (4/1 - 7/1)	Oats	80 lbs/acre
	Annual Ryegrass	40 lbs/acre

* seed rate only

D. Silt Fence shall be supported by posts and installed per the manufacturer's recommendations.
   1. A trench 6-inches in width and 6-inches in depth should be excavated to toe in the bottom of the silt fence. The trench should be backfilled after the silt fence is installed.

E. Mulch All Areas Receiving Seeding:
   1. Use either wood cellulose fiber mulch (750 lbs/acre); or straw mulch with chemical tack (as per manufacturer's specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.

F. Erosion control matting for slopes and ditches shall be anchored with pegs and/or staples per manufacturer's recommendations. Contractor shall provide matting along the flowline of all ditches and swales having a longitudinal slope in excess of 0.01 ft/ft, and on all slopes in excess of 3(H) to 1(V).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Temporary Erosion Checks:
   1. Temporary erosion checks shall be constructed in ditches and at other locations designated by the Engineer. The Engineer may modify the Contractor's arrangement of silt fences, bales and bags to fit local conditions.
   2. Baled hay, silt fences, or sandbags, or some combination, may be used in other areas, as necessary, to inhibit soil erosion.
   3. Siltation fence shall be located and installed as shown on plans or as required to comply with all Federal, State and Local Regulations.
   4. Sedimentation ponds shall be sited and constructed to the grades and dimensions as shown on the Drawings and will include drainage pipe and an emergency spillway.

B. Erosion control matting for slopes and ditches shall be installed where indicated on the Drawings and as required to stabilize the soil until permanent vegetative stabilization is established.

C. Maintenance:
   1. Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the Owner or Engineer for effectiveness of location, installation and condition with corrective action taken by the Contractor, as appropriate.

D. Removing and Disposing of Materials:
   1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of upon approval by Engineer.
   2. When removed, such devices may be reused in other locations, provided they are in good condition and suitable to perform the erosion control for which they are intended.
   3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.
   4. Sedimentation basins, if no longer required, will be filled in, the pipe removed, the surface loamed and grass cover shall be established.

END OF SECTION

SECTION 02485

LOAMING & SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the drawings and protect and maintain seeded areas disturbed by construction work, as directed by the Engineer.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS AND TESTING

A. Seed:
   1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
   2. This certification shall appear in, or with, all copies of invoices for the seed.
   3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and certificates have been approved.
   4. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:
   1. Inform the Engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
   2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
   3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.
   4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
   5. Approval, by the Engineer, to use topsoil for the work will be dependent upon the results of the soils tests.

C. Lime & Fertilizer:
   1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.4 DELIVERY, STORAGE & HANDLING

A. Seed:
   1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
   2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:
   1. Furnish all fertilizer in unopened original containers.
   2. Containers shall be labeled with the manufacturer's statement of analysis.

1.5 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the Engineer, to the proposed planting or to proper grading.

B. Seeding:
   1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
   2. Weather Conditions:
      a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
      b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.
      c. Resume the work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:
   1. All seed used in wetlands shall be Big Bluestem and/or Switch grass as required by the NRPA permit. This seed mix is also required for any disturbance within 25 feet of the stream.
   2. Provide the grass seed mixture approved by the Engineer, having the following composition:

a. Park Mixture:
   i. 50 percent Creeping Red Fescue
   ii. 30 percent Kentucky Bluegrass
   iii. 20 percent Annual Ryegrass
   iv. Add 1 pound White or Dutch Clover per acre
   v. No weed seeds allowed

b. Roadside Mixture:
   i. 50 percent Creeping Red Fescue
   ii. 15 percent Kentucky Bluegrass
   iii. 5 percent White Clover
   iv. 2 percent Red Top
   v. 3 percent Birdsfoot Trefoil
   vi. 25 percent Annual Ryegrass
   vii. Add 1 pound of White or Dutch Clover per acre
   viii. No weed seeds allowed

c. Lawn Areas:

i.	Kentucky 31 Fescue	25 percent
ii.	Chewing Fescue	15 percent
iii.	Creeping Red Fescue	15 percent
iv.	Pennfine Perennial Rye	25 percent
v.	Lynn Perennial Rye	10 percent
vi.	Common Annual Rye	10 percent
vii.	No weed seeds allowed	

3. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.

B. Topsoil:
1. Fertile, friable, natural topsoil typical of the locality, without admixture of subsoil, refuse or other foreign materials and obtained from a well-drained site. Mixture of sand, silt, and clay particles in equal proportions.
2. Free of stumps, roots, heavy of stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, weeds, sticks, brush or other deleterious matter.
3. Not less than 4 percent nor more than 20 percent organic matter.
4. Topsoil depth shall be 4-inches, unless otherwise indicated.

C. Lime:
1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. l00 sieve.
2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. l00 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Fertilizer:
1. Provide a commercial fertilizer approved by the Engineer.

2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
   l0% Available phosphoric acid
   l0% Available potash
   l0% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:
   1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
   2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.
   1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
   2. Apply topsoil to a depth of 4 inches or as directed on areas to be seeded.
   3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions.
   4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:
   1. Grade the areas to be seeded as shown on the Drawings or as directed by the Engineer.
   2. Leave all surfaces in even and properly compacted condition.
   3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:
   1. Uniformly distribute and evenly spread topsoil on the designated areas.
   2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
   3. Correct any irregularities in the surface resulting from topsoiling or other operations to prevent the formation of depressions where water may stand.
   4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, harrowing, or other approved method until the condition of the soil is acceptable to the Engineer. The surface shall be cleared of all debris and or stones one inch or more in diameter.

C. Placing Fertilizer:
   1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
   2. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.
   3. The incorporation of fertilizer may be a part of the tillage operation specified above.

4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:
   1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
   2. Distribute lime at a rate determined from the pH test, to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.

E. Seeding:
   1. Fine rake and level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.
   2. Hydroseeding:
      a. Hydroseeding may be performed where approved and with equipment approved by the Engineer.
      b. Sow the seed over designated areas at a minimum rate of 5 pounds per 1000 square feet.
      c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.
      d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.
   3. Drill Seeding:
      a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
      b. Sow the seed uniformly over the designated areas to a depth of l/2 inch and at a rate of 5 pounds per l,000 square feet.
   4. Broadcast Seeding:
      a. Broadcast seeding may be performed by equipment approved by the Engineer.
      b. Sow the seed uniformly over the designated areas at a rate of 5 pounds per l,000 square feet.
      c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
      d. Cover the seed to an average depth of l/2 inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
      e. Do not perform broadcast seeding work during windy weather.

F. Compacting:
   1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
   2. Compact the entire area immediately after the seeding operations have been completed.
   3. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.

4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

G. Mulching for Permanent Seeding:

1. Apply mulch at the specified rate for the given type and as specified by the "Maine Erosion and Sedimentation Control Best Management Practices" prepared by the Maine DEP.
2. Erosion Control Mix must contain some soil.
3. Hydraulic mulches, such as paper mulch and cellulose fiber, can include seeds, fertilizer, or soil binders.

Maine	
Mulch Type	**Rate**
Straw	2 bales (70-90lbs)/1,000 SF
Erosion Control Mix	<3:1 Slope: 2 inches min. >3:1 Slope: 4 inches min.
Paper Mulch	5 lbs/1,000 SF
Cellulose Fiber	40 lbs/1,000 SF
Erosion Control Blankets	Per manufacturer's instructions
Wood Chips and Bark Mulch	3 inches min.

3.3 PROTECTION & MAINTENANCE

A. Protection:
1. Protect the seeded area against traffic or other use.
2. Erect barricades and place warning signs as needed.

B. Maintenance:
1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with Engineer.
2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed, and shall not necessarily related to Substantial Completion of the General Contract.
4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand for the specified grasses, and shall continue until Acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by Engineer prior to use.

3.4 ACCEPTANCE

A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches (3") in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

SECTION 02513A

BITUMINOUS CONCRETE PAVING (MAINE)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Furnish all plant, labor, equipment and materials required to install bituminous concrete pavement courses, including sidewalks, driveways, temporary and permanent trench paving and restoration of pavement markings as shown on the Drawings and as specified herein.
   2. Remove bituminous asphaltic and/or Portland cement pavement, and replace bituminous asphaltic pavement, base, binder courses and surface courses, including temporary pavement, within the area(s) shown on the Drawings and as directed by the Engineer.
   3. Keep pavement removal to a minimum width suitable for the required construction.
   4. Apply pavement markings to the permanent paving as specified.

B. Work Not Included: Removal and replacement of paving for the convenience of the Contractor will not be considered for payment.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Materials: Use only materials furnished by a bulk bituminous concrete producer regularly engaged in the production of hot mixed, hot laid bituminous concrete.

B. Equipment: Provide, maintain and operate pavers, dump trucks, tandem, 3-wheel and pneumatic tired rollers well suited to the mixtures being placed. Provide, maintain and operate hand equipment as required. When applicable, provide, maintain and operate trimming equipment and materials.

C. Mix Requirements, Method of Placement and Compaction: All mixes shall conform to the State of Maine Department of Transportation's SUPERPAVE mix standards.

1.4 SUBMITTALS

A. A Job Mix Formula approved by the State of Maine Department of Transportation's Central Laboratory in Bangor shall be submitted for each mixture to be supplied at least 15 calendar days prior to production.

B. Delivery slips shall be furnished with each load of mix delivered to the project. Information shall include:
   1. Vehicle identification.
   2. Date.
   3. Project.
   4. Identification of material.
   5. Gross, tare and net weights.

6. Signed by the bituminous concrete producer.
7. Stamped by a licensed public weighmaster.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hot Bituminous Paving Mix:
   1. Refer to paving details for Maine DOT Superpave mix requirements for each area.

B. Composition of Mixtures - Control Points

SIEVE SIZE	GRADING			
	TYPE 25 mm	TYPE 19 mm	TYPE 12.5 mm	TYPE 9.5 mm
	PERCENT BY WEIGHT PASSING - COMBINED AGGREGATE			
37.5 mm	100			
25 mm	90-100	100		
19 mm	-90	90-100	100	
12.5 mm	-	-90	90-100	100
9.5 mm	-	-	-90	90-100
4.75 mm	-	-	-	-90
2.36 mm	15-41	23-49	28-58	32-67
1.18 mm	-	-	-	-
0.60 mm	-	-	-	-
0.30 mm	-	-	-	-
0.075 mm	1-7	2-8	2-10	2-10

C. Tack Coat:
   1. Emulsified type, Grade RS-1, CRS-1, HFMS-1, CSS-1, 1h

D. Pavement markings shall be in accordance with Section 02577.

PART 3 - EXECUTION

3.1 GENERAL

A. Grade Control:
   1. The Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during construction operations.

B. Trench areas shall receive initial paving as the work progresses where trenches are in paved streets. Not more than 300 linear feet of backfill trench shall be left unpaved.

C. Reset all existing manholes to finished grade as required at no additional cost to the Owner.

3.2 PAVEMENT REMOVAL

A. General:
   1. Exercise extreme care in the removal of pavement so that pavement will not be unnecessarily disturbed or destroyed.

2. Mechanically cut pavement to be removed to a straight line, unless otherwise directed by the Engineer.
3. All pavement removed shall become the property of the Contractor and disposed of at locations acceptable to or designated by the Owner at no additional cost to the Owner.

B. Maine DOT Areas:
1. When removing pavement under the jurisdiction of the Maine DOT, strictly adhere to all DOT regulations controlling pavement openings.

3.3 SURFACE PREPARATION

A. Tack coats shall conform to Section 410 of the Maine D.O.T. Standard Specifications.
B. Tack Coat:
1. Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

3.4 WEATHER AND SEASONAL LIMITATIONS

A. The State is divided into 2 paving zones as follows:
1. Zone 1 - Areas north of US Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais.
2. Zone 2 - Areas south of Zone 1 including the US Route 2 and Route 9 boundaries.

B. The Contractor may place Hot Mix Asphalt Pavement for use other than a traveled way wearing course in either Zone between the dates of April 15th and November 15th, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving location) is 2°C or higher and the area to be paved is not frozen. The Contractor may place Hot Mix Asphalt Pavement as traveled way wearing course in Zone 1 between the dates of May 1st and the Saturday following October 1st and in Zone 2 between the dates of April 15th and the Saturday following October 15th, provided the air temperature determined as above is 10°C or higher. For the purpose of this Subsection, the traveled way includes truck lanes, ramps, approach roads and auxiliary lanes.

C. Hot Mix Asphalt Pavement used for curb, driveways, sidewalks, islands, or other incidentals is not subject to seasonal limitations, except that conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, the Contractor shall not place Hot Mix Asphalt Pavement on a wet or frozen surface, and the air temperature shall be 2°C or higher.

3.5 PLACING THE MIX

A. General:
1. Place asphalt concrete mixture on prepared surface. The temperature of the mixture shall be measured at the truck and at the paver unless otherwise authorized by the Engineer. The temperature of the mixture shall be within the following tolerances:

PGAB Grade(s)	Temperature Range (°F)
PG58-28/PG64-28	275-325
PG64E-28/PG70E-28	285-335

2. Place in areas inaccessible to paving machine and small areas by hand. Place each course to required grade, cross-slope and compacted thickness.

B. Protection:
   1. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened to the extent that the pavement will not be damaged.

3.6 PAVEMENT MARKINGS

A. Material, approved by the Engineer, is to be furnished and applied after the installation of permanent paving.

B. Apply pavement markings in accordance with existing markings. Match paint color, marking dimensions, layout and other details with existing markings in the vicinity of the project.

C. If new pavement markings are not shown on the Drawings, replace previously existing pavement markings to restore existing conditions.

END OF SECTION

SECTION 02525

GRANITE CURBS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: This work shall consist of removing and relaying existing curbing or edging in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the Drawings or established by the Engineer. The types of curbs are designated as follows:
Type 1 - Vertical granite curb
Type 5 - Sloped granite edging

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

Not used

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 REMOVAL OF CURBING

A. The Contractor shall carefully remove, store and clean curb specified on the Drawings or designated for resetting.

B. Curbing damaged or destroyed, as a result of the Contractor's operations or because of his failure to store and protect it in a manner that would prevent loss or damage, shall be replaced with curbing of equal quality at the Contractor's expense.

3.2 EXCAVATION

A. Excavation shall be made to the required depth and base material upon which the curb is to be set shall be compacted to a firm, even surface.

B. All soft and unsuitable material shall be removed and replaced with suitable material which shall be thoroughly compacted.

3.3 INSTALLATION

A. The curb and sloped edging shall be set so that the front top arris line is in close conformity to the line and grade required.

B. All space beneath the curbing shall be filled and thoroughly tamped with material meeting the requirements of the bed course material.

3.4 JOINTS

A. The required spacing between stones shall be a minimum of 1/4 inch and a maximum of 5/8 inch for Type 1 curb.
B. The required spacing between stones shall be a maximum of 1/2 inch for Type 5 curb.
C. Joints between stones shall be carefully filled with mortar along the back portion of the joint to prevent loss of backfill material.

3.5 BACKFILLING

A. After the joints have set, any remaining excavated areas shall be filled and tamped with approved material placed in eight (8) inch layers.

3.6 CURB INLETS

A. Curb placed adjacent to curb inlets shall be installed with steel dowels cemented into each stone with epoxy grout.

END OF SECTION

SECTION 02527

BITUMINOUS CONCRETE CURBS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. This work shall consist of constructing a hot-mixed, hot-laid bituminous concrete curb on a completed bituminous surface in accordance with these Specifications and within reasonably close conformity to the lines and grades shown on the Drawings or established by the Engineer.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Use only materials which are furnished by a bulk bituminous concrete producer which is regularly engaged in production of hot-mix, hot laid bituminous concrete and approved for use by the MDOT.

1.4 SUBMITTALS

A. Certificates:

1. Provide certificates in lieu of laboratory test reports.
2. Certify that materials comply with Specification requirements.
3. Signed by bituminous concrete producer and Contractor.

1.5 JOB CONDITIONS

A. Weather Limitations:

1. Bituminous concrete curbs shall not be placed on a wet surface.
2. Construct between the dates of May 1 and November 22, and then only when the air temperature in the shade is 40° F or above.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials for bituminous concrete curbing shall be as required in Section 609 of the State of Maine Department of Transportation's "Standard Specifications for Highways and Bridges," latest version.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Conditioning of the Existing Surface:

1. Thoroughly clean of all objectionable material.

2. Apply a light tack coat of 0.08 to 0.20 gallons per fifteen linear feet of curb area.

B. Equipment:
   1. The curb shall be placed by an approved power operated extruding type machine using the shape mold called for. A tight bond shall be obtained between the base and the curb. The Engineer may permit the placing of curbing by other than mechanical curb placing machines when short sections or sections with short radii are required. The resulting curbing shall conform in all respects to the curbing produced by the machine.

C. Placing:
   1. Place mix at temperature between 275 - 325°F.
   2. Where conditions necessitate joints in curb, they shall be constructed to ensure bond between old and new sections of the curb. Prior to placing the new curb material, the old joint shall be tack coated.

D. Curing:
   1. Protect from traffic until the heat of the mix has dissipated and the mix has obtained the proper hardness.

E. Backfilling:
   1. Backfill as soon as possible after mix has obtained the proper degree of hardness.

END OF SECTION

SECTION 02577

PAVEMENT MARKINGS - MAINE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. This work shall consist of providing final reflective pavement lines and markings during paving operations as shown on the plans. It shall consist of providing temporary pavement markings during construction.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. All submittals shall be in accordance with 01340 – Submittals, and the General Conditions of the Construction Contract.

B. Submit product data for all pavement marking materials.

PART 2 - PRODUCTS

2.1 MATERIALS - TAPE

A. Performed Plastic:

1. General - Reflectorized pavement marking tape and marking sheeting, performed into rolls or ribbons of various lengths, pliability, and widths suitable for use as reflective markings on Portland cement concrete or bituminous pavement shall consist of a mixture of high-quality polymeric materials, pigments, or glass beads that are uniformly distributed throughout, with a reflective layer of beads bonded to the top. The edges of the performed material shall be clean cut and true. It may be supplied with a precoated, factory applied adhesive for immediate pavement application without the use of heat, solvent or other types of adhesive operations, or it may be furnished with separate adhesives as recommended by the manufacturer. The affixed material shall be capable of molding itself to the pavement contoured by the action of traffic and maintain its original dimensions and placement under normal traffic conditions at the pavement temperatures, which could occur within Maine.
2. Physical Requirements - Color Pigments shall be selected and blended to conform to standard highway colors throughout the expected life of the material. When tested by Federal Test Method Standard 141 Method 4232, the white shall be no darker than Color Number 37778 of Federal Standard number 595 and the yellow shall conform to Color Number 33538 of Federal Standard Number 595 (Highway yellow Color PR#1).
3. Retro-Reflectivity - The retro-reflective performed film shall have a layer of reflective spheres bonded to the top surface. The white and yellow film shall have the following initial minimum retroreflectance values at 0.2° and 0.5°

observation angles and 86° entrance angle as measured in accordance with the photometric testing procedures of ASTM D4061. Retroreflectance values shall be expressed as specific luminance in millicandelas per square meter per lux (medm 2lx 1) [millicandelas per square foot/foot candle (med ft 2fc 1)]

	White		Yellow	
Observation Angle	0.2°	0.5°	0.2°	0.5°
SL[medm ^{2}lx ^{1}] [med ft ^{2}fc ^{1}]	550	380	410	250

The test distance shall be 15 m [50 feet] and the sample size a 600 mm by 750 mm [3 feet by 2.5 feet] rectangle. The angular aperture of both the photoreceptor and light projector shall be 10 minutes of arc. The reference center of the sample and the reference axis shall be taken perpendicular to the test sample.

4. Bead Retention - When tested with a 50 mm by 150 mm [2 in by 6 in] sample bent over a 13 mm [½ in] diameter mandrel with the 50 mm [2 in] dimension perpendicular to the mandrel axis, microscopic examination of the arc on the mandrel shall show no more than 10% of the beads are entrapped in the binder and less than 40% of the surface of the bead.
5. Application - The preformed plastic material shall be capable of application to non-defective pavement surfaces that are dry and free from dirt or other foreign matter. For normal application, the pavement temperature should be at least 15°C [60°F] and rising.
6. Special Instructions - Special instructions should be supplied by the vendor for application to be made at pavement temperatures below 15°C [60°F]. Application shall be according to manufacturer's recommended procedures. Plastic pavement marking materials shall only be applied to surfaces with temperatures within the range specified by the manufacturer for optimum adhesion.
7. Adhesive, Activators or Special Coatings - Adhesive, activators or special coatings for various types of pavement surfaces shall be provided with the preformed plastic material. Detailed information must be supplied with the material outlining required application procedures for such adhesives, activators, or special coating.
8. Preformed Plastics - Performed plastics shall be capable of being applied to new asphalt pavement immediately prior to the final rolling of the new surface and of being rolled into place with conventional pavement and highway rollers. The plastic material and adhesives used in such applications shall be of the type that water used on the roller to prevent asphalt pickup shall not be harmful to the successful application of the plastic.
9. Special Equipment - Special equipment necessary for the successful installation of any preformed plastic material shall be available from the manufacturer of the plastic material on a lease, loan, or purchase basis. These materials following application shall be immediately ready for traffic without any damage to the material surface or injuries to passing vehicles. The retro reflective pavement marking tapes are intended for use as longitudinal lines such as lane

lines, edge lines, channelization lines, gore markings or stop bars and crosswalk lines, and shall be inlaid into new asphaltic concrete by using a steel pavement roller while the pavement is at temperatures between 130°F. and 150°F.

2.2 MATERIALS -PAINT

A. Pavement Marking Paint for final and temporary pavement marking shall meet the requirements of Federal Specification TT-P-1952E. Either Type N, regular dry traffic paint or Type F, fast dry traffic paint may be used.

PART 3 - EXECUTION

3.1 GENERAL

A. All pavement lines and markings shall be applied in accordance with the Manual on Uniform Traffic Control Devices. Longitudinal lines placed on tangent roadway segments shall be straight and true. Longitudinal lines placed on curves shall be continuous smoothly curved lines consistent with the roadway alignment. All pavement markings placed shall meet the tolerance limits shown on the plans.

B. Broken lines shall consist of alternate 3 m [10 ft] painted line segments and 9m [30 ft] gaps. Temporary pavement marking lines, will be applied as many times as necessary to properly delineate traffic lanes for the safe passage of traffic. Bi-directional delineators may be used in place of temporary lines. Delineators will be applied at 12 m [40 ft] intervals.

C. In overnight lane closure areas that are not to be overlaid, temporary plastic lines or raised pavement markers shall be used through the length of the taper.

D. The plastic final pavement lines and markings shall be applied in accordance with the manufacturer's recommendations by the inlay method of application.

3.2 ESTABLISHMENT PERIOD

A. Inlaid plastic pavement lines and marking material furnished and installed under this contract for final pavement markings shall still be subject to a six-month period of establishment.

B. The period of establishment shall commence as soon as the plastic pavement lines and markings are complete and in place and shall continue for six months. At the end of the establishment period, a minimum of 95% of the plastic pavement lines and markings shall still be in place to be acceptable.

C. If less than 95% of the plastic pavement lines and markings are in place after six months, the Contractor shall replace all unsatisfactory plastic pavement lines and markings on the project without additional payment. Plastic pavement lines and markings designated for replacement shall be installed according to these specifications, unless otherwise directed. Plastic pavement lines and markings replaced at the end of the six month establishment period will not be subject to a further establishment period.

3.3 PAVEMENT MARKING TAPE MATERIAL REPLACEMENT PROVISION GUARANTEE

A. The Contractor shall supply the Owner with a written guarantee for a minimum of two years for all materials contained in these specifications.

B. The period of guarantee shall begin from the date of application to the road.

3.4 PREPARATION OF SURFACE FOR PAINT

A. Immediately before applying the pavement marking paint to the pavement or curb, the surface shall be dry and entirely free from dirt, grease, oil, or other foreign matter. Surface preparation for application of plastic markings shall conform to the manufacturer's recommendations.

3.5 APPLICATION OF PAINT

A. Prior to applying paint for final pavement lines, the Contractor shall perform a test for paint thickness by furnishing and placing a piece of smooth, clean metal with an area of at least 0.1 m^2 [144 in^2] in the path of the striping truck. The striping truck shall be passed over the piece of metal, painting the surface as it passes, without applying beads. The result of this test will be used to determine the pressure setting and speed of the truck when applying paint to obtain the specified thickness. Additional paint thickness testing may be required on the final paint markings. The wet thickness of paint without beads on final pavement lines shall be a minimum of 0.400 mm [16 mils].

B. On other final pavement markings and on curb, where the paint is applied by hand painting or spraying, application shall be in two uniform covering coats, each at least 0.25 mm [10 mils] thick. Before the second coat of paint has dried, the glass beads shall be applied by a pressure system that will force the glass beads onto the undried paint as uniformly as possible.

C. Glass beads shall be applied to the final and temporary pavement lines, marking and curb at the rate of 0.72 kg/L [4.5 lb/gal] of paint and in sufficient quantity to assure complete and uniform coverage of hand painted surfaces.

D. Temporary painted lines and markings shall be applied as specified for permanent painted lines, except that the thickness shall be a minimum of 0.400 mm [16 mils].

E. Temporary pliant polymer marking material shall be used for temporary markings on the final pavement and on pavements not to be resurfaced when such pavement markings do not conform to the final pavement markings pattern.

F. Newly painted lines, markings and curb shall be protected from traffic by the use of cones, stationary vehicles or other approved methods until the paint is dry.

3.6 REMOVING LINES AND MARKINGS

A. When it is necessary to remove pavement lines and markings, it shall be done by grinding, high temperature flame, sand blasting, solvent or other acceptable means. The method chosen must be capable of completely eradicating the existing line or marking without damage to the pavement. Burning and grinding to remove temporary markings from final pavement or from existing pavement not to be resurfaced will not be permitted.

END OF SECTION

SECTION 02601

MANHOLES, COVERS AND FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Construct manholes, covers, frames, brick masonry, inverts and apply waterproofing in conformance with the dimensions, elevations, and locations shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Precast Manhole Base, Barrel and Top Sections:
   1. Conform to ASTM C478 except as modified herein, and on the Drawings.
   2. Average strength of 5,000 psi at 28 days.
   3. Testing:
      a. Determine concrete strength by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the bases, barrels and tops.
      b. Have tests conducted at the manufacturer's plant or at a testing laboratory approved by the Engineer.
      c. Have not less than 2 tests made for each 100 vertical feet of precast manhole sections.
      d. Test aggregate in accordance with ASTM C1293 and Section 03420. Aggregate having an expansion less than 0.04% at 1-year is acceptable for use.

B. Manhole Steps:
   1. Conform to ASTM C478-06 for load carrying capacity and pull out resistance.
   2. Acceptable Manufacturers:
      a. Parson Environmental Products, Inc.
      b. M. A. Industries, Inc.
      c. Or equal

C. Frames and Covers:
   1. Acceptable Manufacturers:
      a. EJ Castings
      b. Neenah Foundry Company.
      c. Or equal

D. Exterior Chimney Wrap/Seal
   1. Acceptable Manufacturers:
      a. Sealing Systems, Inc. Infi-Shield Uni-Band
      b. Or equal

E. Masonry:
   1. Brick: Shall comply with the ASTM Standard Specifications for Sewer Brick (made from clay or shale), Designation C32, for Grade SS, hard brick.

2. Cement: ASTM C150.
3. Hydrated Lime: ASTM C207
4. Sand: ASTM C33

F. Waterproofing:
1. Acceptable Manufacturers:
a. Karnak #220 AF Fibered Emulsion Dampproofing, Karnak Corp., Clark, NJ.
b. PPS 922 Superseal, International Precast Supply.
c. Or equal.

G. Pipe connections shall conform to ASTM C 923, "Standard Specifications for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

1.4 SUBMITTALS

A. Submit shop drawings and manufacturer's literature in conformance with Section 01340 and the Standard General Conditions of the Construction Contract.

B. Precast Manhole Sections:
1. Submit concrete test results for review prior to delivery to the site.

1.5 WARRANTY

A. Contractor’s one year warranty, as specified in Division 0, shall include but not be limited to:
1. Cracking, spalling or other surface and structural defects.
2. Separation of joints or misalignment of adjacent units due to faulty precast concrete sections.
3. Leakage through all joints between concrete sections due to faulty materials or improper installation.

B. The Contractor shall repair or replace all defective work at no additional cost to the Owner within warranty period.

PART 2 - PRODUCTS

2.1 PRECAST MANHOLE SECTIONS

A. Dimensions, shall be as shown on the Drawings:
1. Base & Riser Sections:
a. Diameter: As shown on the Drawings.
b. Length: As required.
c. Wall Thickness: Not less than 5 inches.
d. Joints: Bell-and-spigot or tongue-and-groove formed on machine rings to ensure accurate joint surfaces.
2. Tops:
a. Diameter: Eccentric cone type, 24 inches I.D. at top, 48 inches I.D. at bottom unless otherwise shown on the Drawings.
b. Height: 4 feet.
c. Wall thickness: Not less than 5 inches at the base, tapering to not less than 8 inches at the top.
d. Joints: Bell-and-spigot or tongue-and-groove formed on machine rings to ensure accurate joint surfaces.
e. Exterior face of cone sections shall not flare out beyond the vertical.

3. Flat Slab Tops:
    a. Location: Where shallow installations do not permit the use of a cone-type top and where indicated on the Drawings.
    b. Slab thickness: Not less than 6 inches.
    c. Constructed to support an HS-20 wheel loading.

B. Aggregates:
1. The use of crushed hydraulic cement or recycled aggregate is prohibited.
2. Coarse aggregate shall consist of a well graded crushed stone or a washed gravel conforming to the requirements of ASTM C33/C33M.

C. Openings:
1. Provide openings in the risers to receive pipes entering the manhole.
2. Make openings at the manufacturing plant.
3. Size: To provide a uniform annular space between the outside wall of pipe and riser.
4. Location: To permit setting of the entering pipes at the correct elevations.
5. Openings shall have a flexible watertight union between pipe and the manhole base.
    a. Cast into the manhole base and sized to the type of pipe being used.
    b. Type of flexible joint being used shall be approved by the Engineer. Install materials according to the Manufacturer's instructions.
        i. Lock Joint Flexible Manhole Sleeve made by Interpace Corporation.
        ii. Kor N Seal made by Trelleborg.
        iii. Press Wedge II made by Press-Seal Gasket Corporation.
        iv. A-Lok Manhole Pipe Seal made by A-Loc Corporation.
        v. Or equivalent.

D. Joints:
1. Joint gaskets to be flexible self-seating butyl rubber joint sealant installed according to manufacturer's recommendations. Install a double row of joint sealants for every manhole joint. For cold weather applications, use adhesive with joint sealant as recommended by manufacturer.
    Acceptable Materials:
    a. Kent-Seal No. 2
    b. Ram-Nek
    c. Or equivalent.
2. Joints between precast sections shall conform to related standards and manufacturer's instructions.
3. All manholes greater than 6 ft. diameter and all manholes used as wet wells, valve pits and other dry-pit type structures shall be installed with exterior joint collars. The joint collar shall be installed according to the manufacturer's instructions.
    Acceptable Materials:
    a. MacWrap exterior joint sealer as manufactured by Mar-Mac Manufacturing Company
    b. Cretex External Joint Wrap
    c. Or equivalent.

E. Waterproofing:
1. The exterior surface of all manholes shall be given two coats of waterproofing material at a application rate as recommended by the manufacturer.

2. The coating shall be applied after the manholes have cured adequately and can be applied by brush or spray in accordance with the manufacturer's written instruction.
3. Sufficient time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat.

F. Frost Protective Wrapping:
1. The frost protective wrap shall be constructed of an ultraviolet resistant polyethylene material and shall be a minimum thickness of 6 mils.

2.2 FRAMES AND COVERS

A. Standard Units:
1. Made of cast iron conforming to ASTM A48-76, Class 30 minimum.
2. Have machined bearing surfaces to prevent rocking.
3. Castings shall be smooth with no sharp edges.
4. Constructed to support an HS-20 wheel loading.
5. Dimensions and Style shall conform to the Drawings, Standard castings differing in non-essential details are subject to approval by the Engineer:
a. Covers - Solid with sewer in 3-inch letters diamond pattern. Pick hole dimensions shall not exceed the thickness of the frame inner flange.
b. Frame - 24-inch diameter clear opening, with flange bracing ribs.

B. Waterproof Units:
1. Same features as above for Standard Units, with 22-inch diameter minimum clear opening.
2. Sealing features:
a. Inner lid held by a bronze tightening bolt in a locking bar.
b. Neoprene gasket
c. Water tight pick hole.
3. Constructed to support HS-20 wheel loading.

2.3 MANHOLE STEPS

A. Polyethylene coated steel safety type designed with a minimum concentrated live load of 300 pounds.
B. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.
C. The steps shall become thoroughly dry before being placed into the concrete.
D. All steps shall be cast into walls of the precast section so as to form a continuous ladder with a distance of 12-inches between steps.

2.4 MASONRY

A. Brick:
1. Sound, hard, uniformly burned, regular and uniform in shape and size, compact texture, and satisfactory to the Engineer.
2. Immediately remove rejected brick from the work.

B. Mortar:
1. Composition (by volume):
a. 1 part Portland cement.
b. 1/2 part hydrated lime.
c. 4-1/2 parts sand.

2. The proportion of cement to lime may vary from 1:1/4 for hard brick to 1:3/4 for softer brick, but in no case shall the volume of sand exceed 3 times the sum of the volume of cement and lime.

C. Cement shall be Type II Portland cement.

D. Hydrated lime shall be Type S.

E. Sand:
   1. Shall consist of inert natural sand.
   2. Grading:

Sieve	Percent Passing
No. 4	100
No. 8	95-100
No. 16	70-100
No. 30	40-75
No. 50	10-35
No. 100	2-15
No. 200	0-5

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Precast Manhole Sections:
   1. Perform jointing in accordance with manufacturer's recommendations and as approved by the Engineer.
   2. Install riser sections and tops level and plumb.
   3. Make all joints watertight.
   4. When necessary, cut openings carefully to prevent damage to barrel sections and tops. Replace damaged manhole sections and tops at no additional cost to the Owner.
   5. When manhole steps are included in the Work, install barrel sections and tops so that steps are in alignment.

B. Drop Manholes:
   1. The difference in elevation between the invert of the inlet pipe and outlet pipe is to be either less than 6-inches (which does not require a drop manhole) or more than 24-inches (which does require a drop manhole).
   2. Where difference in elevation between the invert of the inlet pipe to the invert of the outlet pipe exceeds 24 inches, construct a drop manhole as shown on the Drawings or as directed by the Engineer.

C. Adjust to Grade:
   1. Adjust tops of manholes to grade with precast concrete grade rings.
   2. In paved areas, set frame and cover to final grade after binder pavement is placed and the grade of surface pavement has been determined.

D. Pipe Connections to Manholes: Connect pipes to manholes with joint design and materials approved by the Engineer. Special care shall be taken to ensure that the openings through which pipes enter the structure are watertight.

E. Invert Channels:
   1. After manhole and all pipes entering or exiting the manhole have been installed, construct the invert channels and shelf.

2. Channels to be smooth and semicircular in shape conforming to the inside of the adjacent sewer section.
3. Make changes in direction of flow with smooth curves having a radius as large as permitted by the size of the manhole.
4. Stop the pipes at the inside face of the manhole where changes of direction occur.
5. Form invert channels and shelf with brick.
6. The maximum change in elevation from the invert of the inlet pipe to the invert of the outlet pipe is 6-inches. Shape invert to make smooth transition in vertical grade.
7. Slope the floor of the manhole (shelf) to the flow channel, as shown on the Drawings.

F. Masonry:
1. Laying Brick:
   a. Use only clean bricks in brickwork for manholes.
   b. Moisten the brick by suitable means until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.
   c. Lay each brick in a full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and thoroughly bond as directed.
   d. Construct all joints in a neat workmanlike manner. Construct the brick surfaces inside the manholes so they are smooth with no mortar extending beyond the bricks and no voids in the joints. Maximum mortar joints shall be 1/2 inch.
   e. Outside faces of brick masonry shall be plastered with mortar from ¼-inch to 3/8-inch thick.
   f. Completed brickwork shall be watertight.
2. Curing:
   a. Protect brick masonry from drying too rapidly by using burlaps which are kept moist, or by other approved means.
   b. Protect brick masonry from the weather and frost as required.

G. Frames and Covers:
1. Set all frames in a full bed of mortar, true to grade and concentric with the manhole opening.
2. Completely fill all voids beneath the bottom flange to make a watertight fit.
3. Place a ring of mortar at least one inch thick around the outside of the bottom flange, extending to the outer edge of the manhole all around its circumference.
4. Clean the frame seats before setting the covers in place.

H. Plugging and Patching:
1. Fill all exterior cavities with non-shrink grout and with bituminous waterproofing once the concrete and mortar has set.
2. Touch up damaged water proofing.

I. Cleaning:
1. Thoroughly clean manholes, steps, frames and covers of all debris and foreign matter.

J. Bedding and Backfilling:
1. Bedding of manholes shall be 6 inches of 3/4" screened stone.
2. Backfill a minimum of 18 inches all around manhole with gravel borrow.

K. Frost Protective Wrap:
   1. The Contractor shall comply with the manufacturer's instructions for the particular conditions of installations in each case.
   2. Clean each manhole exterior of all dirt and remove any sharp protrusions.
   3. Apply two 6-inch wide vertical strips of bituminous waterproofing material and/or duct tape from the top to bottom of the manhole per layer.
   4. Prior to installing pipe through each manhole or valve pit, wrap each manhole to the maximum depth of frost penetration, but not less than 5 feet below grade, with four layers of the polyethylene material by beginning the wrap at the adhesive strip and proceeding around the manhole, valve pit, etc., continuously by overlapping the adhesive strip by 24 inches on the final layer. Cut the polyethylene wrap in areas where piping exits the manhole. The size of the cut is to be equivalent to the pipes outside diameter.
   5. Tuck and pleat the polyethylene wrap at the top of each manhole in a continuous manner, minimizing the size of each fold. Extend the polyethylene wrap past the top of the manhole frame and temporarily tuck the remainder inside the frame, until final backfill and paving.
   6. In paved areas, cut the polyethylene wrap flush with the manhole rim after the pavement is in place.
   7. In unpaved areas, pull the polyethylene wrap together, and tie around frame with galvanized wire.
   8. Protect the installed frost barrier from harmful weather exposures and from possible physical abuses, where possible by prompt installation of concealing work or, where that is not possible, by temporary covering or enclosure.
   9. Backfill around the manhole/frost barrier with material as outlined in Section 02200 - Earthwork.

3.2 MANHOLE TESTING

A. General:
   1. Perform a vacuum test on all manholes
   2. Perform all testing in the presence of the Engineer.
   3. Suitably plug all pipes entering each manhole and brace plugs to prevent blow out.

B. Vacuum Test:
   1. The manhole shall be tested by a vacuum test after assembly of the manhole, connection piping and backfilling. Vacuum testing to be conducted prior to construction of invert channels.
   2. Plug all lifting holes completely with non-shrink grout.
   3. Properly tighten all boot clamps and brace all plugs to prevent them from being sucked into the manhole.
   4. Install the testing equipment according to the manufacturer's instructions.
   5. A vacuum of 10 inches of Hg shall be drawn on the manhole and the loss of 1 inch of Hg vacuum timed. The manhole shall be considered to have passed the test if the time for the loss of 1 inch of Hg vacuum is:
      a. Greater than 2 minutes for manholes less than 10-feet deep.
      b. Greater than 2.5 minutes for manholes 10 to 15-feet deep.
      c. Greater than 3 minutes for manholes more than 15-feet deep.

6. If the manhole fails the initial test, the Contractor shall locate the leak(s) and make repairs. The manhole shall be retested until a satisfactory test result is obtained.

3.3 FIELD REPAIRS

A. Structural repairs shall be completed at the direction of the Engineer.

B. Leakage Repairs

1. Correct leakage by reconstruction, replacement of gaskets and/or other methods as approved by the Engineer.
2. The use of lead-wool or expanding mortar will not be permitted.

C. After the manholes have been backfilled, and prior to final acceptance, any signs of leaks or weeping visible inside the manholes shall be repaired and the manhole made watertight.

END OF SECTION

SECTION 02610

RIGID BOARD INSULATION FOR PIPE IN TRENCHES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install rigid board insulation in trenches over or between piping, as shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM C272 - Test Method for Water Absorption of Core Materials for Structural Sandwich Construction.
B. ASTM C518 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter.
C. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics.

1.4 SUBMITTALS

A. Submit shop drawings, product data and manufacturer’s written installation instruction in accordance with the applicable section of Division 1 and the General Conditions of the Construction Contract.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in manufacturer's original unopened packaging.
B. Identify contents, manufacture, brand name, thermal values, and applicable standards.
C. Store materials in area protected from weather, and moisture.
D. Remove damaged materials from site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Rigid Pipe Insulation
    1. Dow Chemical Company – Styrofoam Highload 40
    2. Certifoam 40
    3. Or equivalent

2.2 RIGID PIPE INSULATION

A. Insulation: Closed cell polystyrene foam board
    1. Standard Two Foot Width.
    2. Aged "R" Value - "R" = 5.0 per inch, ASTM C518.
    3. Water Absorption - 0.1 percent, ASTM C272.
    4. Water Vapor Permeance - 1.0 perm (max) ASTM E96
    5. Compressive Strength - 40 pounds per square inch, ASTM D1621.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lay rigid board insulation in trenches over or between piping where depth of pipe cover is than that required on the Drawings. Install rigid board insulation as shown on the Drawings.

END OF SECTION

SECTION 02615

DUCTILE IRON PIPE & FITTINGS (BURIED APPLICATIONS)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test ductile iron pipe and fittings of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, Division 1, and Division 2.

1.3 QUALITY ASSURANCE

A. Standards (As Applicable):
   1. Cement-mortar lining for water: ANSI A2l.4 (AWWA C104).
   2. Rubber gasket joints: ANSI A2l.ll (AWWA C111).
   3. Ductile iron pipe thickness: ANSI A2l.50 (AWWA C150).
   4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A2l.51 (AWWA C151).
   5. Pipe flanges and fittings: ANSI Bl6.l and ANSI A21.10 (AWWA C110).
   6. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
   7. Cast and ductile iron fittings: ANSI A2l.l0 (AWWA C110).
   8. Ductile Iron Compact Fittings: ANSI 21.53 (AWWA C153).
   9. NSF 61: Drinking Water System Components – Health Effects.
   10. NSF 372: Drinking Water System Components – Lead Content
   11. All components in contact with potable water, or water being processed to become potable water, shall be compliant with NSF 61 and shall be constructed of "Lead-free" material in compliance with NSF 372.

B. Acceptable Manufacturers:
   1. American
   2. US Pipe
   3. McWane
   4. Or equal.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the applicable section of Division 1 and the General Conditions of the Construction Contract.

B. Submit manufacturer's "Certification of Conformance" that pipe and fittings meet or exceed the requirements of these Specifications.

C. Submit manufacturers installation instructions and specifications for all pipe and fittings.

1.5 DELIVERY, STORAGE & HANDLING

A. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.

B. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. General:
   1. All buried ductile iron pipe shall have push-on or mechanical joints unless otherwise specified or shown on the Drawings.
   2. All pipe within valve pits and other structures and all pipe that is above grade is considered exposed pipe and shall be flanged.
   3. Unless otherwise shown on the Drawings or in the Pipe Schedule, the minimum thickness of ductile iron pipe shall be:
      a. For non-flanged pipe: Class 52.
      b. For flanged pipe: Class 53.
   4. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
   5. Pipe for use with split type couplings or restrained joints shall have ends with cast or machined shoulders or grooves that meet the requirements of the manufacturer of the couplings.

B. Linings
   1. Pipe shall be double thickness cement lined and seal coated unless noted otherwise on the Drawings.

C. Coatings
   1. Finish layer of factory applied bituminous coatings (in accordance with AWWA C151) shall be furnished on the exterior of all buried piping unless specified otherwise.
   2. For above grade or exposed piping:
      a. Coatings in accordance with Section 09900 and 09905.

D. Joints (as shown on Drawings or as specified):
   1. Push-on and Mechanical Joint:
      a. The plain ends of push-on pipes shall be factory machined to a true circle and chamfered to facilitate fitting the gasket.
      b. Provide gaskets manufactured from a composition material suitable for exposure to the fluid to be contained within the pipe. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 250°F.
      c. Bolts and nuts for buried mechanical joints shall meet the AWWA C-111 requirements and be made of high strength, low alloy steel. After jointing, coat entire joint with bituminous material compatible with pipe coating unless other coating required by Section 09900.
   2. Boltless Restrained Joint:
      a. Boltless joint with integral bell slots for locking segment retainers.

b. Manufacturer supplied gaskets with stainless steel wedge-shaped elements to firmly grasp the spigot end of the pipe.
c. Capable of being deflected after assembly.
d. Working pressure and test pressure equal to, or higher than, pipe ratings.
e. American Flex-Ring®, US Pipe HDSS, McWane TR FLEX® or approved equal.

3. Flanged:
   a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
   b. Flanges shall be long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
   c. Gaskets:
      i. Ring type of rubber with cloth insertion.
      ii. Thickness of gaskets l2 inches in diameter and smaller: l/l6 inch.
      iii. Thickness of gaskets larger than l2 inches in diameter: 3/32 inch.
      iv. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 200°F.
   d. Fasteners:
      i. Make joints with bolt, studs with a nut on each end, or one tapped flanged with a stud and nut.
      ii. The number and size of bolts shall meet the requirements of the applicable ANSI standard.
      iii. Nuts, bolts, and studs shall be Grade B meeting the requirements of ASTM A307. After jointing, coat entire joint with bituminous material compatible with pipe coating unless other coating required by Section 09900.
   e. When applicable, provide and install flange clamps as shown on the Drawings.

E. Joint Bracing:
   1. Provide joint bracing to prevent the piping from pulling apart under pressure as required and as shown on the Drawings or in the Pipe Schedule.
   2. Types of bracing:
      a. Pipe and fittings furnished with approved lugs or hooks cast integrally for use with socket pipe clamps, tie rods, or bridles. Bridles and tie rods shall be a minimum of 3/4 inch diameter except where they replace flange bolts of a smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The clamps, tie rods, and bridles shall be coated with bituminous paint in buried installations and shall be coated with the same coatings as the piping system in exposed installations after assembly or, if necessary, prior to assembly.
      b. Mechanical joint bolted-type follower gland pipe restrainers.
         i. Ductile iron gland and restraining ring.
         ii. Gasket shall be standard MJ gasket -ANSI/AWWA-C111/A21.11.
         iii. Working pressure 350 psi for 18-inch diameter and larger; 250 psi for less than 16-inch diameter and smaller.
         iv. Test pressure two times working pressure.

v. Grip Rings™ by Romac Industries, RomaGrip by Romac Industries, MEGALUG® by EBAA Iron, or other equivalent as approved by Engineer.

c. Other types of bracing as shown on the Drawings.

2.2 FITTINGS

A. Standard Fittings:

1. Unless otherwise indicated on the Drawings, fittings shall be ductile iron and shall match or exceed the pressure rating of the piping system.
2. Pressure rating of 350 psi for D.I. compact fittings and 250 psi for all others unless indicated otherwise on the Drawings or as specified.
3. Unless otherwise shown on the Drawings, flanged joint fittings shall be used with flanged joint pipe and mechanical joint fittings shall be used with push-on joint and mechanical joint pipe.
4. Lining shall match that specified for the pipe.
5. Coating shall match that specified for the pipe and pipe location.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.

B. Carefully inspect all materials at the time of delivery and just prior to installation.

C. Carefully inspect all pipe and fittings for:

1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
2. Deviations beyond allowable tolerances for pipe clearances.

D. Immediately remove all rejected materials from the project site. Replace all damaged and rejected materials at no cost to the Owner.

3.2 INSTALLATION

A. General:

1. Install in strict accordance with the pipe and fitting manufacturer's instructions and recommendations and as specified or as shown on the Drawings.
2. Provide and install thrust restraint at each pipe joint, as necessary to meet the thrust restraint requirements per Drawings and manufacturer recommendations, whichever provide the larger thrust requirements.
3. The use of thrust blocks is prohibited except for work areas where: 1) a new fitting has been installed on an existing pressure pipe and it is not feasible to restrain existing joints; or 2) when directed by the Engineer. Where thrust blocks are used, they shall be placed against undisturbed soil or screened gravel compacted to 95 percent and shall be placed so that the joints are accessible for repairs.

B. Assembling Joints:

1. Push-on Joints:

a. Insert the gasket into the groove of the bell.

b. Uniformly apply a thin film of special lubricant over the inner surface of the gasket that will contact the spigot end of the pipe.
c. Insert the chamfered end of the plain pipe into the gasket and push until it seats against the bottom of the socket.

2. Bolted Joints:
   a. Remove rust preventive coatings from machined surfaces prior to assembly.
   b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings, and gaskets.
   c. After jointing coat all bolts with bituminous material compatible with the pipe coating required herein and/or in Section 09900.
3. Boltless Joints:
   a. Insert the gasket into the groove of the bell.
   b. Uniformly apply a thin film of special lubricant over the inner surface of the gasket that will contact the spigot end of the pipe.
   c. Insert the chamfered end of the plain pipe into the gasket and push until it seats against the bottom of the socket.
   d. Insert locking segments and rotate clockwise around the pipe.
   e. Hold the segments apart and wedge the rubber retainer into the slot between the locking segments.
   f. Extend the joint to remove the slack in the locking segment cavity.
   g. Set the joint deflection to not exceed 75% of the manufacturer maximum allowable value.
4. Flanged Joints:
   a. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
   b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
5. Mechanical Joints:
   a. Thoroughly clean, with a wire brush, surfaces that will be in contact with the gaskets.
   b. Lubricate the gasket, bell, and spigot by washing with soapy water.
   c. Slip the gland and gasket, in that order, over the spigot and insert the spigot into the bell until properly seated.
   d. Evenly seat the gasket in the bell at all points, center the spigot, and firmly press the gland against the gasket.
   e. Insert the bolts, install the nuts finger tight, and progressively tighten diametrically opposite nuts uniformly around the joint to the proper tension with a torque wrench.
   f. The correct range of torque (as indicated by a torque wrench) and the length of wrench (if not a torque wrench) shall not exceed:
      i. Range or Torque: 60-90 ft.-lbs.
      ii. Length of Wrench: l0 inches.

g. If effective joint sealing is not attained at the maximum torque specified above, disassemble, thoroughly clean, and reassemble the joint. Do not overstress the bolts to tighten a leaking joint.

6. Bell and Spigot Joints:
   a. Thoroughly clean the bell and spigots and remove excess tar and other obstructions.
   b. Insert the spigot firmly into place and hold securely until the joint has been properly completed.

C. Fabrication:
   1. Tapped Connections:
      a. Make all tapped connections as shown on the Drawings or as required by the Engineer.
      b. Make all connections watertight and of adequate strength to prevent pullout.
      c. Drill and tap normal to the longitudinal axis of the pipe.
      d. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.
      e. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANS A2l.51 based on 2 full threads for ductile iron and 3 full threads for cast iron.
   2. Cutting:
      a. Perform all cutting as set forth in AWWA C600.
      b. Carefully chamfer all cut ends to be used with push-on joints to prevent damage to gaskets when pipe is installed.

D. Pipe/Joint Deflection:
   1. Push-on and Mechanical Joints:
      a. The maximum permissible deflection of alignment at joints shall be limited to 75% of that given in AWWA C600.
   2. Flexible Joints:
      a. The maximum deflection in any direction shall not exceed the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 02622

POLYVINYL CHLORIDE (PVC) NON-PRESSURE PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide and install PVC non-pressure pipe and fittings of the size(s) and type(s) and in the location(s) shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Manufacturers:
   1. Ipex
   2. JM Eagle
   3. National Pipe & Plastics
   4. Or equivalent.

1.4 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.
B. Submit manufacturer's "Certification of Conformance" that pipe and fittings meet or exceed the requirements of these Specifications.
C. Submit other documents as specified in the appropriate Sections of this Division.

1.5 DELIVERY STORAGE AND HANDLING

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets and other materials.
B. Carefully inspect all materials at the time of delivery and just prior to installation.
C. Carefully inspect all pipe and fittings for:
   1. Defects and damage
   2. Deviations beyond allowable tolerances for joint dimensions.
   3. Removal of debris and foreign matter.
D. Examine area and structures to receive piping for:
   1. Defects, such as weak structural components that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerance for pipe clearances.
E. All materials and methods not meeting the requirements of the Contract Documents will be rejected.
F. Immediately remove all rejected materials from the project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe and Fittings:
   1. The polyvinyl chloride pipe and fittings, including those required for stubs, shall conform to ASTM standard specification for PVC Sewer Pipe and Fittings, Designation D 3034 (SDR 35) (4" to 15"), F679 (18" to 36"), or F1760-01 (for recycled pipe, all diameters).
   2. Straight pipe shall be furnished in lengths of not more than 14 feet.
   3. Saddles will not be allowed.

B. Joints:
   1. Joints for the polyvinyl chloride pipe shall be push-on joints using factory installed elastomeric ring gaskets.
   2. The gaskets shall be securely fixed into place by the manufacturer so that they cannot be dislodged during joint assembly.
   3. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and ground water, and which will endure permanently under the conditions of the proposed use.
   4. The joints shall conform to ASTM Specifications for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals, Designation D3212-76.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection:
   1. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight.
   2. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length.
   3. If a piece of pipe fails to meet this requirement for straightness it shall be rejected and removed from the site.
   4. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. Jointing:
   1. All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.
   2. Pipe and fittings shall be installed to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to ensure true alignments and gradients.
   3. All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation.
   4. Each pipe unit shall than be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends.

5. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer.

C. Service Connections:
   1. All service connections to new pipe shall utilize an insertion style tee or wye fitting as required on the drawings.
   2. All service connections must enter the top half of the mainline pipe.
   3. Service connections shall be 6-inch, minimum, unless otherwise noted.
   4. Contractor shall provide all necessary fittings, adapters and couplings to connect the service to the sewer main.
   5. Service laterals shall be placed at minimum of 2% slope, unless otherwise noted. If 2% slope is not available, notify the Engineer.
   6. Contractor shall maintain the trench for sufficient time for the Engineer to inspect the work. Contractor shall provide 3 working day notice to the Engineer.

D. Pipe Deflection:
   1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
   2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
   3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

E. Testing:
   1. Clean and test pipe in accordance with appropriate sections of this division.
   2. CCTV pipe in accordance with Section 02755.

END OF SECTION

SECTION 02623

UNDERDRAIN PIPE – BID ALTERNATE A

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Provide and install underdrain pipe and fittings of the size(s) and type(s) and in the location(s) shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Manufacturers:
   1. Advanced Drainage Systems, Inc.
   2. J-M Manufacturing.
   3. Contech Engineered Solutions
   4. Or equivalent.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the applicable section of Division 1 and the General Conditions of the Construction Contract.
B. Submit manufacturer's "Certification of Conformance" that pipe and fittings and other piping appurtenances meet or exceed the requirements of these Specifications.
C. Submit manufacturers installation instructions and specifications for all fittings, couplings, adapters, saddles, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe and Fittings:
   1. ABS Pipe for Underdrain
      a. Pipe, ASTM D2680
      b. Perforations, AASHTO M36, Type III
   2. Smooth wall perforated PVC pipe shall conform to the requirements of AASHTO M 278.
   3. Corrugated polyethylene (CPE) smooth wall underdrain pipe shall conform to the requirements of AASHTO as follows:
      a. M 252 Type S for pipe sizes 4 through 10-inch slot perforations.
      b. M294 Type S for pipe sizes 12 through 60-inch circular perforations.

B. Joints:
   1. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and ground water, and which will endure permanently under the conditions of the proposed use.

2. The joints shall be soil tight (ST) and shall be sealed by a factory installed rubber o-ring gasket that meets the requirements of the current ASTM F477.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Inspection:
   1. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/4 inch per foot of length.
   2. If a piece of pipe fails to meet this requirement for straightness it shall be rejected and removed from the site.
   3. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.
   4. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. Jointing:
   1. All pipe and fittings shall be cleared of all debris, dirt, etc., before being installed and shall be kept clean until accepted in the completed work.
   2. Pipe and fittings shall be installed to the lines and grades indicated on the drawings or as required by the Engineer. Care shall be taken to ensure true alignments and gradients.
   3. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer.

C. Pipe Deflection:
   1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

D. Construction:
   1. Underdrain - The trench shall be excavated to the required width and depth and a bed of the specified granular material, 3 inches in depth, shall be prepared in the trench. Perforated pipe shall be laid in this bed with the perforations above the springline of the pipe.
   2. After the pipe has been firmly bedded and joints securely connected, it will be inspected before any backfill is placed. The remaining backfill shall be granular material meeting the same requirements as that used for bedding the pipe.
   3. For underdrain placed under areas of proposed pavement, the backfill material shall be placed in 8 inch layers, loose measure and thoroughly compacted except that the initial layer of backfill around the pipe may be placed in a layer not exceeding 12 inches. For underdrains placed under areas not proposed to be paved, the initial layer of backfill shall not exceed 12 inches and the remaining material may be placed in 1 lift to the elevation of the subgrade and compacted with heavy rubber tired or vibratory compaction equipment to the satisfaction of the Engineer.

4. The upstream end of all completed underdrain pipe that is to be buried shall be sealed with cement mortar or other acceptable material. Care shall be taken that soil does not enter the pipe. Pipe so contaminated before backfilling shall be removed, cleaned and relaid.
5. When underdrain is to be constructed in embankment fill, the excavation for the trench shall be done after the embankment has been completed to subgrade elevations.

END OF SECTION

SECTION 02650

BURIED UTILITY MARKINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. This work shall consist of providing and installing utility line markings above all buried lines installed as part of this contract and replacing existing markings disturbed as part of this contract. Buried utilities are indicated on the Civil and Electrical Drawings.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the applicable section of Division 1 and the General Conditions of the Construction Contract.

B. Submit manufacturer's "Certification of Conformance" that utility markings meet or exceed the requirements of these Specifications.

C. Submit manufacturers specifications for utility markings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials and color shall be in accordance with latest AASHTO specifications for pipe and utility marking.

B. Marking tape color shall be in accordance with latest American Public Works Association (APWA) Uniform Color Code and American National Standards Institute ANSI Standard Z535.1, Safety Color Code specifications for buried utility marking as noted in the Schedule below.

1. Schedule

Marker Color	Buried Utility
Blue	Potable Water &Associated lines
Green	Sanitary Sewers, Storm Drain and other Drain lines
Orange	Telecommunication, signal, alarm
Purple	Reclaimed, Recycled, Irrigation Water and Slurry Lines
Red	Electric Power lines cables conduits and lighting cables
Yellow	Gas, Oil, Steam, Petroleum or Gaseous Material Lines

2. Warning Information shall be in Black Letters with typical wording of:
   a. "CAUTION: BURIED (NAME OF UTILITY LINE) BELOW"

C. For ferrous pipe material use 0.004" minimum polyethylene film; 6" wide clearly marking type of buried utility.
D. For non-ferrous pipe material (e.g. Concrete, PVC, PE, etc.) use detection tape composite of polyethylene and metallic core 6" wide clearly marking type of buried utility.
E. Seton Identification Products, New Haven, CT, Utility Safeguard LLC or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Marking tape shall be installed over utility lines centerline and buried 24" below grade.
B. Markings damaged during opening of trench shall be reinstalled with 2' overlap at broken sections.

END OF SECTION

SECTION 02654

PIPE INSTALLATION UNDER RAILROAD TRACKS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish and install all materials including all support structures, labor, equipment, and services necessary and perform all work required to install sewers under railroad tracks as shown on the Drawings and specified herein. Sewer installation shall be by installing a casing pipe by pipe ramming method and installing gravity carrier pipe inside casing pipe. Contractor shall bypass wastewater flows, dewater surrounding soil, post television inspect and test the completed pipe system as identified on the drawings.
2. Set-up of pipe ramming machine of suitable capacity to drive home entire length of casing.
3. Perform all work to meet requirements of the Railroad. If a conflict exists between this Division and the Railroad Specifications, the Railroad Specification shall apply unless specifically noted otherwise. Wherever the Railroad Specifications indicate "Owner or its Contractor" the specifications shall be altered to indicate "Contractor".
4. Perform any additional work specifically required by the Railroad.

B. The Owner shall be responsible for obtaining all necessary right-of-ways and easements. The Contractor shall verify that the necessary easements have been secured by the Owner. It is the responsibility of the Contractor to be familiar with applicable provisions of each easement as they apply to the work prior to bidding and abide by those provisions during construction. Copies of all right-of-ways and easements are available for review from the Owner.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
B. Section 02140: Temporary Construction Dewatering System
C. Section 02200: Earthwork
D. Section 02622: Polyvinyl Chloride (PVC) Non-Pressure Pipe
E. Section 02751: Sewer Flow Control
F. Section 02753: Television Inspection of Sewers
G. Section 02755: Final Sewer Testing

1.3 REFERENCES

A. AREMA Chapter 1, Section 4: Culverts.
B. AREMA Chapter 1, Section 5: Utilities.

1.4 INSURANCE AND CERTIFICATES

A. Obtain Workman's Compensation Insurance.
B. Obtain and submit insurance policies in accordance with the Contract Documents

C. All insurance policies shall be in effect before any work is started and remain in effect until formal acceptance of work by the Owner and Maine DOT.

1.5 DEFINITIONS

A. Pipe Ramming: A non-steerable system of forming a bore by driving an open-ended casing using a percussive hammer from a pit and only displacing the wall thickness of the casing.

B. Carrier Pipe: The interior pipe within the casing pipe. For this contract, the carrier pipe shall be SDR 35 PVC pipe.

1.6 QUALITY ASSURANCE

A. The pipe ramming Contractor shall be certified and satisfactorily trained by the pipe ramming system manufacturer.

B. Contractor shall have at least five years' experience in the installation of similar subsurface pipelines using pipe ramming technology or installed over 2,000 feet of steel casing in grade bore/difficult soil situations within United States in the last four years using pipe ramming equipment and materials of the type that meet the minimum requirements of the job specification. Contractor shall submit a reference list of projects including Owner, Engineer, addresses, phone numbers and dates that said projects were completed with their proposal.

C. Pipe Ramming shall be in accordance with the current AREMA Specifications, Chapter 1, Section 4.20: Earth Boring and Jacking of Culvert Pipes.

1.7 SUBMITTALS

A. Provide Submittals in accordance with Section 01340.

B. At a minimum, submit the following:

1. Certifications of training by the pipe ramming systems manufacturer for the operators on the project.
2. Certifications of training by the pipe fusion equipment manufacturers that the operators have been fully trained in the use of the fusion equipment.
3. Detail layout plans and written descriptions of the entire construction procedure to install casing pipe and carrier pipe, bypass sewage flow (Section 02751), pit sizes, pit locations, pit construction and shoring, replacement of manholes and connection, dewatering, and the sequence of construction. The following is not intended to limit, but to provide the minimum of details which must be included.
    a. A detailed description of the pipe ramming procedure including construction techniques to provide the access required to install pipe in conformance with contract documents.
    b. Manufacturer's literature describing in detail the pipe ramming system to be used. Detailed description of projects on which this system has been successfully used including the names, addresses and telephone numbers of Owner's representatives for these projects as well as length, diameter, and pipe material used.
    c. Calculations and drawings indicating limits of access pits and any ground support to be utilized.
    d. Methods of spoils disposal.

e. A groundwater stabilization scheme covering the excavations for starter and receiver pits. Verify this plan to stabilize anticipated unstable soil conditions. Such verifications shall include all calculations and detail drawings for methods of controlling groundwater.
f. Certification by the pipe ramming manufacturer of the thrust, condition, and operational characteristics of all equipment to be used for installing the specified pipes. The equipment shall employ a spoil removal system. The system shall include a safeguard to prevent caving beyond the outside diameters of the pipe.
g. Working Drawings, including the following pages:
    i. Layout of pipe ramming and ancillary equipment at each pit location.
    ii. Shop drawings, including configuration of cutter head shoe and overcut.
    iii. Spoil removal system details.
    iv. Pipe lubrication system details.
    v. Grade and alignment control system details.
    vi. Groundwater control provisions.
h. Details of mucking system and soil disposal methods.
i. Calculations demonstrating that the pipe selected has been designed to support the maximum anticipated earth loads and superimposed live loads, both static and dynamic, which may be imposed on the pipe. Determine the additional stresses imposed on the pipe during ramming operations and upgrade the quality and strength of the pipe and pipe joints to extent necessary to withstand the additional stresses imposed by the ramming operation. The details shall be submitted for approval.
j. Complete information on Contractor's safety plan for personnel conducting the ramming operations and appurtenance installation. The plan shall include provisions for lighting and electrical safeguards.
k. Pipe certification of compliance.
l. Pipe jointing method and details.
m. All Contractor submittals requiring structural design shall be signed by a professional civil or structural engineer registered in the State of Maine.
n. Written documentation summarizing the qualifications of the project, superintendent, operators, and site safety representative.

4. Detailed procedures for the installation and bedding of the new pipe in the launching and receiving pits.
5. Manufacturer's technical data showing complete information on material composition, physical properties and dimension for the new pipe and fittings. Manufacturer's recommendations for transport, handling, storage and repair of pipe and fittings.
6. Contingency plans for the following potential conditions: unforeseen obstructions causing casing stoppage, substantial surface heave occurs, damage to other existing utilities, loss of and return to line and grade, and soil heaving or settlement.

7. Project schedule.
8. Submit a log of the ramming operations. At a minimum the log shall consist of the following:
    a. The position of the pipe in relation to the design line and grade.
    b. The date, the starting time, and the finish time.
    c. Inclination.
    d. Advance rates.
    e. Hammer strokes per minute.
    f. Operating pressure.
    g. Muck quantities removed.
9. Submit a separate hand log tracking pipe lubricant used in gallons, its viscosity, and pumping pressure. Log shall be submitted daily.

C. Contractor to submit post construction CCTV inspection as specified in Section 02753.

1.8 CONTRACTOR QUALITY CONTROL

A. Field Tests and Inspections
    1. The Engineer will witness field tests specified in this section.
    2. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications.

B. Casing Testing
    1. General: Check each straight run of casing pipe for gross deficiencies by holding a light in the casing; it shall show a practically full circle of light through the casing when viewed from the adjoining end of line.
    2. Make sure that the pipe is unloaded from trucks with crane or backhoe and not dropped off or pushed off.

1.9 QUALITY CONTROL

A. Contractor shall establish and maintain quality control for operations under this section to assure compliance with contract requirements and maintain records of his quality control for materials, equipment, and construction operations including but not limited to the following:
    1. Preparatory Inspection: (To be conducted prior to commencing work.)
        a. Check pipe for conformance to approved certified tests.
        b. Check to make sure that there is no mid seam welds or if there are they be certified as 100% penetration welds.
        c. Check pipe for proper storage and handling.
        d. Discuss and review pipe installation procedure with Engineer to include placing of pipe, joint preparation and application of each pipe used.
    2. Initial Inspection: (To be conducted after a representative sample of the work is complete.)
        a. Check for proper depth and grade for pipe.
        b. Check method of joining pipes.
        c. Check the pipe for proper alignment.

1.10 JOB CONDITIONS

A. Procedures and materials shall meet the requirements and specifications of all parties involved.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Casing Pipe:
   1. ASTM A-53 Grade B carbon steel, seamless.
   2. Shall be smooth wall carbon steel pipe
   3. Black steel.
   4. Diameter as shown on Drawings.
   5. Pipe wall thickness shall be determined based on static and dynamic loads from traffic loading and anticipated ramming forces for selected pipe and driven pipe lengths. Pipe lengths shall be determined by Contractor.
      a. Pipe wall thickness for 48-inch Steel Casing Pipe shall be no less than 0.688 inches.
   6. Minimum yield strength shall be 35,000 psi.
   7. Allowable deflection of pipe = 3% of pipe diameter
   8. The new pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other defects. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other defect greater in depth than ten percent of the wall thickness, shall not be used and must be removed from the site.
   9. Steel pipe joints shall be watertight and welded.
   10. All steel casing pipe shall be square cut (with beveled ends for welding).
   11. Steel casing pipe shall have a roundness such that the difference between the major and minor outside diameters shall not exceed 1% of the specified outside diameter or 0.25 inches, whichever is less.
   12. Steel casing shall have an outside circumference which is within 1% of the nominal circumference or 0.50 inches, whichever is less.
   13. Steel casing pipe shall have a minimum allowable straightness deviation in any 10 foot length of 1/8 inch.

B. Carrier (PVC) Pipe
   1. The new pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other defects.
   2. Polyvinyl Chloride Plastic Pipe: SDR35. Refer to Section 02622 for additional information.

C. Restrained Pipe Spacers:
   1. Pipe spacers shall be a two-piece 14-gauge T-304 stainless steel assembly with stainless steel bolts. Assembly shall be the restrained positioning type. The runners shall be an ultra high molecular weight polymer with a maximum coefficient friction 0.12. The runners shall be attached to the support structures (risers) at appropriate positions to properly support the carrier pipe within the casing and to ease installation. The support heights are to be adjusted to provide the carrier (PVC sewer) pipe with the desired slope. The assembly shell liner shall be 0.090” (2.3 mm) ribbed PVC with 85-90 durometer. Spacer assembly

shall be as manufactured by Cascade Waterworks MFG. Co. or approved equivalent.

D. Rubber Casing End Seals
   1. Rubber casing end seals shall be designed to wrap around the casing and carrier pipes after installation to provide a barrier to backfill debris and seepage.
   2. End seals shall be manufactured of Virgin SBR with T-304 stainless steel bands to attach the seals to the casing and carrier pipes.
   3. End seals shall be Cascade Model CCES End Seals as manufactured by Cascade Waterworks Mfg. Co. of Yorkville, IL or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. All work shall be done in compliance with all current OSHA safety regulations.
B. The Contractor shall verify the elevations of the upstream invert for carrier pipe and intermediate point on sewer trunk line for verification that line and grade is maintained.
C. The Contractor shall not commence pipe ramming work until given authorization by the Owner and Engineer.
D. The Contractor shall control sewer flow and bypass pump per Section 02751.
E. The Contractor shall control dewatering per Section 02140.
F. The Contract Drawings show the conceptual layout of the entrance pits and exit pits. The pit sizes are only for guidance. The pits shall be sized based on the type of pipe ramming.
G. After the casing pipe installation is complete and prior to installation of carrier pipe, all field welds shall be inspected by CCTV for the full circumference of the pipe.
H. After completion of the work, perform CCTV inspection of the newly installed carrier PVC pipe per the requirements of Section 02753.
I. After completion of the work, perform sewer testing per the requirements of Section 02755.
J. Any settlement or heaving of the ground surface during or after construction (up to the one-year warranty period) shall be corrected by the Contractor at no additional cost to the Owner.
K. During the one-year warranty period, any defects which will affect the integrity or the strength of the PVC pipe shall be repaired at no additional costs to the Owner.

3.2 CASING PIPE INSTALLATION

A. Contractor to conduct pipe ramming per the requirements of the Contract Documents.
   1. Steel pipe segments shall be field welded during installation.
   2. The Contractor shall transport, handle, and store pipe and fittings as recommended by manufacturer.
   3. New pipe and fittings that are damaged before or during installation shall be repaired or replaced, as recommended by the manufacturer or required by the Engineer. The costs of such repair or replacement shall be borne by the Contractor and be accomplished prior to proceeding with the project.
   4. All work shall be conducted within existing easements and/or right-of-ways as indicated on the Drawings, unless otherwise indicated by the Owner and Engineer.

B. Locating Utilities: The Contractor is responsible for determining the location of the existing utilities that may be impacted by the pipe ramming. If necessary, the Contractor shall conduct a test pit to verify the location of an existing utility.

C. The Contractor shall be responsible for furnishing all bypass pumping or diversion equipment around a manhole or insertion pit.

D. The Contractor shall prevent damage to adjacent areas during ramming process.

E. No work shall commence on the pipe ramming phase until the design and construction procedure has been approved in writing by the Engineer. The Contractor is totally responsible for the performance of the equipment and methods selected for this phase. The Engineer's review and acceptance signifies only that the construction process is compatible with the overall objectives of the project.

F. Each pipe section shall be rammed forward as the excavation progresses in such a way to provide complete and adequate ground support at all times. Jacked installations shall have a bore hole having essentially the same outside diameter as the casing pipe. A hammer frame shall be positioned to develop a uniform distribution of ramming forces around the periphery of the pipe. Special care shall be taken by the Contractor to ensure that the launch seal is properly designed and constructed. Special care should be taken when setting the pipe guard rails in the pit to ensure correctness of the alignment.

G. The Contractor shall be responsible for monitoring ground movements associated with the work and making suitable changes in the construction methods to control ground movements and prevent damage or detrimental movement to the work and adjacent structures. Permissible tolerances with respect to settlement of ground surface and alignment of pipe shall not be exceeded.

H. If during installation an obstruction is encountered which prevents installation of the pipe in accordance with this specification, the pipe shall be abandoned in place and immediately filled with grout. A new installation procedure and revised plans must be submitted to, and approved by, the Railroad before work can resume.

I. Once work begins, operations must continue on a 24-hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the casing pipe has reached the receiving pit to prevent sleeve from "freezing".

J. The soil transportation method shall be capable of handling and removing material during the work. All excavated material from the pipe ramming and pit construction shall be disposed of off-site by the Contractor. Material may be disposed of at the City of Bath landfill free of charge.

K. A lubrication system shall be provided that injects an approved lubricant on the inside and outside of the pipe to lower the friction developed on the sides of the pipe during ramming.

L. The overcut on the pipe shall not exceed 1 inch without review and acceptance of the Engineer. The annular space created by the overcut shall be filled with a lubricant that has been proved suitable for the particular soil conditions.

M. Clean pipe of all debris from construction.

N. The Contractor shall guarantee that the installation meets the inverts as shown on the Contract Drawings. The Contractor is responsible for replacing the entire system including the pipe casing and carrier pipe if the desired inverts are not obtained.

3.3 CONSTRUCTION PITS

A. Construction techniques required to provide access for pipe ramming shall be such as to ensure the safety of the work.

B. Final dimensions of access pits shall be determined by the Contractor to provide safe conditions for the work.

C. Access pits and service pits shall be sheeted or shored in accordance with OSHA standards and shall be backfilled in accordance with Section 02200 - Earthwork to the satisfaction of the Owner and Engineer. All open pits and trenches shall be kept secured and backfilled at the end of the day unless otherwise indicated by the Engineer or Owner.

D. The number of pits for the machine and pipe insertion shall be the minimum necessary to accomplish the work.

E. Construct pits to accommodate the installation of pipe casings and ramming device. Install seals in the pit walls as required to control ground movement where the casings enter and exit the ground.

F. All work of excavating shoring and bracing, and pipe ramming shall be so executed that settlement is minimized, the in-place casing shall have full bearing against earth, and no voids or pockets are left in any portion of the work.

G. Before beginning construction at any location of this project, adequately protect existing structures and other permanent objects. The repair of or compensation for damage to permanent facilities due to negligence or lack of adequate protection on the part of the Contractor will be at no cost to the Owner.

H. Secure the required permits and promptly remove and dispose of any spillage.

I. Provide all dewatering and test any groundwater discharges. All discharge limits and reporting requirements shall be the responsibility of the Contractor.

3.4 CONTROL OF LINE AND GRADE

A. The Contractor shall establish a construction baseline and any needed temporary benchmarks, based upon the information provided on the Drawings. Check these baselines and benchmarks at the beginning of the contract period and report any error or discrepancies to the Engineer.

B. Use these baselines and benchmarks to furnish and maintain all reference lines and grades for the pipe installation. Use these lines and grades to establish the exact starting location of the pipe.

C. Submit to the Engineer copies of field notes used to establish all lines and grades; however, the Contractor remains fully responsible for the accuracy of their work and the correction of it, as requires.

D. The excavation and run of pipe rammed shall be controlled such that the deviation from grade is below the design grade requirements.

E. After installation of the pipe, provide the Engineer with access to both casing ends for visual inspection of the line and grade of the completed casing.

3.5 CARRIER PIPE INSTALLATION

A. PVC pipe segments shall be joined using push-on joints with factory-installed elastomeric ring gaskets per the requirements of Section 02622.

B. Carrier pipes shall be inserted within the casing pipe in a restrained position to maintain the slope by use of stainless steel casing spacers. Care shall be taken during

installation to keep the pipe from rotating and to keep the casing spacer runners aligned for the entire length of the carrier pipe.

C. Casing spacers shall be placed at no more than 8-foot intervals with a minimum of two casing spacers per length of carrier pipe. One spacer shall be placed not more than two feet from each end of the casing.

D. When carrier pipe is "in place", enclose the downstream end of the sleeve between the pipe and the sleeve with flexible seal, Portland cement grout or mortared brick, providing 1 inch diameter weep hole at invert of casing pipe.

E. Block the upstream end of sleeve with flexible seal, Portland cement grout or mortared brick

END OF SECTION

SECTION 02655

COUPLINGS & CONNECTORS FOR BURIED APPLICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install couplings and connectors of the type and size in the location shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. Minimum pressure rating equal to that of the pipeline in which they are to be installed.

B. Couplings and connectors, other than those specified herein, are subject to the Engineer's approval. Acceptable Manufacturers:
   1. Romac Industries
   2. Krausz
   3. Smith Blair
   4. Ford Meter Box Company
   5. Or Equal

C. Reference Standards:
   1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
   2. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
   3. AWWA C116 – Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
   4. AWWA C153 – Ductile-Iron Compact Fittings
   5. AWWA C213 – Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
   6. AWWA C219 – Bolted, Sleeve-Type Couplings for Plain-End Pipe
   7. All components in contact with potable water, or water being processed to become potable water, shall be compliant with NSF 61 and shall be constructed of “Lead-free” material in compliance with NSF 372.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the applicable section of Division 1 and the General Conditions of the Construction Contract.

B. Submit manufacturers product data and installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All Couplings and Connectors:
   1. Gasket Materials: Composition suitable for exposure to the liquids to be contained within the pipes.

2. Diameters to properly fit the specific types of pipes on which couplings and connectors are to be installed.

B. Sleeve Type Transition Couplings (for 4 – 12" pipe size)
   1. Buried Non-Restrained Couplings:
      a. Two top facing bolt design
      b. Fusion bonded epoxy ductile iron center sleeve, end rings and bolt guides. Ductile iron meeting or exceeding ASTM A536, Grade 65-45-12.
      c. Two wedge-section EPDM or NBR rubber gaskets compounded for water service. NSF-61 certified for potable water service.
      d. Ductile iron heat treated grippers, 304 stainless steel draw hooks, and reinforced nylon ramp runners.
      e. Nuts and bolts shall be 304 Stainless Steel with rolled thread and anti-galling compound.
      f. Couplings shall be long barrel type.
      g. Coupling shall be fusion bonded epoxy coated meeting AWWA C213 and NSF-61 standards for potable water applications.
      h. Acceptable Manufacturers:
         i. Romac Industries – Macro HP™
         ii. Krausz – Hymax® 2
         iii. Smith Blair – Model 421
         iv. Or Equal
   2. Buried Restrained Couplings:
      a. Two top facing bolt design
      b. Fusion bonded epoxy steel or ductile iron center sleeve and end rings.
      c. Two wedge-section EPDM or NBR rubber gaskets compounded for water service and NSF-61 certified.
      d. 304 Stainless Steel bridge or Armor over gasket in expansion zone.
      e. Nuts and bolts shall be 304 Stainless Steel with rolled thread and anti-galling compound.
      f. Couplings shall be long barrel type.
      g. Coupling shall be fusion bonded epoxy coated meeting AWWA C213 and NSF-61 standards for potable water applications
      h. Acceptable Manufacturers:
         i. Romac Industries – Alpha™
         ii. Krausz – Hymax Grip
         iii. Smith Blair – Pipe Lock Coupling
         iv. Or Equal

C. Solid Sleeve Couplings
   1. Solid sleeves shall be ductile iron with mechanical joint ends.
   2. Couplings shall meet AWWA/ANSI C-153/A21.53 and C-111/A21.11 for joints, and C-104/A21.4 for cement lining in sizes 3"-24".
   3. Nuts and bolts shall be ductile iron low alloy steel per ANSI/AWWA A21.11/C-111.
   4. Acceptable Manufacturers:
      a. Romac – Model 501
      b. Smith Blair – Model 441.
      c. Ford – Model FC1 or FC2A
      d. Or Equal

D. Flexible Couplings for drain connections (Fernco or equal)
   1. Rubber material with stainless steel clamps
   2. Must provide a positive seal against infiltration and exfiltration
   3. Coupling materials must conform to applicable portions of ASTM C443 (Concrete), C564 (Cast Iron), D1869 (A.C.), D5926 (PVC), C1173 (transition) and CSA B602.

E. Mechanical Joint Adaptors (Foster Adaptor® – Infact Corporation)
   1. Required to connect fittings and valves with mechanical joints
   2. Ductile iron construction mechanical joint bolt pattern.
   3. Bolts and nuts shall meet AWWA C-111.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sleeve Type Couplings:
   1. Thoroughly clean pipe ends a minimum of 12-inches from the ends prior to installing couplings and use soapy water as a gasket lubricant.
   2. Slip an end ring and gasket over each pipe and place the center sleeve centered over the joint.
   3. Insert the other pipe length into the center sleeve the proper distance.
   4. Press the gaskets and end rings evenly and firmly into the center sleeve flares.
   5. For two-bolt systems, insert or tighten the bolts, finger tighten and progressively tighten nuts on the top of the coupling with a torque wrench applying the torque recommended by the manufacturer. For multiple bolt systems, insert or tighten the bolts, finger tighten and progressively tighten diametrically opposite nuts around the coupling with a torque wrench applying the torque recommended by the manufacturer.
   6. Insert and tighten the tapered threaded lock pins as needed.

B. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.

END OF SECTION

SECTION 02656

AIR RELEASE VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test combination air vacuum/release valves of the sizes and the types and in the locations shown on the Drawings and specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. All air release valves, for the same service, shall be manufactured by one manufacturer.
B. The valve manufacturer shall have ISO 9001 and ISO 14001 certifications.
C. All air valves shall be provided with a written Five-year warranty.
D. Acceptable Manufacturers:
    1. Dezurik/APCO Valves
    2. A.R.I.
    3. Crispin
    4. GA Industries
    5. Or equal.

1.4 SUBMITTALS

A. Submit shop drawings in accordance with the applicable section of Division 1 and the General Conditions of the Construction Contract.
B. Submit manufacturers installation instructions and specifications for all valves.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:
    1. All valves shall be suitable for the intended service.
    2. Valve sizing shall be as recommended by the manufacturer to suit the pressure and flow condition of each application shown on the drawings.
    3. The valve manufacturer shall furnish installation, operation and maintenance manuals with each valve.
B. Sewage Service:
    1. Combination Air Vacuum/Release Valves (sewage service):
        a. Combination Air Valves shall be float operated valves designed to release accumulated air or gas from a piping system while the system is in operation and under pressure. The valve shall allow unrestricted venting or re-entry of air, through it, during filling or draining of a pipeline/force

main, to prevent water column separation or pipeline collapse due to vacuum.

b. Valve shall incorporate one upper and one lower stainless steel float, connected by a common stainless steel float guide, thereby maintaining an air gap between the bottom float and top shut-off float. The air gap shall retard waste solids from fouling or clogging the top shut-off float.
c. The internal baffle shall be fitted with a guide bushing and act to protect the shut-off float from direct air flow. The baffle shall retain the 45 Durometer Buna-N seat in place without distortion, for tight shut-off.
d. Cast iron body, cover and baffle; brass internal parts.
e. All internals shall be easily removed through the top covers without removing the main valve from the lines.
f. Both floats shall withstand 500 psi or more.
g. Furnished with inlet shutoff valve; outlet; blowoff/drain valve; shutoff valve with quick disconnect coupling and 5-feet of hose to permit backflushing without dismantling valve.
h. The valve inlet shall have 3-inch N.P.T. and the outlet 3-inch N.P.T.
i. Equal to APCO Series ASC-3 sewage air and vacuum valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves in accordance with manufacturer's instructions and recommendations and as shown on the Drawings.
B. Install all valves in the vertical position and allow sufficient clearance around valve for proper maintenance and removal. Valves shall be properly supported.
C. Provide piping and valves between air valve and pipeline as shown on the drawings.
D. The exhaust lines from the air valves shall terminate in down turned position 18 inches above the floor.
E. Test all valves in the presence of the Engineer to demonstrate proper operation. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. The Contractor shall set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges and reset upon completion of test to the design value. Contractor shall take care not to over-pressurize any valves or appurtenances during testing.
F. If the equipment does not successfully pass the tests listed above, the Manufacturer/Contractor shall repair the equipment and perform the tests again until passing the tests successfully. If any deficiencies are revealed during any test, such deficiencies shall be corrected, and the tests shall be re-conducted at no additional cost to the Owner.

END OF SECTION

SECTION 02751

SEWER FLOW CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: During the installation, replacement, rehabilitation and/or testing of sanitary sewer lines and sanitary sewer manholes via open-cut or trenchless approach, the Contractor shall maintain and control flow around the pipe segment(s) or structure(s) that are temporarily out of service. Existing sewer services shall remain live at all times during the progress of the Work. Sewer flow control which extends outside of Contractor work hours shall be completed in accordance with Section 01515. All temporary pumping equipment shall meet the requirements outlined in local noise regulations.

B. Additional Requirements Specified Elsewhere:
   1. Summary of Work: Section 01010
   2. Submittals: Section 01340
   3. Temporary Bypass Pumping Systems: Section 01515
   4. Sewer Line Cleaning: Section 02752
   5. Television Inspection of Sewers: Section 02753
   6. Final Sewer Testing: Section 02755

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. In accordance with the requirements of Section 01340. Additional specific information required is listed below.
   1. Proposed schedule, sequence of construction, duration of activities and description of sewer control methods to be utilized for each element of the project.
   2. Technical data (including capacity and fuel tank size) of any portable temporary pumping equipment to be used during normal Contractor work hours.
   3. Supplemental information required under Section 01515 for sewer flow control which extends beyond Contractor work hours.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.1 COORDINATION OF WORK

A. Provide all labor and equipment necessary to coordinate work of this section and maintain communications.

B. Notify all personnel, including but not limited to the Owner, Engineer, and Utility Companies seven days in advance of any temporary bypass pumping work. The Owner will identify personnel to be notified in addition to those identified by the Contractor.

C. Contractor shall coordinate temporary bypass pumping operations with the Owner and Engineer on a daily basis.

3.2 PERFORMANCE

A. General
   1. The Contractor shall install and test all sewer flow control methods to the satisfaction of the Owner and Engineer prior to proceeding with the Work.
   2. The Contractor shall be solely responsible for clean-up, repair, property damage costs and claims resulting from failure of the diversion system.

B. Plugging or Blocking:
   1. Insert plug at a manhole upstream of line to be inspected and tested.
   2. Plug shall be so designed that all or any portion of the sewage flows can be released.
   3. Flows shall be shut off or substantially reduced during line testing.

C. Pumping and Bypassing:
   1. When required, supply the necessary pumps, conduits and other equipment (including standby equipment) to divert the flow of sewage around the line in which work is being performed.
   2. Furnish the necessary labor and 24-hour supervision to set up, test and operate the pumping and bypassing system.
   3. Any temporary pumps, piping, fuel storage, or other appurtenances associated with the portable temporary pumping equipment shall be either located above the 100-year flood elevation or protected against flotation or other damage which would be caused by a flood event.

END OF SECTION

SECTION 02752

SEWER LINE CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide all equipment necessary for the proper cleaning of the sewers prior to the joint testing operations and/or closed circuit television inspection.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCE

A. The type of pipe cleaning (light vs heavy) shall be chosen based on the definitions in the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) Version 7.0 standards.
   1. Light cleaning definition – Cleaning and removal of settled deposits when the deposits are less than the following percentage of the pipe diameter:
      a. Pipe diameters less than or equal to 12-inches: < 25%
      b. Pipes diameters between 13-inches and 24-inches: < 15%
      c. Pipes diameters between 25-inches and 30-inches: < 10%
      d. Pipe diameters greater than 30-inches: not applicable (use heavy cleaning)
   2. Heavy cleaning definition – Cleaning and removal of settled deposits when the deposits are greater than the following percentage of the pipe diameter:
      a. Pipe diameters less than or equal to 12-inches: > 25%
      b. Pipes diameters between 13-inches and 24-inches: >15%
      c. Pipes diameters between 25-inches and 30-inches: >10%
      d. Pipe diameters greater than 30-inches: all pipes regardless of the amount of deposits

PART 2 - PRODUCTS

2.1 MATERIALS

A. High Velocity Hydro-Cleaning Equipment shall:
   1. Have a minimum of 400 feet of high pressure hose.
   2. Have multiple high velocity nozzles, as follows:
      a. Standard 35 degree nozzle with multiple rear jets and one front jet.
      b. Sand nozzle capable of transporting sand and gravel to the downstream manhole; and
      c. Rotating nozzle for removal of grease and scale.
   3. Include a high velocity gun for washing and scouring manhole walls and floor.
   4. Be capable of producing flows from a fine spray to a long distance solid stream.
   5. Include a water tank, auxiliary engines and pumps, and a hydraulically driven hose reel.
   6. Have equipment operating controls located above ground.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Select cleaning equipment based on the conditions of the lines at the time the work commences.
   1. Light cleaning (as defined by NASSCO PACP): Use high pressure water jetting equipment, brushes and swabs.
   2. Heavy cleaning (as defined by NASSCO PACP): Use high pressure water jetting equipment specifically designed for the intended use.

B. Use selected equipment to remove all dirt, grease, rock and other deleterious materials and obstructions.

C. Protect existing sewer lines from damage caused by improper use of cleaning equipment.

D. Take precautions to avoid damage or flooding to public or private property being served by the line being cleaned.

E. Removal of Materials:
   1. Remove all solids and semi-solids at the downstream manhole of the section being cleaned.
   2. Passing material from one section of a line to another will not be permitted.

F. Disposal of Materials: Remove from the site and dispose of all solids or other waste materials recovered during the cleaning operations in an approved manner.

3.2 DETERMINING TYPE OF CLEANING

A. All heavy cleaning must be coordinated with RPR or Engineer verbally or written for each pipe before any heavy cleaning commences.

3.3 FIELD QUALITY CONTROL

A. Acceptance of this portion of the work may be made upon completion of subsequent television inspection and shall be to the complete satisfaction of the Engineer.

END OF SECTION

SECTION 02753

TELEVISION INSPECTION OF SEWERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish all necessary labor, materials, supervision and equipment to satisfactorily inspect gravity sewer lines as required by the Contract Documents by means of a closed circuit television (CCTV) system.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 QUALITY ASSURANCE

A. CCTV work shall be completed and delivered per the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) Version 7.0 standards. Operators of CCTV equipment shall be currently certified in NASSCO PACP.

1.4 SUBMITTALS

A. Provide shop drawings as specified in the General Conditions and Section 01340.
B. Contractor shall submit copies of active NASSCO PACP certifications.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. The cameras shall be designed and constructed for sewer line inspection work. The mechanical design of the lens shall allow it to turn and rotate 360 degrees to provide a close up view of sewer pipe walls and sewer service pipes. The camera shall be designed to maintain proper orientation of the picture while the lens is turning and rotating.
B. The cameras shall be operative in 100% humidity conditions.
C. The lighting for the cameras shall be suitable to allow a clear picture of service pipes and the entire periphery of the mainline sewer pipe, such that joints, root intrusions, cracks, offset joints, deposits, etc. can be seen and identified by the Engineer.
D. The lens focus and rotational capabilities and the light intensity will be remotely controlled from an above ground television "studio".
E. The cameras shall produce a continuous, full color picture with a quality acceptable to the Engineer.

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Flow Control:

1. A minimum of 75% of the periphery of the sewer line shall be visible at all times.
2. The Engineer may require that the line be plugged so that the entire periphery can be inspected. For details on sewer flow control, see Section 02751.

B. Operation:
1. Perform inspection of sewer lines after lines have been suitably cleaned.
2. When inspecting newly constructed sewer lines, introduce water into the sewer lines to be tested from the upstream manhole prior to the television inspection, but no more than 24 hours in advance of the inspection.
3. Lines will be suitably isolated from the remainder of the sewer line as required.
4. Move the cameras through the line in either direction at a moderate rate, not to exceed 30 feet per minute, as recommended by NASSCO PACP standards.
5. The Engineer may require Contractor to pull cameras back to get a second view of a section of the pipe.
6. Use manual winches, power winches, television cable reel powered rewinds, high-pressure hose and reels on jet-cleaning trucks, or a flexible pole, to move the camera through the sewer.
7. If, during the inspection operation, the camera will not pass through the entire pipe section, the Contractor shall set up the equipment so that the inspection can be performed from the opposite manhole on the pipe segment.
8. The screen monitor and winch operators shall be in full communication at all times.
9. Remove all wires, screens, sand bags, etc. used in the television inspection process from the sewers at the completion of inspection of each sewer section.

C. Measurement:
1. Measurement for location of defects, service connections, etc., shall be accurate to two tenths (0.2) of a foot over the length of the section being inspected.

D. Records:
1. Printed records shall be provided, reflecting location of defects, service connections, etc., and shall be recorded per NASSCO PACP standards and stored to a NASSCO PACP-certified digital reporting software:
    a. Keep records and supply to the Engineer when the work has been completed.
    b. Show the exact location in relation to adjacent manholes, of each infiltration point discovered by the television camera.
    c. Show locations of laterals, unusual conditions, roots, break-in storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible features.
2. Inventory the houses and apparent empty lots bordering each section of sewer line that is inspected and compare results to the number and location of house services found during the inspection. Log inconsistencies and report them to the Engineer.
3. Database
    a. One copy of the NASSCO PACP Exchange database shall be provided in digital format (MS Access).

4. Video / Photographs:
   a. Two copies of the video shall be provided on an external hard drive, downloaded or output from a NASSCO PACP-certified software: one copy to the Engineer and one copy to the Owner.
   b. The video shall be digitally recorded, indexed by pipe section (labeled by manhole number or other means acceptable to Engineer) and allow for printing of still photographs. Videos shall be labeled with the following naming convention:
      i. StartMH###EndMH###, where ### shall indicate the manhole as identified by the Owner's manhole numbering convention. No hyphens or other symbols shall be used.
   c. Photographs shall be printed at Engineer's request and shall be identified on the back as follows:

      Date_____; Section: MH#_____ to MH#_____
      Diameter of Sewer _____; Distance from MH#_____ is _____LF
      Description of item photographed _____
      _____

END OF SECTION

SECTION 02755

FINAL SEWER TESTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Final sewer testing work includes the performance of testing and inspecting each and every length of sewer pipe, pipe joints and each item of appurtenant construction.
2. Perform testing at a time acceptable to the Engineer, which may be during the construction operations, after completion of a substantial and convenient section of the work, or after the completion of all pipe laying operations.
3. Provide all labor and equipment necessary to conduct tests.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

PART 2 - PRODUCTS - NOT APPLICABLE

PART 3 - EXECUTION

3.1 PERFORMANCE

A. General:

1. All sewers, manholes, and appurtenant work, in order to be eligible for acceptance by the Engineer, shall be subjected to tests that will determine the degree of watertightness and horizontal and vertical alignment.
2. Thoroughly clean and/or flush all sewer lines to be tested, in a manner and to the extent acceptable to the Engineer, prior to initiating test procedures.
3. Perform all tests and inspections in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes.
4. Perform testing by test patterns determined by or acceptable to the Engineer.
5. Remedial Work:
    a. Perform all work necessary to correct deficiencies discovered as a result of testing and/or inspections.
    b. Completely retest all portions of the original construction on which remedial work has been performed.
    c. Perform all remedial work and retesting in a manner and at a time acceptable to by the Engineer at no additional cost to the Owner.

B. Alignment Tests (Gravity Sewers):

1. Perform tests for the correctness of horizontal and vertical alignment on each and every length of gravity sewer pipeline between manholes.
2. Alignment tests to be conducted after all pipe has been installed and backfilled.

3. The observation test shall be conducted after all upstream work has been completed and the pipeline cleaned of debris.
4. Notify the Engineer at least 24 hours in advance of the proposed observation testing.
5. Introduce water into the sewer lines to be tested from the upstream manhole prior to the observation test but no more than 24 hours in advance of the test.
6. Beam a source of light, acceptable to the Engineer, through the pipeline from both ends and the Engineer will directly observe the light in the downstream, and/or upstream manhole of each test section.
7. To pass this test, the following conditions must be met:
    a. A full circle of light (full diameter of the pipe) shall be observed.
    b. No standing water shall be allowed. The presence of standing water shall be cause for rejection of that pipe (including manhole) section.
8. Improper alignment will be corrected by re-excavation and resetting of pipe at no additional cost to the Owner.

C. Pipe Deflection: (Gravity Sewers)
1. Pipe provided under this specification shall be installed so there is no more than a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (normal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
2. The Contractor shall wait a minimum of 30 days after completion of a section of sewer, including placement and compaction of backfill, before measuring the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.
3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

D. Television Inspection Tests (Gravity Sewers)
1. For all gravity sewer lines, television inspection testing is required. Test procedures shall be in compliance with the requirements outlined in Specification Section 02753.
2. No standing water shall be allowed. The presence of standing water may be cause for rejection of that pipe.
3. Any standing water, detectable leaks, improper joints or any other unacceptable feature detected by the television inspection will be corrected by re-excavation and resetting pipe at no additional cost to the Owner.

E. Inspection of Appurtenant Installations:
1. Completely inspect, at a time determined by the Engineer, all manholes and inlets to ascertain their compliance with the Drawings and Specifications.
2. Provide access to each manhole and inlet and check the following characteristics:
    a. Shape and finish of invert channels
    b. Watertightness and finish of masonry structures
    c. Location, type, and attachment of stops
    d. Elevation and attachment of frames, covers, and openings

e. Pattern and machining of covers
f. Drop connection arrangements

F. Testing Pressure Sewers – Ductile iron:
1. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, the Contractor shall make the necessary excavations backfilling and taps at such points and shall plug said holes after completion of the test.
2. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
3. Perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi whichever is greater (based on the elevation of the lowest point of the section under test and corrected to the gage location). Test duration shall be two hours.
4. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. Leakage, if any, shall be equal to or less than the amounts as determined by Section 4.2 of AWWA C 600.

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

L = allowable leakage in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure, in pounds per square inch

5. In addition to meeting the leakage testing above, all joints within chambers and all flanged joints shall have no visible leakage.
6. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.

G. Manhole Leakage Testing:
1. Specified in the "Manholes, Covers and Frames" Section in Division 2.

END OF SECTION

SECTION 02760

CLEANING AND PIGGING OF FORCE MAIN

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes requirements for cleaning and pigging of existing force main pipelines to remove accumulated solids, debris, or construction-related materials to restore or maintain hydraulic capacity and performance.

B. The Work shall include furnishing all labor, equipment, tools, and incidentals necessary for cleaning by means of pigging and water flushing.

C. Refer to Appendix D for drawings and available information on the existing force main alignment, configuration, and appurtenances.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Provide submittals in accordance with Specification Section 01340.

1. Proposed schedule, sequence of construction, duration of activities and description of cleaning and pigging methods to be utilized for each element of the project.
2. Call list for alarm response should cleaning or pigging result in the pump station or force main being taken offline for an emergency during cleaning and pigging. Names of septage haulers and individuals responsible for on-call response during entire duration of cleaning and pigging activities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning and Pigging Equipment shall:

1. Be appropriately sized for the force main diameter and capable of traversing all bends, fittings, and valves.
2. Be retrievable from the force main upon completion of cleaning and pigging activities.
3. Include, but is not limited to, pig launchers and receivers (as needed), flow control valves, pressure gauges, and flushing systems.

2.2 ACCEPTABLE MANUFACTURERS

A. Vortex Companies;

B. Or equal.

PART 3 - EXECUTION

3.1 COORDINATION OF WORK

A. Provide all labor and equipment necessary to coordinate work of this section and maintain communications.

B. Notify all personnel, including but not limited to Owner, and Engineer seven days in advance of any cleaning and pigging work. The Owner will identify personnel to be notified in addition to those identified by the Contractor.

C. Contractor shall coordinate cleaning and pigging operations with the Owner and Engineer on a daily basis, should it take more than one day.

D. Wastewater conveyance must be maintained at all times, unless coordinated and approved by Owner and Engineer.

E. The pump station and force main are susceptible to increased flows during wet weather. The work shall be planned to occur during forecasted dry weather periods.

3.2 PREPARATION

A. Coordinate with the Owner prior to commencing work to provide access to the sections of pipeline to be cleaned.

B. Confirm access locations and operational status of valves and appurtenances.

3.3 CLEANING PROCEDURE

A. Clean the force main using pigging methods suitable for the pipe material, configuration, and condition.

B. Perform cleaning until visual indicators show debris removal is complete, and flow conditions have improved to the satisfaction of the Owner.

C. Methods shall avoid excessive pressure or flow rates that could damage the system.

3.4 CLEAN UP

A. Upon completion, remove all cleaning equipment and restore work areas to original conditions.

B. Provide a summary of the cleaning activity, including observations and anomalies encountered during the work and provide to Owner.

3.5 FIELD QUALITY CONTROL

A. Acceptance of this portion of the work may be made upon completion of subsequent cleaning and pigging and shall be to the complete satisfaction of the Engineer.

END OF SECTION

SECTION 03010

CONCRETE MODIFICATIONS AND REPAIRS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Modifications and Repairs

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-301 – Specifications for Concrete Construction
B. ASTM C920 – Standard Specification for Elastomeric Joint Sealants

1.4 SUBMITTALS

A. Submit product data and Safety Data Sheets for repair materials. Indicate the intended use and locations for all products.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 except as modified herein.
B. All repair materials shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) Compliance.

PART 2 - PRODUCTS

2.1 CEMENTITIOUS REPAIR MATERIAL/ CONCRETE RESURFACER

A. To be used for resurfacing the wetwell walls and spot repair of damaged and degraded concrete.
B. Polymer modified concrete resurfacing material
    1. Acceptable products:
        a. Sikatop 122 Plus by Sika Corporation
        b. Flo-Coat Concrete Resurfacer by Sakrete
        c. Akona Polymer-Modified Concrete Resurfacer by TCC Materials
        d. Or equivalent.

2.2 REPAIR MATERIALS

A. Grout Paint: 1 part portland cement, 1 part fine sand, and water for the consistency of thick paint.
B. Patching Mortar for tie holes: 1 part of a mixture of white and grey Type II portland cement to 2.5 parts of damp loose sand. Cement type to match substrate.
C. Bonding Agent:
    1. For concrete - as specified in Section 03150.
    2. For repair mortar – bonding agent shall also serve as anti-corrosion coating for exposed steel reinforcement, and shall be as recommended by the manufacturer for compatibility with the repair material (also specified herein):

a. Armatec 110 EpoCem by Sika Corporation
b. Duralprep A.C. by Euclid Chemical Co.
c. MasterProtect P 8100 AP by Master Builders

D. Repair of random cracks (dry – free of liquid or moisture):
1. 2-component, 100% solids, moisture-tolerant, low-viscosity, high-strength, multipurpose, epoxy resin adhesive.
2. Acceptable products:
a. Sikadur 35 Hi-Mod LV by Sika Corporation
b. Eucopoxy Injection Resin by Euclid Chemical Co.
c. MasterInject 1380 by Master Builders
d. Or equivalent

E. Repair of random cracks (wet - presence of liquid or moisture):
1. Low viscosity polyurethane resin that expands and forms a closed cell foam when it comes in contact with water.
2. All cracks that are wet (either damp or leaking) at the time of repair shall be repaired with a material that is specifically intended for wet repair as recommended by the manufacturer.
3. Acceptable products:
a. SikaFix HH Hydrophilic by Sika Corporation
b. SikaFix HH LV by Sika Corporation
c. Or equivalent

F. Repair of spalls, honeycomb areas and air voids and cementitious overlays:
1. Polymer modified, non-sag cementitious repair mortar with corrosion inhibitor.
2. Repair material shall include peastone for repairs of greater depth as required by the manufacturer. Install in lifts as recommended by the manufacturer. For repair areas involving depths generally in excess of three (3) inches, utilize a repair material suitable for the depth of repair.
3. Acceptable products:
a. SikaTop 122 Plus or 123 Plus by Sika Corporation
b. Duraltop Gel by Euclid Chemical Co.
c. MasterEmaco N 400 by Master Builders
d. Or equivalent

G. All repair materials shall be installed in accordance with the manufacturer's recommendations.

PART 3 - EXECUTION

3.1 FINISH

A. Repair and properly cure all defects, and match finish of surrounding concrete.
B. Clean all exposed concrete surfaces and adjoining work stained by leakage of repair materials.

3.2 CURING

A. Curing shall be in accordance with Section 03390.

3.3 COLD WEATHER:

A. Repairs during cold weather shall be in accordance with Section 03340.

3.4 HOT WEATHER:

A. Repairs during hot weather shall be in accordance with Section 03341.
B. Protect repairs from plastic shrinkage cracking and rapid evaporation of water.
C. Shade from direct sun and protect from wind.

3.5 REPAIRS TO CONCRETE (GENERAL)

A. Definitions:
   1. Honeycombed areas: Areas where voids are left in the concrete due to inadequate vibration and consolidation resulting in a failure of the mortar to effectively fill the spaces among coarse aggregate particles.
   2. Spalls: Concrete that has chipped, flaked, scaled or broken off from the surface of the concrete.
   3. Surface Defects: Those defects that affect the appearance of the finished concrete but do not affect the structural integrity.
   4. Structural Defects: Those defects that affect the appearance of the finished concrete and the structural integrity.
B. Surface Defects include, but are not limited to:
   1. Form tie holes
   2. Air voids (bugholes) larger than those specified for the required surface finish
   3. Honeycomb areas with a depth less than 1 inch
   4. Blisters
   5. Delaminations
   6. Visible construction joints, fins and burs
   7. Non-uniform concrete color and appearance
   8. Surfaces that are not level
C. Structural Defects include, but are not limited to:
   1. Random cracks
   2. Excessive cracking (crazing)
   3. Spalls
   4. Air voids (bugholes) & honeycombed areas, depth of 1 inch and greater
D. All repairs to newly placed concrete shall be at no additional cost to the Owner.
E. All repairs shall be in accordance with the repair material manufacturer's recommendations.

3.6 REPAIR OF SURFACE DEFECTS

A. As soon as the forms have been stripped and the vertical concrete surfaces exposed or concrete slabs have been finished and cured, repair all surface defects. All concrete repair work shall result in a concrete surface of uniform color and texture and shall be free of all irregularities.
B. Form Tie Holes: After cleaned and thoroughly dampened, apply cementitious repair mortar or grout paint and fill holes solid with patching mortar.
C. Air voids (bugholes): After cleaned and thoroughly dampened, apply cementitious repair mortar or grout paint and fill holes solid with patching mortar.
D. Honeycomb areas:
   1. All honeycombed areas shall be removed to sound concrete by means of hand chisels or pneumatic chipping hammers or hydrodemolition.
   2. Saw cut 1/2-inch deep around the edges of the defective area. Saw cut the edges perpendicular to the surface. No feather edges shall be allowed.

3. Remove all loose aggregate paste and debris and scrub clean. Thoroughly wet area to be repaired. Brush and scrub grout paint into the substrate of the area to be repaired.
4. Mix patching mortar using as little water as possible. Allow to stand with frequent manipulation of trowel to achieve stiffest consistency. Blend white and gray portland cement to achieve color match with surrounding concrete.
5. Prior to the set of grout paint (but after it has cast its water sheen), apply a stiff consistency of patching mortar to the area with a trowel. Leave patched surface slightly higher than surrounding surface. Do not finish for 1 hour minimum. Cure in same manner as adjacent concrete.

E. Blisters and delaminations: Repairs shall be similar to those for honeycomb areas. Depth of saw cut shall match the depth of the defective concrete.

F. Visible construction joints, fins and burrs: Remove by grinding until a smooth uniform surface is attained.

G. Concrete with an overall non-uniform color or appearance as determined by the Engineer shall be repaired with a complete cementitious overlay. Application of the overlay shall be in strict accordance with the manufacturer's written instructions and recommendations.

H. Finished Flatwork exceeding specified tolerances:
1. High areas shall be repaired by grinding after the concrete has cured 14 days.
2. Low areas shall be repaired by adding appropriate overlay material. Grind concrete if required to provide minimum overlay thickness as required by the manufacturer. Finish repair area to match adjacent concrete.

3.7 REPAIR OF STRUCTURAL DEFECTS

A. Remove and replace or repair all structural defects in newly placed concrete.

B. Repair all structural defects in existing concrete that are identified by the Engineer during construction. These repairs are identified either on the Structural Drawings or as directed by the RPR and delineated as base bid or per square foot bid items.

C. Unless otherwise indicated, all concrete defects shall be repaired in accordance with the specific repair material manufacturer's recommendations.

D. Random cracks:
1. Cleaning of cracks:
   a. Dry cracks: Crack or void must be dry at time of application. Remove all dust, debris, loose or degraded/disintegrated material from cracks or voids by the use of oil-free compressed air or vacuuming and mild mechanical wire brushing. Cracks saturated with oil or grease must be chipped out to unsaturated concrete.
   b. Wet cracks: Clean the crack surface so that the crack can be located. If the crack is wide or flowing water is encountered, seal the surface of the crack with a surface sealing material as recommended by the manufacturer.
2. Where cracks extend through horizontal members and are accessible, seal bottom of crack which is to receive the specified repair material.
3. Patching of vertical wall or overhead cracks shall be accomplished in the same manner using a similar material of higher viscosity as recommended by the manufacturer.
4. Apply specified repair material in strict accordance with manufacturer's recommendations.

E. Spalls and honeycomb areas:
   1. Saw cut 1/2-inch deep around the edges of the defective area to serve as the boundary for concrete removal. Saw cut the edges perpendicular to the surface. No feather edges shall be allowed.
   2. All weakened, damaged, disintegrated, and unsound concrete shall be removed to sound concrete substrate by means of hand chisels, pneumatic chipping hammers, or hydrodemolition. Pneumatic chipping hammers shall not exceed 15 pounds due to resulting substrate bruising, unless followed by abrasive or high pressure (15 ksi minimum) water blasting.
   3. If defective areas extend to reinforcement, chip out concrete to provide a clear space of at least 3/4 inch, and not less than ¼ inch plus the repair mortar maximum aggregate size, all around the bar. Remove concrete along the bar to the point where the bar is fully bonded to the surrounding concrete and without loose corrosion products. Notify the Engineer if excessively corroded reinforcement is encountered so it can be evaluated. This includes 1/8 inch or greater loss of the original bar diameter after removal of corrosion.
   4. Exposed reinforcement shall be cleaned to bare metal by wire brushing or abrasive blasting.
   5. Fully coat all surfaces of reinforcement with bonding/anti-corrosion agent specified herein.
   6. Prepare and fully coat concrete substrate with specified bonding agent as recommended by manufacturer.
   7. Apply specified repair material in strict accordance with manufacturer's recommendations.

3.8 MODIFICATIONS TO EXISTING CONCRETE

A. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, temporary bracing and shoring and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work and to prevent damage to the structures or contents by falling or flying debris.

B. Remove concrete to the depths shown or required. Except for the removal of concrete from around reinforcement to remain, the use of heavy-duty pneumatic hammers to remove concrete is not permitted.

C. Use of scabblers, scarifiers, bush hammers, or pneumatic hammers greater than 15 pounds is not permitted due to resulting substrate bruising, except if followed by steel shot-blasting, abrasive blasting, or high-pressure (minimum 15,000 psi) water-jetting.

D. Surfaces must be clean and sound. Remove dust, laitance, grease, curing compounds, impregnations, waxes, foreign particles, and disintegrated materials. Clean surface of all contamination and debris, and roughen as recommended by repair material manufacturer.

E. Exposed reinforcement shall be cleaned by wire brushing, steel shot blasting, or abrasive sand blasting.

F. Prepare and fully coat concrete substrate with specified bonding agent as recommended by manufacturer.

G. As indicated, install concrete repairs or specified repair material in strict accordance with manufacturer's recommendations.

3.9 CORING OF HOLES

A. Core drill holes only where shown. Prior to coring holes in existing concrete, Contractor shall coordinate with the Owner and Engineer to determine the location of existing utilities in the concrete.

B. Coring shall be performed with a non-impact rotary tool with diamond core drills, size shall be suitable for pipe conduit, sleeves or mechanical seals to be installed. Protect all existing equipment, utilities and critical areas against water or other damage caused by the drilling operation.

C. No additional structural members shall be cut without review by the Engineer with no exceptions taken.

D. Apply epoxy paint (5 mils DFT minimum) to exposed reinforcement cut during coring that will not be covered with new concrete or repair material.

3.10 CUTTING

A. Prior to cutting existing concrete, Contractor shall coordinate with the Owner and Engineer to determine the location of existing utilities in the concrete.

B. Cutting shall be done with a concrete saw and diamond saw blades of proper size.

C. Provide for control of slurry generated by sawing operation on both sides of wall.

D. When cutting a reinforced concrete wall, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure.

E. New openings in existing concrete shall be overcut and formed as follows:

1. The opening size removed shall be 6" greater on each side, unless otherwise indicated on the Drawings.
2. The concrete shall be saw cut to the limits indicated.
3. While removing the concrete, either:
   a. Maintain the existing reinforcing steel such that it extends 2" beyond the cut.
4. Apply specified bonding agent to the cut concrete surface. Apply 2 rows of caulking type surface applied waterstop.
5. Add additional reinforcing steel and place new concrete to form the new opening as indicated.

END OF SECTION

SECTION 03100

CONCRETE FORMING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete forming

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

A.	Dovetail Anchor Slots	Section 03150 – Concrete Accessories
B.	Anchor Rods	Section 05500 – Metal Fabrications
C.	Anchor Rods furnished under other sections including equipment, etc.	
D.	Embedded Angles	Section 05500 - Metal Fabrications
E.	Embedded Plates	Section 05500 - Metal Fabrications
F.	Aluminum Nosings	Section 05500 - Metal Fabrications
G.	Flashing Reglets	Section 07620 - Sheet Metal Flashing and Trim
H.	Hatches	Section 08310 - Floor Access Doors
I.	Pipe Sleeves and Castings	Division 15

1.4 REFERENCES

A. ACI SPEC-117 – Specifications for Tolerances for Concrete Construction and Materials

B. ACI SPEC-301 - Specifications for Concrete Construction

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 and ACI SPEC-117 as modified herein.

1.6 SUBMITTALS

A. Submit product data and Safety Data Sheets for form release agent.

B. Submit product data for form ties.

C. Submit product data for blindside forms.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Undamaged smooth form facing materials such as plywood, hardboard, metal and plastic that will produce a smooth form finish with fins and offsets not exceeding 1/8 inch. Surfaces shall be clean, free of scratches, marring, and discolorations. The Engineer may reject formwork the Engineer deems to be unacceptable or that may produce concrete that will not meet the specified requirements including surface finish.

B. Steel: Minimum 16 ga. sheet, well matched, tight fitting, stiffened to resist loads without excess deflection.
C. Aluminum: Forms with unoxidized surfaces shall be pretreated with a calcium hydroxide and water paste followed by repeated water rinsing until hydrogen bubbles no longer form.
D. Chamfer Corners: Chamfer, Wood Strip Type; ¾" x ¾" minimum, maximum possible length.
E. Blindside forms: galvanized sheets, minimum 0.0217 in thick, Stay-form by Amico
F. Form Ties:
    1. Liquid retaining structures and backfilled walls of below grade spaces:
        a. Factory fabricated adjustable length assembly providing a minimum 1.5 inch break back dimension with minimum 1 inch diameter tapered plastic cones on both sides of the wall to leave a uniform hole for patching. All ties require a tightly fitted waterstop washer at the midpoint.
        b. Factory fabricated adjustable length tapered assembly that is removed from the wall, and the hole plugged with an EPDM plug insert that is mechanically tightened with a stainless steel bolt. Holes are to be fully packed with a cementitious crystalline waterproofing grout struck flush at wall face.
    2. Non-liquid retaining structures: Snap-off type, adjustable lengths designed to break back at least 1 inch from finished surface or ties as indicated above.
G. Form release agent: Non-staining colorless, compatible with finishes
    1. StarSeal EF Bio-Release by Vexcon
    2. Q-2 Form Release by Unitex
    3. Seacord RA II by Concord Chemical
H. Rustication Strips by Symons Elasto-Tex Model Number 30757 or equal.

2.2 STORAGE OF MATERIALS

A. Protect materials from ground and the elements.
B. Remove defective materials, as determined by the Engineer, from site immediately. Do not store on site.

PART 3 - EXECUTION

3.1 FORMWORK

A. Conform to ACI SPEC-301.
B. Verify lines, level, and measurements before proceeding.
C. Erect plumb and straight. Maintain rigid. Brace sufficiently.
D. Allow no concrete leakage. Provide continuous, straight, smooth formed surfaces.
E. Treat forms with form release agent prior to erecting forms. Remove all traces from formed construction joints prior to subsequent concrete placement. Protect reinforcement from contact with form release agent. Form release agent that contacts reinforcement shall be thoroughly removed.
F. Earth forms not permitted for below grade walls, slabs and footings.
G. Camber formwork as necessary.
H. Provide removable wall panels to allow cleaning and inspection.
I. Plugs for tapered form-tie holes:

1. Installation procedures shall strictly follow all manufacturer's recommendations.
2. After removal of tapered tie, thoroughly brush out tapered hole as recommended by the manufacturer with a brush provided by the manufacturer.
3. Insert plug from wide end of tapered hole until it is seated and with its tightening nut facing the wide end of tapered hole.
4. Attach socket to nut with extension from the wide end of the tapered hole, and fully tighten with a manual ratchet wrench to ensure that achievement of full tightening is detected by installer.

J. Except where covered by backfill, chamfer all outside corners and edges 0.75 inch unless otherwise noted.

K. Clean out inside of forms of all foreign materials prior to concrete placement.

L. Install blindside forms and follow concrete placement instructions in strict accordance with form manufacturer's instructions.

M. Maintain specified clear cover to reinforcement.

N. Maintain specified tolerances.

O. Maintain forms and shores supporting the cast concrete for the minimum time periods indicated below:
   1. Walls and Vertical Surfaces:
      a. Walls containing liquids (subjected to internal hydrostatic pressure) and backfilled walls of interior spaces - 48 Hours
      b. All other walls – 36 hours
      c. Forms may be unlocked after 24 hours but shall remain in place for the indicated time periods
   2. Time periods listed above represent cumulative number of days or hours during which the temperature of the air surrounding the concrete is above 50°F and the concrete has been damp and no loss of moisture has occurred.
   3. Alternate form removal periods:
      a. Alternately to the stripping times specified above, additional concrete cylinders may be made of representative concrete, field-cured, and tested at no additional cost to the Owner.
      b. The supporting forms and shores may be removed when the concrete strength of the field-cured cylinders, as tested per ASTM C39/C39M is a minimum of 75 percent of the specified design strength.
      c. General Contractor shall notify the Engineer 24 hours in advance of casting the field-cured cylinders.
      d. Field-cured cylinders - where noted on the plans and/or when used by the Contractor, specimens shall be field-cured in accordance with ASTM C31/C31M under conditions that are not more favorable than the most unfavorable conditions for the portions of the concrete that the test specimens represent.

P. Reshore as required.

Q. Form pressures increase with the use of concrete with High Range Water Reducers. Design forms accordingly.

R. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material is not acceptable. Apply new form release agent as specified for new formwork.

S. Standing water shall be removed from all forms and excavations.

T. The accumulation of concrete on the forms above the level of placement shall be avoided. The splashing of concrete upon formwork that is set for a subsequent concrete placement shall be prevented due to the resulting marks on the finished concrete.

3.2 TOLERANCES

A. Tolerances shall conform to all requirements of ACI SPEC-117.

3.3 PROTECTION

A. Setting of forms upon slabs on ground shall not commence until a minimum of 24 hrs after placement. Placement of concrete walls upon slabs on ground shall not commence until after the 7-day curing period unless field cured cylinders are taken and coordinated with the Engineer.

3.4 DEFICIENT CONCRETE

A. Concrete work will be considered deficient if it does not conform to the requirements of this section and the location, elevation, dimension, shape, alignments, and/or appearance as required in the Contract Documents. Specific examples of deficient concrete include (but are not limited to):
   1. Concrete members cast in the wrong location.
   2. Concrete which differs from the required dimensions.
   3. Formed surfaces that don't comply with specified dimensional tolerances. If the Engineer permits the Contractor to correct the error, it shall be in such a manner as to maintain the strength, function and appearance of the structure.
   4. Concrete with defects that adversely affect the appearance of the specified finish shall be repaired. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete may be rejected by the Engineer. Examples include:
      a. Non-uniform appearance including texture and color
      b. Excessive visible repairs of structural defects

B. Deficient concrete may be subject to rejection and replacement at no additional cost to the Owner if the Engineer deems necessary.

END OF SECTION

SECTION 03150

CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete accessories, including, but not necessarily limited to:
   1. Waterstops
   2. Dovetail anchor slots, cast in
   3. Reglets, cast in
   4. Inserts
   5. Bonding agents
   6. Bond breaker

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
B. Joint sealant, backer rod and bond breaker tape are specified in Section 07920.

1.3 REFERENCES

A. ACI SPEC-117 – Specifications for Tolerances for Concrete Construction and Materials
B. ACI SPEC-301 - Specifications for Concrete Construction
C. ASTM A48/A48M – Standard Specification for Gray Iron Castings
D. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
E. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
F. ASTM D1752 – Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
G. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstops

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 and ACI SPEC-117 as modified herein.

1.5 SUBMITTALS

A. Submit layout drawings showing the location and extent of all waterstops, the type and size of all waterstops to be used and splice type, details, and locations for each joint. Submit these layout drawings for review prior to the submittal of the reinforcement shop drawings and the start of concrete work.
B. Submit product data and Safety Data Sheets for concrete accessories.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Premolded Joint Fillers (expansion joints and slab isolation joints):
   1. For isolation joints up to ½" wide: polyethylene, neoprene, or polypropylene closed cell foam with tear off strip for sealant and backer. Acceptable products: Foamtastic by Hohmann & Barnard Co., Stripoff by AH Harris, Deck-O-Foam by WR Meadows, or equivalent.
   2. For isolation joints greater than ½" wide and all expansion joints: self-expanding cork meeting ASTM D1752 Type III. Acceptable manufacturers: WR Meadows, Hohmann & Barnard Inc., J&K Foam Fabricating, Inc., and other manufactures of specified product.
   3. Premolded joint filler to match concrete thickness less required space for backer rod or bond breaker tape and sealant - with sealant geometry of width equal to twice its depth unless otherwise recommended by sealant manufacturer.

B. Surface applied waterstops (hydrophilic rubber type):
   1. Hydrotite CJ-1020-2K-ADH by Sika Greenstreak
   2. De Neef Swellseal Joint by GCP Applied Technologies
   3. Adeka Ultra Seal MC 2010
   4. Or equivalent

C. Waterstop Caulk (single component polyurethane water-swelling sealant):
   1. Leakmaster LVZ by Sika Greenstreak
   2. De Neef Swellseal WA by GCP Applied Technologies
   3. Adeka Ultraseal P-201
   4. Or equivalent

D. Dovetail anchor slots: 1 inch by 0.625 inch by 1 inch, 24 gage, stainless steel, 10-foot lengths, foam filled by Heckman Building Products, Hohmann & Barnard, BLOCK-LOK, or equivalent.

E. Epoxy bonding agent:
   1. Two or three-part water-based epoxy
   2. Acceptable products:
      a. Armatec 110 EpoCem by Sika Corporation
      b. Duralprep A.C. by Euclid Chemical Company
      c. Epobond by Laticrete/L&M Construction Chemicals, Inc.
      d. MasterProtect P 8100 AP by Master Builders
      e. Crackbond 2100 MV by Adhesives Technology Corporation
      f. Sure Bond J58 by Dayton Superior
      g. or equivalent.

F. Structural inserts: of type and size shown on the drawings; Richmond Screw Anchor or Heckman Building Products, Hohman and Barnard, Dayton Sure-Grip or equivalent.

G. Bond Breaker: Thompson's Water Seal or equivalent, or form release agent (as specified in Section 03100).

H. Cast-in-place Reglet: 26 gage minimum stainless steel. Type 304 "CO" concrete reglet, foam filled with connector clips and flashing by Fry Reglet Corporation, #230 Standard Flashing Reglet by Heckmann Building Products or equivalent.

2.2 STORAGE OF MATERIALS

A. Protect materials from ground and the elements.
B. Store embedded items on skids.
C. Store PVC waterstops in a location that is protected from sunlight, precipitation, soiling, etc. Keep surface applied waterstops dry.
D. Remove defective materials, as determined by the Engineer, from site immediately. Do not store on site.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

A. Contractor shall coordinate the installation and securing of all embedded accessories.
B. Expansion joint dowels shall be held horizontally in forms to prevent displacement and to allow at least one inch of expansion after installation.
C. All embedded accessories shall be secured prior to concrete placement. Embedded accessories shall not be placed during or after concrete placement.

3.2 WATERSTOPS

A. Waterstops shall be continuous throughout and around all corners and intersections.
B. All waterstops shall have 2 inches of concrete cover where designated to terminate.
C. Installation of surface applied waterstops:
    1. Surfaces to receive surface-applied waterstop shall be cleaned of all debris.
    2. Apply primer in accordance with manufacturer's recommendations and install surface-applied waterstop.
    3. Surface applied waterstops shall be positioned such that the concrete edge distance on each side of the waterstop is equal to or exceeds the manufacturer’s minimum requirements.
    4. Protect waterstop from submerged or extended contact with water prior to concrete placement.
    5. Hydrophilic rubber waterstops are to be applied using integral adhesive backing or held in place with concrete nails. For areas that can be kept dry prior to concrete placement, hydrophilic rubber waterstops can be pressed into a continuous bead of waterstop caulk.
D. Waterstop caulk shall be applied in a minimum 3/8” diameter continuous bead to cleaned concrete surface in accordance with the manufacturer’s recommendations. Protect from contact with water.
E. Place concrete uniformly to avoid displacing waterstop.
F. Thoroughly vibrate concrete around waterstop to avoid honeycombing and voids in concrete and to insure complete contact between waterstop and concrete.

3.3 TOLERANCES

A. Tolerances shall conform to all requirements of ACI SPEC-117.

END OF SECTION

SECTION 03155

CONCRETE POST-INSTALLED ANCHORS AND REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Epoxy adhesive anchorage of reinforcement

B. Epoxy adhesive and expansion anchors are specified herein but shall be provided and installed under the specification sections wherein the items requiring such anchors are specified.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI CODE-355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete

B. ACI CODE-355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete

C. ASTM C881/C881M – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

D. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

1.4 QUALITY ASSURANCE

A. Expansion and epoxy adhesive anchors shall meet the following requirements:

1. Expansion anchors shall be qualified for use in cracked concrete in accordance with ACI CODE-355.2.
2. Epoxy adhesive anchors shall be qualified for use in cracked concrete in accordance with ACI CODE-355.4.
3. Epoxy adhesive anchors shall be qualified in accordance with ACI CODE-355.4 requirements for sensitivity to installation direction.
4. Epoxy adhesive anchors shall be installed by personnel certified by an applicable certification program that includes written and performance tests in accordance with ACI/CRSI Adhesive Anchor Installation Certification program.

1.5 SUBMITTALS

A. Submit product data and personnel certifications for epoxy adhesive anchors. Data shall include:

1. Material properties of anchors and epoxy adhesive
2. ICC-ES AC308 report
3. Allowable and ultimate loads of the anchor system
4. Storage requirements
5. Installation requirements including:
   a. Drilling method (diamond drill bit shall be prohibited)
   b. Drill bit diameter and depth of hole for each size anchor
   c. Hole cleaning procedure and required condition of hole

d. Requirements for discarding initial discharge to ensure proper mixing
e. Hole filling procedure
f. Time period when anchor cannot be contacted or otherwise disturbed
g. Gel and cure times as a function of temperature
h. Installation temperature requirements for cartridges and base material

6. Certifications for personnel installing epoxy adhesive anchors, in accordance with ACI/CRSI Adhesive Anchor Installation Certification program.

PART 2 - PRODUCTS

2.1 EXPANSION ANCHORS

A. Approved for use in cracked concrete in accordance with ACI CODE-355.2.
B. Stainless steel AISI Type 316 for galvanized and aluminum fabrications; zinc-plated for painted steel fabrications.
   1. Hilti Kwik-Bolt TZ or Hilti HSL, by Hilti Fastening Systems
   2. Trubolt+ Wedge Anchor by ITW Red Head
   3. Power Stud+ by Powers Fasteners
   4. Strong-bolt 2, by Simpson Strong Tie Co.
   5. Or equivalent

2.2 EPOXY ADHESIVE ANCHORS

A. Includes epoxy anchor systems and epoxy adhesive for threaded rods and steel reinforcement.
B. Approved for use in cracked concrete in accordance with ACI CODE-355.4.
C. Materials:
   1. Anchor: AISC Type 316 Stainless Steel threaded rod with washer and nut.
   2. Adhesive:
      a. Epoxy adhesive for anchoring to concrete shall be a two-component solid epoxy-based system supplied in manufacturer's standard side-by-side cartridge and dispensed through manufacturer's standard static-mixing nozzle. Except for gel times, epoxy adhesive shall conform to ASTM C881. The Grade, Class and Type of epoxy shall be that which is appropriate for the intended use.
      b. Epoxy adhesive shall pass the creep test requirements of ICC-ES AC308.
      c. Acceptable manufacturers:
         i. SET-XP or ET-HP by Simpson Strong Tie Co., Inc.,
         ii. HIT-RE 500-V3 or HIT HY-200 by Hilti, Inc.,
         iii. or equal.
D. Embedment depth for reinforcement: 6” unless otherwise indicated on the Drawings

PART 3 - EXECUTION

3.1 EXPANSION ANCHORS AND EPOXY ADHESIVE ANCHORS

A. Anchors shall be installed by qualified personnel trained to install expansion and adhesive anchors.
B. Anchors shall be installed in strict accordance with the Manufacturer’s Printed Installation Instructions (MPII).
C. Each installer shall at all times have in their possession the MPII.

D. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at time of installation.

E. All adhesive anchor cartridges shall have the expiration date clearly visible. Material past its expiration date shall not be used and shall be immediately removed from the site.

F. Embedded reinforcement shall be located with proper equipment prior to drilling to ensure that each drilling location does not coincide with existing reinforcement. Drilling through reinforcement shall be prohibited.

G. If existing reinforcement is encountered while drilling, offset the drill hole by a maximum of 2-inches. The new relocated hole shall be in the same line as the line of drilled holes. All offset holes shall be a minimum of 4-inches from a free concrete edge. Maintain the original spacing locations of the remaining dowels as indicated on the Drawings.

H. Diamond drill bits shall not be permitted. Hammer drills shall be used.

I. The initial material extruded from each adhesive anchor cartridge shall be discarded in accordance with the manufacturer's instructions to ensure that all material is properly mixed.

J. Depth stop shall be used to ensure correct drilling depth. Drilled holes shall be blown out with air, thoroughly wire-brushed with a repeated back and forth movement, blown out, thoroughly wire-brushed, and blown out again. Adhesive shall be injected starting from the bottom of the hole, and slowly withdrawn as filling progresses to prevent air pockets.

K. Anchored reinforcement shall remain completely undisturbed between manufacturer's specified gel time and the full cure time. Zero load shall be applied during this time.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete deformed reinforcement bars and accessories
B. CMU deformed reinforcement bars

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
B. Fiber reinforcement is specified in Section 03300.

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Vertical and horizontal deformed masonry reinforcement excluding dowels embedded in concrete: Section 04200 - Unit Masonry.

1.4 REFERENCES

A. ACI SPEC-117 – Specifications for Tolerances for Concrete Construction and Materials
B. ACI SPEC-301 - Specifications for Concrete Construction
C. ACI MNL-66 – ACI Detailing Manual
D. ASTM A615/A615M – Standard Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
E. ASTM A706/A706M – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
F. ASTM A775/A775M – Standard Specification for Epoxy-Coated Reinforcing Steel Bars
G. ASTM A1064/A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain or Deformed, for Concrete
H. AWS D1.4/D1.4M – Structural Welding Code – Reinforcing Steel
I. Concrete Reinforcing Steel Institute – 10MSP, Manual of Standard Practice
J. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 and ACI SPEC-117 as modified herein.

1.6 SUBMITTALS

A. Submit shop drawings for concrete and masonry reinforcement prior to fabrication, showing bar bends, details and placement and certified copies of Mill Test Reports for the reinforcement. Conform to ACI SP-66. Details shall include:
    1. Sizes, dimensions, and locations for reinforcement and supports
    2. Bending diagrams and schedules
    3. Splices

4. Dowel Bar Splicers and Mechanical Bar Splicers: product data including strength tests
5. Cover and clearances
6. Class designation and details for bar supports
7. Pertinent reinforced concrete details with dimensions and elevations
8. Embedded items furnished by other trades and/or under other sections of the specification that are to be cast in concrete where interference with reinforcement may occur
9. Show reinforcement on: Plan views of slabs, wall elevations and sections, beam elevations and details. Provide plan details at wall intersections and openings.

B. Shop drawing submittal for masonry reinforcement shall include a statement from Project mason that they reviewed the reinforcement shop drawings and provided any necessary input.

C. For conduit to be encased in concrete structures submit a conduit layout plan under Section 16050. The conduit layout plan shall be reviewed with no exceptions taken by the Engineer prior to submission of reinforcement shop drawings.

PART 2 - PRODUCTS

2.1 REINFORCEMENT AND ACCESSORIES

A. Reinforcement and accessories includes all bars, anchorages, stirrups, reinforcement dowels, ties, tie-wire, chairs and other steel supports, and spacers, as noted on the Drawings, specified herein, and as required for the proper completion of the Work.

B. Bars: ASTM A615/A615M or ASTM A706/706M; Grade 60; deformed new materials. Cold bent in accordance with CRSI 10MSP.

C. Welded wire fabric: ASTM A1064/A1064M. Flat sheets are required; rolls are not permitted.

D. Tie wire: ASTM A1064/A1064M, annealed.

E. Bolsters, chairs, spacers and other supports to properly position reinforcement shall conform to the “Bar Support” recommendations of CRSI 10MSP and shall be of adequate strength and design to prevent displacement of reinforcement and discoloration of concrete. Where concrete surfaces are exposed to view, weather and/or moisture supports shall be Class 1 Plastic, Plastic Protected, or epoxy coated. Supports for bottom reinforcement for slabs placed on soil or on a mud mat with no more than 3 inches of cover shall be Class 3 chairs with integral plates or precast concrete blocks not less than 4 inches square.

2.2 DOWEL BAR SPLICERS

A. Dowel bar splicers shall be used only at joints as shown on the Drawings or only after review with no exceptions taken by the Engineer.

B. Thread bars in shop only.

C. Provide plastic plugs in female end at form.

D. Develop 125% of yield strength of specified bar size across joint.

E. Forged from deformed steel bars conforming to ASTM A615/A615M or ASTM A706/A706M, Grade 60.

F. Acceptable products:
   1. Dayton Superior Dowel Bar Splicer System: DB-SAE with DI
   2. Or equivalent.

2.3 MECHANICAL BAR SPLICERS

A. Mechanical bar splicers shall be used as shown on the Drawings or only after review with no exceptions taken by the Engineer.
B. Develop 125% of yield strength of bar across mechanical splice.
C. Acceptable products:
   1. Lenton Lock B-Series or Lock S-Series Splicing System by Erico
   2. Dayton Superior Bar-Lock S-Series Coupler System
   3. Zap Screwlok Type 2 Series, SL Series or Transitions by Barsplice Products, Inc.
   4. Or equivalent.

2.4 FABRICATION OF REINFORCEMENT

A. Conform to CRSI Code of Standard Practice-Fabrication.
B. Cold bend bars.
C. Bend bars around revolving collar of recommended size.

2.5 EPOXY ANCHORAGE

A. Epoxy anchorage for steel reinforcement is specified in Section 03155.

2.6 STORAGE OF MATERIALS

A. Protect materials from ground and the elements.
B. Store reinforcement and all other embedded items on skids.
C. Remove defective materials, as determined by the Engineer, from site immediately. Do not store on site.

PART 3 - EXECUTION

3.1 REINFORCEMENT

A. Conform to the CRSI Code of Standard Practice.
B. Protect reinforcement from contact with form release agent. Form release agent that contacts reinforcement shall be thoroughly removed.
C. Install reinforcement supports and spacers in slabs, beams, walls, columns, and all other concrete members as required to maintain specified clear cover.
D. Maintain specified tolerances.
E. Do not weld reinforcement unless the Engineer takes no exceptions - in writing. When permitted, welding shall be in accordance with AWS D1.4/D1.4M.
F. Splicing reinforcement:
   1. Reinforcement bars: Splices shall be located as shown on the Drawings. Where not shown, splices shall be located away from areas of maximum stress, and shall be reviewed, with no exceptions taken, by the Engineer. Minimum splice lengths shall be as indicated on the Drawings.
G. Reinforcement shall be securely tied at intersections with tie wire or clips in a manner that will keep all metal away from exposed concrete surfaces.

H. Cutting, heating, and bending of reinforcement embedded in the concrete will not be allowed.

I. Mechanical splices shall be installed in accordance with the manufacturer's recommendations and as shown on the Drawings. Additional mechanical splices proposed by the Contractor will not be allowed unless the Engineer has reviewed and takes no exceptions in writing.

J. All reinforcement within an area of a continuous concrete placement shall be installed, supported, and secured before beginning concrete placement.

3.2 EMBEDDED ITEMS

A. Contractor shall coordinate the installation and securing of all embedded items such as steel dowels and all other required embedded items indicated in the Contract Documents.

B. Contractor shall coordinate number and layout of masonry dowels with the mason prior to installation.

C. All embedded items shall be secured prior to concrete placement. Embedded items shall not be placed during or after concrete placement.

3.3 PLACING CONCRETE

A. Notify Engineer and Independent Testing Laboratory 24 hours minimum prior to each placement.

B. All reinforcement within the area of one day’s concrete placement shall be tied in place, and observed by the Engineer, prior to commencing concrete placement.

C. Assure placement and proper location of all embedded items.

3.4 TOLERANCES

A. Tolerances shall conform to all requirements of ACI SPEC-117.

3.5 DEFICIENT CONCRETE

A. Deficient concrete includes concrete containing reinforcement that does not meet the requirements of the Contract Documents for material, size, quantity, strength, position, or arrangement.

B. Deficient concrete may be subject to rejection and replacement at no additional cost to the Owner as determined by the Engineer.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cast-In-Place Concrete

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. AASHTO T 26 – Standard Method of Test for Quality of Water to Be Used in Concrete
B. ACI SPEC-301 - Specifications for Concrete Construction
C. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary
D. ASTM C33/C33M – Standard Specification for Concrete Aggregates
E. ASTM C40/C40M – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
F. ASTM C87/C87M – Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
G. ASTM C88/C88M – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
H. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete
I. ASTM C114 – Standard Test Methods for Chemical Analysis of Hydraulic Cement
J. ASTM C131/C131M – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
K. ASTM C150/C150M – Standard Specification for Portland Cement
L. ASTM C260/C260M – Standard Specification for Air Entraining Admixtures for Concrete
M. ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete
N. ASTM C535 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
O. ASTM C595/C595M – Standard Specification for Blended Hydraulic Cements
P. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
Q. ASTM C989/C989M – Standard Specification for Slag Cement for Use in Concrete and Mortars
R. ASTM C1012/C1012M – Standard Test Method for Length Change of Hydraulic Cement Mortars Exposed to a Sulfate Solution
S. ASTM C1116/C1116M – Standard Specification for Fiber-Reinforced Concrete
T. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures

U. ASTM C1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
V. ASTM C1293 – Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
W. ASTM C1567 – Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
X. ASTM C1602/C1602M – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
Y. ASTM C1603 – Standard Test Method for Measurement of Solids in Water
Z. ASTM C1609/C1609M – Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)
AA. ASTM C1812/C1812M – Standard Practice for Design of Journal Bearing Supports to be Used in Fiber Reinforced Concrete Beam Tests
BB. ASTM D516 – Standard Test Method for Sulfate Ion in Water
CC. ASTM D4130 – Standard Test Method for Sulfate Ion in Brackish Water, Seawater, and Brines
DD. ASTM E329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.4 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 as modified herein.

1.5 SUBMITTALS

A. Submit Concrete Mixture designs including:
   1. Proportions for all ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, air content and density.
   2. Cement Manufacturer's Certificates of conformance with ASTM C150/C150M or C595/C595M taken during the last 90 days.
   3. Supplementary Cementitious Materials: Source and test reports with certificates of conformance with ASTM C618 for fly ash and ASTM C989/989M for slag cement for actual material to be used in the Work taken during the last 90 days.
   4. Fine and coarse aggregate data shall include test results from within the last 90 days, except test results for soundness, abrasion, and alkali reactivity shall be from within the last 12 months:
      a. Sources
      b. Specific Gravity
      c. Sieve analyses per ASTM C33/C33M, including fineness modulus of fine aggregate
      d. Organic impurities per ASTM C40/C40M (fine aggregate)
      e. Aggregate reactivity (fine and coarse aggregate), one of the options provided in Part 2
      f. Soundness per ASTM C88/C88M tested with magnesium sulfate (fine and coarse aggregate)
      g. Abrasion per ASTM C131/C131M or ASTM C535 (coarse aggregate)
   5. Product data and Safety Data Sheets for concrete admixtures

6. Field performance and/or laboratory test reports meeting the criteria specified in ACI SPEC-301, Section 4, by testing agencies meeting ASTM E329:
    a. Field test data used to determine the standard deviation used for establishing the required average design strength, and field test data documenting that the proposed concrete proportions will produce an average compressive strength equal or greater than the required average compressive strength, shall be from within the previous 12 months.
    b. Laboratory trial batch data shall be from with the previous 12 months.
7. Submit sample concrete mixture batch ticket that shall include the following information:
8. Serial number of ticket
9. Date and project location
10. Name and location of ready-mixed concrete plant
11. Truck number, time loaded, cubic yards delivered
12. Mixture design
13. Target and actual quantities of admixtures, with brand names
14. Target and actual quantities and types of cement, fly ash and/or slag
15. Target and actual quantity of water including quantity of water withheld
16. Quantities of fine and coarse aggregate including moisture content, nominal maximum aggregate size, and aggregate sources (quarries)
17. Quantity of water added subsequent to plant batching
18. Unloading time and location

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Each cementitious material shall be furnished from one source throughout the Project.
B. Portland cement: ASTM C150/C150M; Type II.
C. Blended cements: ASTM C595/C595M (MS) types, excluding Type IS (≥70) and Type IT (S ≥70).
D. Supplementary Cementitious Materials:
    1. Slag Cement: ASTM C989 - Grade 100 or 120, and alkali content not to exceed 1.0%.
    2. Silica Fume: ASTM C1240.
    3. Fly Ash: ASTM C618 - Type F, and alkali content not to exceed 4.0%.
    4. In accordance with NSF 61.
E. Aggregates:
    1. Prohibited: crushed hydraulic cement concrete and recycled aggregate.
    2. Fine aggregate
        a. Shall meet FDOT Specifications, Section 902 Fine Aggregate, for Structural Concrete.
        b. Shall consist of washed inert natural sand, free from mineral or other coatings, soft particles, clay, loam, organic or other deleterious materials conforming to the requirements of ASTM C33/C33M and the following requirements:

SIEVE NO.	PERCENT PASSING
4	95 to 100
8	80 to 100
16	50 to 85
30	25 to 60
50	5 to 30
100	0 to 10
200	0 to 3.0

The Fineness Modulus shall be between 2.3 to 3.1. The percentage retained between any two consecutive sieves shall not exceed 45%.

3. Coarse aggregate
   a. Shall meet FDOT Specifications, Section 901 Coarse Aggregate, for Structural Concrete.
   b. Shall consist of a well graded crushed stone or a washed gravel conforming to the requirements of ASTM C33/C33M and the following requirements:

	PERCENT PASSING			
SIEVE	NO. 8 (3/8")	NO. 67 (3/4")	NO. 57 (1")	NO. 467 (1 1/2")
1-½ inch	-	-	100	95-100
1 inch	-	100	95-100	-
¾ inch	-	90-100	-	35-70
½ inch	100	-	25-60	-
3/8 inch	85-100	20-55	-	10-30
No. 4	10-30	0-10	0-10	0-5
No. 8	0-10	0-5	0-5	-
No. 16	0-5	-	-	-
No. 50	-	-	-	-

The limits of deleterious substances and physical property requirements shall be as listed in ASTM C33/C33M, Table 4, for severe weathering regions.

4. Fine Aggregate testing: Perform the following tests on samples of the fine aggregate:
   a. Organic Impurities (ASTM C40/C40M):
      i. Color of supernatant liquid above test sample tested in accordance with ASTM C40/C40M shall not be darker than standard (Organic Plate No. 3/Gardner Color Standard No. 11).
      ii. Use of a fine aggregate failing when tested in accordance with ASTM C40/C40M is not prohibited if when tested in accordance with ASTM C87/C87M the relative strength at 7 days is not less than 95%.
   b. Soundness (ASTM C88/C88M):
      i. Fine aggregate sample tested in accordance with ASTM C88/C88M for five cycles using magnesium sulfate (not sodium sulfate) shall have a weighted average loss not greater than 15%.

c. Alkali Reactivity – Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted. Use one of the following options:

i. Test aggregate in accordance with ASTM C1293. Aggregate having an expansion less than 0.04% at 1-year is acceptable for use.

ii. Test aggregate in accordance with ASTM C1260. Aggregate having an expansion less than 0.10% at 16 days is acceptable for use.

iii. Test concrete mixture with the aggregates and cementitious materials combination submitted, in accordance with ASTM C1293. Aggregates in mixtures having an expansion of less than 0.04% at **2-years** are acceptable for use. (This option also satisfies coarse aggregate requirements.)

iv. Test concrete mixture with aggregates and cementitious materials combination submitted, in accordance with ASTM C1567. Aggregates in mixtures having an expansion less than 0.10% at 16 days are acceptable for use. (This option also satisfies coarse aggregate requirements.)

v. Test aggregate in accordance with ASTM C1293 at 1-year. If the coarse and fine aggregates are of different reactivity, the level of protection shall be based on the more reactive aggregate.

(1) For (moderately reactive) aggregate with expansion greater than or equal to 0.04% and less than 0.12%:

(a) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***or***

(b) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or

(c) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(d) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(2) For (highly reactive) aggregate with expansion greater than or equal to 0.12% and less than 0.24%:

(a) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(b) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement, or

(c) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***and***

(i) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or

(ii) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(iii) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(3) The use of aggregate with expansion greater than or equal to 0.24% shall not be permitted.

vi. Test aggregate in accordance with ASTM C1260 at 16 days if ASTM C1293 aggregate test data is not available. If the coarse and fine aggregates are of different reactivity, the level of protection shall be based on the more reactive aggregate.

(1) For (moderately reactive) aggregate with expansion greater than or equal to 0.10% and less than 0.30%:

(a) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***or***

(b) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplementary cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or

(c) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(d) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(2) For (highly reactive) aggregate with an expansion greater than or equal to 0.30% and less than 0.45%:

(a) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(b) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement, or

(c) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***and***

(i) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental

cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or

(ii) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(iii) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(3) The use of aggregate with expansion greater than or equal to 0.45% shall not be permitted.

5. Coarse Aggregate testing: Perform the following tests on samples of the coarse aggregate:
   a. Abrasion (ASTM C131/C131M or ASTM C535):
      i. Coarse aggregate shall be tested in accordance with either ASTM C131/C131M (aggregate smaller than 1 1/2") or ASTM C535 (aggregate larger than ¾").
      ii. Loss of the mass of the coarse aggregate by abrasion shall not exceed 50%.
   b. Soundness (ASTM C88/C88M):
      i. Coarse aggregate sample tested in accordance with ASTM C88/C88M for five cycles using magnesium sulfate (not sodium sulfate) shall have a weighted average loss not greater than 18%.
   c. Alkali Reactivity:
      i. Test coarse aggregate according to the same requirements specified above for testing of fine aggregate. Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted.

F. Water:
   1. Potable from municipal water supply.
   2. Use of residual and wash water, including such water present in mixer drums prior to commencement of batching, shall not be permitted.

G. Admixtures:
   1. Low Range Water Reducing: ASTM C494/C494M Type A.
   2. High Range Water Reducing (superplasticizer): ASTM C494/C494M Type F.
   3. Water Reducing and Retarding: when ambient temperature is above 70°F, replace water reducing admixture in whole or in part with water reducing and retarding admixture meeting ASTM C494/C494M Type D.
   4. Air Entraining: ASTM C260, vinsol resin based.
   5. Accelerating: non-chloride accelerator meeting ASTM C494/C494M Type C or E.
   6. Not permitted: Calcium chloride, thiocyanates or admixtures containing chloride ions.
   7. All admixtures used for each mixture design shall be from one single manufacturer, except for cementitious waterproofing.

2.2 CONCRETE CLASS

A. Class A: Reinforced structural concrete
B. Class B: Concrete fill, pipe encasements

2.3 CONCRETE MIXTURE DESIGN

A. Concrete class (where f'c is the specified design compressive strength at 28-days and w/cm is the water to cementitious materials ratio):
   1. Class A: f'c = 5,000 psi, max w/cm = 0.40, min w/cm = 0.38
   2. Class B: f'c = 3,000 psi, max w/cm = 0.45, min w/cm = 0.42

B. Nominal maximum aggregate size:
   1. Coarse aggregate shall conform to the grading given in Table 3 of ASTM C33/C33M for sizes (i.e., nominal maximum aggregate sizes) No. 467 (1 ½"), No. 57 (1"), No. 67 (3/4"), No. 7 (1/2"), and No. 8 or No. 89 (3/8").
   2. Nominal maximum aggregate size shall be as follows:
      a. ¾": All other locations, except as specified elsewhere or upon written approval of the Engineer.
      b. Concrete Fill: 3/8"

C. Air entrainment:
   1. All concrete, except as noted below, shall be air entrained in accordance with the nominal maximum aggregate size, with a tolerance of plus or minus 1.5%:
      a. No. 8 or 89 (3/8") – 7.5%
      b. No. 67 (¾") – 6.0%

D. Supplementary cementitious materials may be included as a percentage of total cementitious materials weight as follows. (Supplemental cementitious materials in ASTM C595/C595M cement shall be included in determination of percentages.)
   1. Portland cement: not less than 50%.
   2. Slag cement: if used, not less than 25% nor greater than 35%.
   3. Fly ash: if used, not less than 15% nor greater than 25%.
   4. Silica fume: if used, not less than 5% nor greater than 10%.
   5. Fly ash + slag + silica fume: no more than 50%.
   6. Fly ash + silica fume: no more than 35%.

E. The slump shall be 4" with a 1" plus or minus tolerance at the point of delivery, without use of a high range water reducer. When a high range water reducer is used, the slump shall be as stated above before it is added, and a maximum of 8" at the point of delivery after it is added.

F. Water:
   1. The amount of water carried on the aggregate and the effect of admixtures is included in the water content. The amount of water carried on the aggregate shall be determined periodically by test and the amount of free water on the aggregate shall be subtracted from water added to the mixture.
   2. Maximum amount of water: that required to produce a plastic mixture of the strength and water to cementitious materials ratio specified and the required density, uniformity and workability. Consistency of the mixture: that required for the specific placing conditions and methods.

G. High Range Water Reducing admixtures shall be used for all concrete to be pumped or with a specified water to cementitious ratio below 0.50. High range water reducer shall be added either at the concrete batch plant or on site to obtain the slumps as indicated above.

H. Concrete shall be furnished from one supplier and batch plant during the project.

2.4 SELECTION OF CONCRETE PROPORTIONS

A. The concrete producer shall select the concrete mixture proportions on the basis of past field performance or the use of trial mixtures, both in accordance with ACI SPEC-301, Section 4, "Concrete Mixtures".

B. Adjustments to required average strength (f'cr):

1. Adjustments in the required average strength may be made during the progress of the work to compensate for either high or low average compressive strengths.
2. When a minimum of fifteen 28-day compressive strength tests from this project are available, the average strength and standard deviation shall be computed.
3. Should these determinations indicate an excessive compressive strength with a low standard deviation as determined by the Engineer, modification of the concrete mixture may be made to achieve a lower average strength based upon a new standard deviation.
4. Should these determinations indicate a lower average strength than anticipated, the Engineer will require corrective measures to be taken immediately.

2.5 STORAGE OF MATERIALS

A. Protect materials from ground and the elements.

B. Maintain cement in dry condition.

C. Remove defective materials, as determined by the Engineer, from site immediately. Do not store on site.

PART 3 - EXECUTION

3.1 PRE-BATCHING

A. Mixer drums shall completely discharged (drums backed out) prior to commencement of batching.

3.2 FAILURE TO MEET STRENGTH REQUIREMENTS

A. The strength of the concrete in place will be considered substandard if any one of the following results occur (where a strength test is defined as the average of two 6"Ø x 12" cylinders or three 4"Ø x 8" cylinders):

1. The average any three (3) consecutive strength tests at 28 days is less than the specified strength (f'c).
2. A compressive strength test result falls below the specified strength (f'c) by more than 500 psi.

B. Concrete which fails to meet the strength requirements as outlined above will be reviewed by the Engineer. The Engineer will determine whether the substandard concrete will be accepted, rejected or additional tests performed.

C. When substandard concrete occurs as defined in Part A, the Engineer will require corrective measures to be taken immediately to increase the average of subsequent strength tests. In addition, the Engineer may require cores drilled in the area of

question in accordance with Section 03305. If the core tests are inconclusive or impractical to obtain, load tests may be required, and their results evaluated in accordance with ACI CODE-318. If the average of the three cores is less than 85% of the specified strength or if one core is less than 75% of the specified 28-day strength, then that portion of the structure shall be strengthened by a method proposed by the Contractor and no exceptions taken by the Engineer or replaced by the Contractor at no additional cost to the Owner.

3.3 DEFICIENT CONCRETE

A. Concrete work will be considered deficient if it does not conform to strength and material durability requirements (including water to cementitious materials ratio), location, elevation, dimension, shape, alignments, and/or appearance as required in the Contract Documents. Specific examples of deficient concrete include (but are not limited to):
   1. Concrete members cast in the wrong location.
   2. Concrete that includes residual, wash, and other water, including such water present in mixer drums prior to commencement of batching.
   3. Concrete work not formed in accordance with Section 03100.
   4. Concrete containing reinforcement that does not meet the requirements of Section 03200.
   5. Concrete not placed in accordance with Section 03320.
   6. Concrete surfaces not finished in accordance with Section 03350.
   7. Concrete exposed to view with defects that adversely affect the appearance of the specified finish. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete may be rejected. Examples include:
      a. Non-uniform appearance including texture and color
      b. Excessive visible repairs of structural defects
   8. Concrete not cured in accordance with Section 03390.
   9. Concrete work in cold weather not in accordance with Section 03340.
   10. Concrete work in hot weather not in accordance with Section 03341.
   11. Concrete work damaged from accidents, poor construction practices, or fire.

B. Deficient concrete may be subject to rejection and replacement at no additional cost to the Owner if the Engineer deems necessary.

END OF SECTION

SECTION 03305

CONCRETE TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Testing in accordance with the standards referenced herein, performed by independent Testing Agency.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-506.2 – Specification for Shotcrete
B. ASTM C31/C31M- Standard Practice for Making and Curing Concrete Test Specimens in the Field
C. ASTM C39/C39M- Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
D. ASTM C42/C42M- Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
E. ASTM C138/C138M – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
F. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic-Cement Concrete
G. ASTM C172/C172M- Standard Practice for Sampling Freshly Mixed Concrete
H. ASTM C231/C231M- Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
I. ASTM C1064/C1064M – Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
J. ASTM C1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
K. ASTM C1140/C1140M – Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
L. ASTM E329- Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.4 QUALIFICATIONS

A. Testing Agency shall conform to concrete testing requirements of ASTM E329 and ASTM C1077.
B. Key personnel must be qualified in concrete quality assurance.
C. Perform concrete field quality control testing with personnel certified as an ACI Concrete Field Testing Technician, Grade 1 according to the American Concrete Institute (ACI).

1.5 SUBMITTALS

A. Testing Agency will submit one copy each of all test reports to each of the following: Engineer, Resident Project Representative, Contractor, and concrete supplier. Reports shall indicate the following information:

Project	Air content
Placement location	Cure box min/max temps
Contractor	Cylinder Nos
Concrete supplier	Cylinder weights
Technician	Date of breaks
Date cast	Break type
Date picked up	Break load
Design strength	Break strength
Air temp	Truck Arrival Time
Concrete temp	Truck Unload Time
Initial slump	Lab/Field-cured
Final slump	Cylinder size
Field density	

B. Testing Agency will submit reports within 5 days of testing or inspection.

C. Testing Agency will notify the Engineer within 24 hours if tests indicate deficiencies.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 CAST-IN-PLACE CONCRETE

A. An independent, accredited and certified testing agency (Testing Agency), selected and paid for by the Owner and directed by the Engineer and/or Resident Project Representative, shall test Class A concrete for strength, slump, air content and field density as indicated herein.

B. On the Project site the Contractor shall provide a curing box for proper initial curing and storage of concrete test cylinders as required by ASTM C31/C31M. Contractor to coordinate the location with the Resident Project Representative and Testing Agency. Curing box shall be of suitable size, prevent the loss of moisture from the specimens.

C. The General Contractor shall notify the Resident Project Representative of proposed upcoming concrete placements as follows.
   1. On a weekly basis.
   2. For specific placements - a minimum of 24 hours in advance.

D. At the Project site, for every truck before starting concrete placement, from a test sample taken from the beginning of the discharge: measure concrete temperature and perform slump, air content and field density tests. This testing shall be successfully completed prior to placing the concrete.
   1. Perform tests after the addition of any water that was held back during batching.
   2. Take test sample from the discharge end of the truck.
   3. Before taking test sample, discharge ¼ cubic yard, minimum, of concrete into a container (which can be placed after successful testing). Then take test sample.

E. Measure air content per ASTM C231/C231M and calculate air content per ASTM C138/C138M. If there is a deviation of more than 1.5%, determine and correct cause.
F. All test samples for casting of cylinders shall be taken from the middle of the truck mixer load (not from first 10% or last 10%)
G. Make 7 test cylinders measuring 4"Ø x 8" for each class of concrete as specified in 3.1.A placed in any one day at the following frequency:
    1. For each 100 cubic yards of each concrete placement, and
    2. For each placement that is less than 100 cubic yards
H. Concrete cylinders shall be tested as follows:
    1. 4" Ø x 8" cylinders:
        a. Test (2) cylinders at 7 days; (3) cylinders at 28 days.
        b. Hold two cylinders for later testing (if required)
I. Perform temperature, slump, air content and field density tests and make additional cylinders at other times when directed by the Resident Project Representative.
J. Samples taken for concrete testing are to be disposed of, and not used in the work.
K. Additional testing and sampling required due to deficient results or improper curing shall be paid for by Owner. The cost of resampling and retesting will be determined by Engineer, and Owner will invoice Contractor for this cost. If unpaid after 60 days, this invoice amount will be deducted from the Contract Price.
L. Contractor shall provide site access to Testing Agency personnel at all times.
M. Testing Agency shall transport lab-cured cylinders to testing laboratory within 48 hours of casting, but not less than 8 hours after final set.

3.2 ADDITIONAL TESTS

A. Testing Agency shall provide additional testing of in-place concrete that does not comply with the requirements of the Contract Documents or is considered substandard as directed by Engineer. Additional tests may consist of non-destructive testing, cores drilled from the area in question or load tests. Costs of additional testing will be paid by Owner. The cost of the additional testing will be determined by Engineer and Owner will invoice Contractor for that cost. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price.
B. When the concrete strength is substandard as defined in Section 03300, concrete core specimens shall be obtained and tested from the affected area. A minimum of three (3) cores shall be taken for each sample in which the strength requirements were not met. The drilled cores shall be obtained and tested in conformance with ASTM C42/C42M. Engineer will determine the size and location of the required core samples.
C. Field-cured cylinders may be cast and tested by the Testing Agency as required in the Contract Documents or at the request of the Contractor. The costs of preparing and testing field-cured cylinders shall be borne by the Contractor. If field-cured cylinders are to determine in-place concrete strength to facilitate an accelerated schedule for subsequent concrete placements, or backfilling or leakage testing:
    1. The Contractor shall notify the Engineer and Testing Agency 48 hours in advance of the concrete placement. The Engineer will determine at that point if the results of the field-cured cylinders may be used to determine the in-place concrete strength. The Contractor shall notify the Engineer as to when the field-cured cylinders will be tested and for what purpose.

2. A minimum of three 4"Ø x 8" cylinders shall be cast for each separate test the Contractor requests.
3. The field-cured cylinders shall be left in the field and located such that they are exposed to the identical environmental conditions as the concrete structure.
4. The Engineer shall determine if the strengths indicated by the field-cured cylinder tests are adequate for their intended purpose.

END OF SECTION

SECTION 03320

CONCRETE PLACEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Placement

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

A. For items embedded in concrete refer to Section 03100, par. 1.3.

1.4 REFERENCES

A. ACI SPEC-301 - Specifications for Concrete Construction

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 as modified herein.

B. The Contractor shall require a quality assurance representative from the concrete supplier be on site for a minimum of the first three concrete placements, and thereafter as necessary, to oversee any permitted field adjustments of delivered concrete including slump, water, water reducer, high range water reducer, air entrainment, and any other issues that arise.

1.6 SUBMITTALS

A. For conduit to be encased in concrete structures submit a conduit layout plan under Section 16010. The conduit layout plan shall indicate final equipment locations, path runs, and overall sizes of conduits, and shall be reviewed with no exceptions taken by the Engineer prior to submission of reinforcement shop drawings.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

A. Contractor shall coordinate the installation and securing of all embedded items such as anchor rods, pipes, conduit, pipe hanger inserts, embedded angles, concrete accessories under Section 03150 Concrete Accessories, and all other required embedded items indicated in the Contract Documents.

B. All embedded items shall be secured prior to concrete placement. Embedded items shall not be placed during or after concrete placement.

C. Pipes or conduits for embedment within a slab, wall, or beam, other than those merely passing through, shall satisfy the following:

1. Shall not be larger in outside diameter than one-third (1/3) the thickness of the slab, wall, or beam.
2. Shall not be spaced closer than 3 diameters on center.

3. Shall not significantly impair the strength of the concrete.
4. Shall not be embedded in structural concrete slabs less than 6 inches thick.
5. Only two conduits or pipes shall cross at any point. The sum of the outside diameter of the crossing pipes or conduits shall not exceed one-third (1/3) of the concrete thickness.
6. Conduits shall not be located between the bottom of reinforcement and bottom of concrete slab or beam.
7. Aluminum conduits shall not be embedded in concrete.
8. Conduits shall be installed such that there will be NO cutting, bending, and/or displacement of reinforcement from its proper location.
9. Conduits and/or pipes shall not pass through a waterstop in slabs, beams, or walls.
10. Conduits shall not be installed prior to review of conduit layout plan with no exceptions taken by the Engineer.
11. Voids cast into concrete slabs and walls for pipes or conduits and subsequently filled with concrete or grout shall not be installed unless reviewed with no exceptions taken by the Engineer.

3.2 PLACING CONCRETE

A. Notify Engineer and Independent Testing Laboratory 24 hours minimum prior to each placement.

B. All reinforcement within the area of one day's concrete placement shall be tied in place, and observed by the Engineer, prior to commencing concrete placement.

C. For each concrete placement, the Contractor shall coordinate proper timing of consecutive mixer truck deliveries with the concrete supplier to prevent interrupting continuous placements and to avoid delays in discharging trucks.

D. All concrete delivery trucks at each placement shall be tested as specified in Section 03305.

E. Ensure placement and proper location of all embedded items.

F. Provide concrete Delivery Slip prepared at batch plant with each truck load of concrete showing the information listed under Submittals in Section 03300.

G. Water: water added after batching shall be carefully monitored as follows:
   1. Water added after arrival at Project site: accurately metered and recorded on the delivery ticket. The Engineer's Resident Project Representative shall be notified prior to the addition of water.
   2. No additional water shall be added to the concrete on site that will increase the water to cementitious materials ratio above that specified. If additional water is to be added on site, it shall be held back during batching from the quantity specified in the mixture design. The amount of water held back shall be clearly indicated on the concrete delivery slip, and the addition of more water than indicated shall be cause for non-compliance and rejection of the concrete truck.

H. Place concrete from mixing truck to final location quickly and without segregation.

I. Place all concrete from the delivery truck within 90 minutes of addition of water to cement, or cement to aggregate, whichever occurs first. When air temperature is 90°F and above, this time shall be reduced to 60 minutes. These times may be exceeded only upon review with no exceptions taken by the Engineer, and only if all tests for air content, slump and temperature are also within specified limits.

J. Standing water shall be removed from all forms and excavations and the Work shall be kept dry during concrete placement. No water shall be thrown on, allowed to flow over, or rise upon the concrete until the concrete surface has reached its final set and is rigid.

K. Concrete truck chute shall conform to the following:
   1. Minimum slope: 3 horizontal to 1 vertical. Maximum slope: 2 horizontal to 1 vertical. Between these limits the chute slope shall be such to ensure continuous flow without segregation.
   2. Provide baffle at end of chute to prevent segregation. If the end of the chute is more than 3 feet above the surface of deposit, a spout is to be used. The spout is to be kept full of concrete with the end kept as near as practical to the surface of the deposit.
   3. The chute shall be steel or steel lined. Aluminum chutes are not permitted. Sections of the chute shall have the same slope throughout.
   4. The chute is to be thoroughly flushed with water before and after each use with the water discharged outside the forms.

L. Freefall from concrete truck discharge chute, pump hose and hopper hose: 4 feet maximum.

M. The accumulation of concrete on the forms and/or reinforcement above the level of placement shall be avoided. The splashing of concrete upon formwork that is set for a subsequent concrete placement shall be prevented due to the resulting marks on the finished concrete.

N. Concrete placements shall be carried out in a continuous operation until the placement of the entire section between construction joints is complete. Place against plastic concrete only.

O. Do not place partially hardened concrete. Re-tempering is not permitted.

P. Compacting and vibrating concrete:
   1. Consolidate each layer by mechanical internal vibrating equipment supplemented by hand spading, rodding, and tamping as required. The depth of each layer shall not exceed the smaller of 20 inches and the depth that can be properly vibrated with the equipment used. When deposited in multiple layers, the vibrator shall penetrate the preceding layer approximately 6 inches to blend layers. Ensure that initial setting of the previous layer doesn't occur prior to placement of subsequent layer.
   2. Do not use vibrator to move fresh concrete within the forms. Insert vibrator at approximately 18-inch intervals, and over-vibration resulting in segregation shall be prevented.
   3. Concrete shall be thoroughly consolidated around reinforcement, embedded items and into corners of forms.
   4. Ensure that vibrator is kept several inches clear of waterstops.
   5. Where internal vibration is impractical, the use of form vibrators will be considered, and will be allowed only with the review with no exceptions taken by the Engineer. When allowed, the vibrator shall be placed so that motion is horizontal.
   6. Vibratory screeds are acceptable for slabs up to 8 inches thick, however internal vibration is required in areas of load-transfer dowels and electrical conduit. Internal vibration is required for slabs thicker than 8 inches.

Q. Pumping: The inside diameter of pipes and hoses used to convey the concrete shall be a minimum of three times the maximum size aggregate of the mixture. In order to minimize altering the concrete properties, long vertical sections at the end of the pump line are prohibited. A horizontal hose run, a hose loop, or a slide gate at the end of the hose is to be used to reduce loss of entrained air.
R. Thoroughly moisten subgrade materials prior to placing slabs on grade.
S. Provide concrete pads and foundations for all equipment as shown on Drawings or as required by the equipment manufacturer. Set anchor bolts for equipment with templates at correct elevations using manufacturer's shop drawings reviewed by the Engineer with no exceptions taken unless otherwise indicated. All equipment pads shall be sized by the Contractor and equipment supplier except as otherwise indicated on the Drawings.
T. Contractor shall coordinate concrete truck wash-out area with Owner.

3.3 PRE-EXISTING CONCRETE SURFACE PREPARATION

A. When placing concrete against pre-existing concrete, clean surface of all contamination and debris, and roughen by steel shot-blasting, abrasive (sand) blasting, or high-pressure water-jetting (hydrodemolition). Use of scabblers, scarifiers, bush hammers, or pneumatic hammers greater than 15 pounds is not permitted due to resulting substrate bruising, except if followed by steel shot-blasting, abrasive blasting, or high-pressure water-jetting.

3.4 PLACEMENT OF CONCRETE FILL AND PADS ON CONCRETE SUBSTRATE

A. For pre-existing concrete substrate prepare surface as specified above.
B. For new concrete horizontal substrate, provide scratched finish (SF) specified in Section 03350 Concrete Finishing.
C. Clean substrate with brooms, water jets, or air jets.
D. Using epoxy bonding agent specified in Section 03150:
    1. Substrate shall be dry or saturated surface dry as recommended by the manufacturer for maximum bond.
    2. Apply in accordance with manufacturer's instructions.
    3. Place concrete within open time of bonding agent specified by manufacturer.
E. Apply finish in accordance with schedule in Section 03350.

3.5 JOINTS

A. Unless noted otherwise, prepare construction joints as follows:
    1. Horizontal joints: remove laitance immediately after initial set and roughen surface in an acceptable manner that exposes the aggregate uniformly and doesn't leave laitance or loose aggregate. After the concrete has set to a stiffness that precludes laitance removal by shovels or scrapers, the Contractor shall remove it and create a roughened surface by high-pressure water-jetting or other effective method. The use of pneumatic hammers is not permitted.
    2. Vertical joints: the surface shall be thoroughly cleaned of laitance and form release agent by high-pressure water-jetting or wire-brushing followed by air blasting.
    3. Before concrete is placed against set concrete, the surface shall be thoroughly wetted with standing water removed. Horizontal construction joints shall be in a saturated surface dry condition: saturated for a minimum of 6 hours, with standing water removed.

3.6 PROTECTION

A. Protect concrete against cold weather as specified in Section 03340.
B. Protect concrete against hot weather as specified in Section 03341.
C. Do not compact soil until freshly placed concrete has attained 75% of its 28-day design strength.
D. Protect concrete from load-induced stresses during the curing period.
E. Protect concrete from damage due to construction activity and traffic.
F. Unless reviewed by the Engineer with no exceptions taken, protect concrete against premature loads until the concrete has been in place for 14 days and the 28-day design strength has been attained (unless otherwise indicated). groundwater elevation higher than elevation 9.

3.7 DEFICIENT CONCRETE

A. Deficient concrete includes concrete work not placed in accordance with the requirements of the Contract Documents.
B. Deficient concrete may be subject to rejection and replacement at no additional cost to the Owner if the Engineer deems necessary.

END OF SECTION

SECTION 03340

COLD WEATHER CONCRETING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cast-in-Place Concrete in cold weather.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-301 - Specifications for Concrete Construction
B. ACI SPEC-306.1 – Standard Specification for Cold Weather Concreting
C. ACI PRC-306 – Guide to Cold Weather Concreting

1.4 ENVIRONMENTAL CONDITIONS

A. Cold weather is defined as: when the air temperature has fallen to, or is expected to fall below, 40°F during the protection period as defined in Part 3.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 and ACI SPEC-306.1 as modified herein.

1.6 SUBMITTALS

A. Submit methods to be used to protect the concrete during cold weather placements, as defined herein. The Engineer's review shall be for information only as the Contractor is responsible for the means and methods of protection of concrete placed during cold weather.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 PLACING CONCRETE IN COLD WEATHER:

A. Conform to ACI SPEC-306.1 as modified herein for concrete placements in cold weather.
B. Concrete shall conform to the following temperature limitations "as placed and maintained" and "as mixed", respectively. The minimum temperature maintained shall be for a minimum protection period of 6 days, or 4 days if an accelerating admixture is used, and shall be as measured at the concrete surface by the Engineer:

		Concrete Thickness			
Item	Air Temperature	Less than 12 in	12-36 in	36-72 in	Greater than 72 in
Minimum concrete temperature as placed and maintained					
1	--	55°F	50°F	45°F	40°F
Minimum concrete temperature as mixed for indicated air temperature					
2	Above 30°F	60°F	55°F	50°F	45°F
3	0 to 30°F	65°F	60°F	55°F	50°F
4	Below 0°F	70°F	65°F	60°F	55°F

C. The concrete placement temperature shall not be higher than the minimum concrete placement temperature (in the table above) by more than 20°F.

D. An accelerator may be used in the mixture design when placing concrete in air temperatures below 50°F.

E. All snow, ice and frost shall be removed from the surfaces against which the concrete is to be placed including subgrade and reinforcement.

F. Do not place concrete on frozen ground. Insulate or heat subgrade to ensure temperature of subgrade material is above 32°F when concrete is placed.

G. Procedures for covering, insulating, housing and/or heating concrete shall be prearranged. All material and equipment required for cold weather placement, protection and curing shall be available at the project site before commencing concrete placement.

H. Cover, insulate and/or heat as required to protect concrete and provide frost protection beneath structure. Thermal protection shall be provided immediately after concrete placement. Except when supplemental heat is provided, the R-value of the insulation shall be per the recommendations of Chapter 9 of ACI PRC-306.

I. When used, enclosures shall be in place before depositing any concrete. Heating within enclosure shall maintain temperature specified with a reasonable degree of uniformity in all parts of the enclosure. All exposed concrete surfaces within the enclosure shall be kept sufficiently moist to prevent drying. Heating appliances shall be placed in a manner so as not to damage the enclosure, forms, supports, or expose concrete to drying out or to excessive temperatures.

J. The use of direct fired heaters is not permitted due to the potential damage to concrete surfaces exposed to elevated levels of carbon dioxide, which can result in soft, chalky surfaces and dusting throughout the life of the structure. Heaters shall be indirect fired heaters with combustion exhaust vented outside the enclosure, electric, or hydronic.

K. The temperature shall be monitored at the surface of the concrete, including corners and edges that are more vulnerable to low temperature. The concrete surface temperature shall be recorded a minimum of twice per each 24-hour period.

L. When used in an enclosure, reapply curing compounds every two days during heating period or at greater frequencies as required by the manufacturer.

M. Concrete shall be cooled gradually at the end of the protection period. When the surface temperature of the concrete is within 20°F of the ambient temperature, all protection may be removed. The maximum allowable temperature drop at the concrete surfaces shall not exceed 5°F in any 1 hour, and during any 24 hours after the end of the curing period shall not exceed the following total temperature drop:
   1. Sections of less than 12-inch minimum dimension: 50°F
   2. Sections of 12 to 36-inch minimum dimension: 40°F

3.2 LONG-TERM PROTECTION AGAINST FREEZING:

A. Concrete surface temperature shall be maintained above 32°F until the compressive strength, as verified by field-cured cylinders or embedded thermocouples reaches the specified 28-day design compressive strength.

3.3 DEFICIENT CONCRETE

A. Deficient concrete includes concrete work in cold weather that doesn't meet the requirements of the Contract Documents.

B. Deficient concrete may be subject to rejection and replacement at no additional cost to the Owner if the Engineer deems necessary.

END OF SECTION

SECTION 03341

HOT WEATHER CONCRETING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cast-In-Place Concrete in hot weather.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-301 - Specifications for Concrete Construction

1.4 ENVIRONMENTAL CONDITIONS

A. Hot weather is defined as job-site conditions that accelerate the rate of moisture loss or rate of cement hydration of freshly mixed concrete, including an ambient temperature of 80°F or higher, and an evaporation rate that exceeds 0.2 pounds per square-foot per hour.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 as modified herein.

1.6 SUBMITTALS

A. Submit methods to be used to protect the concrete during hot weather placements as defined herein. The Engineer's review shall be for information only as the Contractor is responsible for the means and methods of protection of concrete placed during hot weather.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 PLACING CONCRETE IN HOT WEATHER:

1. Temperature of concrete when placed shall not exceed 95°F. When the air temperature is 90°F and above, procedures to cool mixture ingredients shall be employed. These include:
    a. Providing shaded storage for aggregate,
    b. Frequent sprinkling or fog spraying of coarse aggregate,
    c. Using chilled batch water and/or ice.
2. Forms and reinforcement shall be sprinkled with cold water just prior to concrete placement. When possible, placement of slabs should be scheduled to minimize problems associated with direct sunlight and/or drying winds.

3.2 DEFICIENT CONCRETE

A. Deficient concrete includes concrete work in hot weather that doesn't meet the requirements of the Contract Documents.

B. Deficient concrete may be subject to rejection and replacement at no additional cost to the Owner if the Engineer deems necessary.

END OF SECTION

SECTION 03350

CONCRETE FINISHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Finishing

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-301 – Specifications for Concrete Construction
B. ACI PRC-302.1 - Guide for Concrete Floor and Slab Construction
C. ASTM D2240 – Standard Test Method for Rubber Property – Durometer Hardness

1.4 SUBMITTALS

A. Submit product data and Safety Data Sheets for specified items. Indicate the intended use and location for all products.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301, except as modified herein.
B. All finishing materials shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) Compliance.
C. Contractor performing flatwork finishing of concrete slabs shall provide at least one (1) flatwork finisher certified as an ACI Concrete Flatwork Finisher.

PART 2 - PRODUCTS

2.1 FINISHING MATERIALS

A. Slab Sealer:
    1. Silane or Siloxane based 96% chloride ion screen.
    2. Do not apply to surfaces cured with curing compounds.
    3. Acceptable products:
        a. Baracade Silane 100 C by Euclid Chemical
        b. Sikagard 701W by Sika Corporation
        c. Certi-Vex Penseal 244 100% by ChemMasters/Vexcon
        d. Intraguard by WR Meadows
        e. Or equivalent.

PART 3 - EXECUTION

3.1 DEFINITIONS

A. Liquid resisting slabs and walls are those that are intended to resist leakage of liquid into space that is intended to remain dry. Liquid may include, but is not limited to, groundwater, wastewater, seawater, treated water, and precipitation, and does not include water vapor.

B. An architectural finish is paint, tile, carpeting, or other finish specified in Division 9 of the Contract Documents.

3.2 FINISHES

A. Repair all defects in accordance with Section 03010 prior to finishing formed surfaces.
B. Except where covered by backfill, clean all concrete surfaces and adjoining work stained by concrete leakage.
C. Finish concrete surfaces in accordance with the schedule herein.

3.3 SLABS AND FLATWORK FINISHES

A. Screed to bring concrete surface to proper contour and elevation.
B. Highway straightedge, bull float or darby float the concrete surface immediately after screeding.
C. Allow bleeding process to complete and for all bleed water to evaporate. Slabs shall not be finished while bleed water is on the surface. Means to accelerate drying such as applying dry cement, sand, and other materials shall be prohibited.
D. The specified evaporation retardant may be used to control plastic shrinkage cracking. Conditions that may warrant its use include high temperature, low humidity, high winds, and direct sunlight. Apply in strict conformance with the manufacturer's recommendations. Do not work into concrete surface.
E. After completion of the above listed procedures, provide one of the concrete finishes listed below as indicated in the Schedule of Finishes:
    1. (FF) Float Finish: Float the surface with magnesium or cast aluminum float or with a power finishing machine. Floating shall begin when the water sheen has evaporated and when the slab has stiffened sufficiently to allow proper operation of a power-driven float. Hand floating with wood, aluminum or magnesium floats shall be used at locations inaccessible to a power float. Tolerances shall be for a conventional surface in accordance with ASTM C117.
    2. (LTF) Light Trowel Finish: Provide Float Finish. Hand trowel with a minimum number of passes to provide a sealed surface free of trowel marks. Do not apply an excessive number of trowel passes. Tolerances shall be for a conventional surface in accordance with ASTM C117.
    3. (WFF) Wood Float Finish: Allow concrete to stiffen. Use wood float to provide even surface with open pores.
    4. (LBF) Light Broom Finish: Provide FF or WFF as indicated above. While plastic draw a soft-bristled broom, over the concrete in long even strokes with downward pressure. Broom transverse to traffic or at right angles to the slope of the slab.
    5. (SF) Scratch Finish: Roughen the surface with stiff brushes or rakes before final setting. Remove laitance and loose aggregate.
F. All slabs shall be true to the gradient and elevations shown on the Drawings. Slabs shall be pitched to drains as indicated on the Drawings. In accordance with ACI 117, using a 10-foot straight edge placed anywhere on the slab, the gap under the straightedge and between support points shall not exceed the following:

1. Conventional slab surface: maximum gap of ½-inch for 90% of samples, and maximum gap of ¾-inch for 100% of samples. A conventional slab surface shall be provided except where moderately flat or flat surface is specified.

3.4 VERTICAL SURFACE FINISHES

A. Surface tolerance classes indicated herein are specified in ACI 117 and include abrupt surface irregularities that are measured within 1-inch of the irregularity, and gradual surface irregularities measured as the maximum gap between the concrete and the near surface of a 5-foot straight-edge, measured between contact points. All repairs shall be in accordance with Section 03010.

B. Surface Finish-1.0 (SF-1.0):
   1. Patch voids larger than 1 ½ inches wide or ½ inch deep.
   2. Projections exceeding 1 inch in height shall be removed.
   3. Except when taper tie system specified in Section 03300 is used, form tie holes need not be patched.
   4. Repair surface and structural defects as indicated in Section 03010.
   5. Surface tolerance Class D with formed surface irregularities not more than 1 inch.

C. Environmental Surface Finish-1.0 (ESF-1.0):
   1. Patch voids larger than 1 ½ inches wide or ¼ inch deep.
   2. Projections exceeding ½ inch height shall be removed.
   3. Patch form tie holes.
   4. Repair surface and structural defects as indicated in Section 03010.
   5. Surface tolerance Class C with formed surface irregularities not more than ½ inch.

D. Environmental Surface Finish-2.0 (ESF-2.0):
   1. Patch voids larger than ¾ inch wide or ¼ inch deep.
   2. Projections exceeding ¼ inch in height to be removed.
   3. Patch form tie holes.
   4. Repair surface and structural defects as indicated in Section 03010.
   5. Surface tolerance Class B with formed surface irregularities not more than ¼ inch.

E. Environmental Surface Finish-3.0 (ESF-3.0):
   1. The concrete surface shall be of uniform color, texture.
   2. The arrangement of the form facing material shall be orderly and symmetrical, with the number of seams kept to the minimum.
   3. Surfaces to subsequently receive a grout-cleaned rubbed finish (GCRF) or a concrete coating (Section 03930) shall receive an abrasive or high-pressure water blast to fully expose air voids prior to finishing. For surfaces to receive a coating, coordinate all work of this section with Sections 03930.
   4. Patch voids larger than ¾ inch wide or ¼ inch deep.
   5. Projections exceeding 1/8 inch in height to be removed.
   6. Patch form tie holes.
   7. Repair surface and structural defects as indicated in Section 03010.
   8. Surface tolerance Class A with formed surface irregularities not more than 1/8 inch.

3.5 MISCELLANEOUS CONCRETE SURFACES

A. Top of walls:
   1. Exposed to view - Strike off smooth and hand steel trowel to produce a smooth hard level surface. Line and elevation shall be pre-established by means of preset wood screeds which shall be removed during the troweling operation.
   2. Not exposed to view – Strike off smooth.

3.6 SLAB SEALER

A. Except if otherwise specified in Section 03390 Concrete Curing, exterior elevated slabs and slabs-on-ground shall receive specified slab sealer unless specified to receive a membrane or waterproofing.
B. Exterior equipment pads, stairs, sidewalks, and drives shall receive specified slab sealer or curing and sealing compound specified in Section 03390.
C. Apply in strict conformance with manufacturer recommendations. The following requirements are minimum and more stringent requirements required by the manufacturer shall be adhered to.
   1. Cure concrete as specified in Section 03390. Let concrete age for a minimum of 30 days prior to application of slab sealer.
   2. Clean surface of oil, grease, dirt, and foreign materials as recommended by the manufacturer.
   3. Apply when slab temperature is between 40°F and 80°F.
   4. Apply in a minimum of 2 coats or more if recommended by the manufacturer. Each successive coat shall be applied perpendicular to the previous coat.

3.7 SCHEDULE OF FINISHES

A. Concrete surfaces "exposed to view" shall be defined as those exposed to view upon completion of the Work, whether or not a painted finish is specified. Surfaces which will be covered by fill, such as exterior faces of walls, shall not be considered exposed to view. Interior surfaces of tanks and channels to receive a cover (including grating), or that are more than one foot below the design water level, shall not be considered exposed to view.
B. Finish concrete surfaces according to the following schedule:

SCHEDULE OF FINISHES	
Location	**Finish**
WALLS AND VERTICAL SURFACES	
Not Liquid Retaining or Resisting	
Exterior surfaces exposed to view from top of walls to 6” below grade	ESF-3.0
Exterior below grade surfaces of building spaces that will receive dampproofing	ESF-2.0
Foundation walls not exposed to view, except as otherwise specified	ESF-1.0
Interior surfaces (painted)	ESF-3.0
Interior surfaces (not painted)	ESF-3.0

SCHEDULE OF FINISHES	
Location	**Finish**
Curbs	ESF-3.0
Liquid Retaining or Resisting, Containment	
Exterior surfaces exposed to view	ESF-3.0
Exterior surfaces not exposed to view	ESF-2.0
Interior surfaces exposed to view	ESF-3.0
Interior surfaces not exposed to view and not included in above categories.	ESF-2.0
Chemical and fuel containment area walls and curbs	ESF-3.0
SLABS, BEAMS, AND CONCRETE FILL	
Liquid Retaining or Resisting Structures and Tanks	
Slabs that will receive concrete fill	SF
Concrete fill	FF
Buildings	
Interior slabs that will not receive concrete fill, surface-applied waterproofing, or an architectural finish	LTF
Slabs that will receive concrete fill	SF
Slabs that will receive an architectural finish	LTF
Concrete fill	LTF
Equipment pads	FF
Chemical and fuel Containment Areas	Interior - LTF Exterior - LBF
Other Exterior Slabs	
Exterior slabs-on-ground	LBF
Exterior stairs, platforms, sidewalks, and drives	LBF

END OF SECTION

SECTION 03390

CONCRETE CURING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Curing

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-301 –Specifications for Concrete Construction
B. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
C. ASTM C309 – Standard Specification for Liquid Membrane - Forming Compounds for Curing Concrete
D. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.4 SUBMITTALS

A. Submit product data and Safety Data Sheets for specified items. Indicate the intended use and location for all products.
B. Submit curing methods. Submittal shall be in a table format indicating each structure and how each of its individual components will be cured.
C. Include timing and procedures for application, maintenance requirements, and duration.
D. Submit all requested information prior to the pre-concrete meeting described in Section 03300.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI SPEC-301 except as modified herein.
B. All curing materials shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) Compliance.

PART 2 - PRODUCTS

2.1 CURING MATERIALS

A. Curing compounds shall not be used for tanks or liquid retaining or resisting structures; moist cure is required.
B. Curing and Sealing Compound:
    1. Acrylic water-based compound
    2. Conform to ASTM C309 Type 1 and ASTM C1315 Type 1 Class A, minimum 25% solids.

3. Acceptable products:
    a. Super Diamond Clear VOX by Euclid Chemical
    b. StarSeal 1315 by ChemMasters/Vexcon
    c. Vocomp 25 by WR Meadows
    d. Dress & Seal WB 25 by L&M Construction Chemicals
    e. Or equivalent.

C. Curing Water: Water shall be potable from a municipal water supply. The temperature of the curing water shall not be lower than 20°F cooler than the surface temperature of the concrete at the time the water and concrete come in contact.

D. Curing Paper: ASTM C171, regular or white waterproof paper.

PART 3 - EXECUTION

3.1 CURING

A. Curing shall begin immediately following the initial set of concrete or after slab surface finishing has been completed when it will not mar, erode, or stain the concrete surface and shall continue after form removal. All concrete shall be cured to attain strength and durability by one of the following methods for a minimum of 7 consecutive days immediately after placement. Moist cure is required for all and liquid resisting walls – curing compounds are not permitted.

1. Moist Cure
    a. Ponding or continuous sprinkling. Intermittent wetting and drying is not an acceptable curing method.
    b. Application of curing paper kept continuously wet. Use wet methods for the first 24 to 30 hours. Lap side joints of paper 4 inches minimum and end joints 6 inches minimum. Tape joints or weigh down paper to prevent displacement. Repair any and all tears during the curing period. Apply paper no earlier than 24 hours, and no later than 30 hours, after finishing. The slab surface shall be maintained in a wet condition beneath the paper at all times. During cold weather as defined in Section 03340, when moist curing is called for in this section, the application of water is not required except when a heated enclosure is provided.
2. Curing compounds
    a. Curing compounds shall not be used on tanks or liquid retaining or resisting walls and slabs. Moist curing methods shall be used.
    b. Curing compounds shall not be used on surfaces to receive toppings, concrete fill, bonded finishes, architectural finishes, coatings, sealers, chemical hardeners, waterproofing, dampproofing as specified in Section 03350. Moist curing methods shall be used.
    c. Apply in strict conformance with manufacturer recommendations.
    d. Apply in a minimum of two perpendicular coats.
    e. For slabs, apply immediately following the disappearance of the surface water sheen after the final finishing pass. For formed concrete, apply immediately after form removal.

B. Moisture loss from surfaces placed against wooden or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed.

C. All exposed concrete (tops of walls) within vertical forms shall begin curing, such as with soaker hoses, within 24 hours of placement, regardless of the duration that the forms will remain in place.
D. After form removal of vertical elements, the concrete shall be cured for the balance of time remaining as specified above.
E. For curing during cold weather, conform to the requirements of Section 03340.
F. For curing during hot weather also see the requirements of Section 03341.

END OF SECTION

SECTION 03420

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast concrete structures:
   1. All circular precast concrete structures with a size greater than or equal to 6'-0" interior diameter (sections assembled vertically). Smaller sections are specified in Division 2.
   2. All rectangular or square precast concrete structures of all sizes (monolithic or assembled vertically), except where specified in Division 2.

B. Joint sealants

C. Leak testing

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ACI SPEC-301 Specifications for Concrete Construction

B. ACI CODE-318 Building Code Requirements for Structural Concrete

C. ACI ITG -7 – Specification for Tolerances for Precast Concrete

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

E. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

G. ASTM A1064/A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain or Deformed, for Concrete

H. ASTM C33/C33M – Standard Specification for Concrete Aggregates

I. ASTM C40/C40M – Standard Test Method for Organic Impurities in Fine Aggregates for Concrete

J. ASTM C87/C87M – Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

K. ASTM C88/C88M – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

L. ASTM C131/C131M – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine

M. ASTM C150/C150M – Standard Specification for Portland Cement

N. ASTM C260/C260M – Standard Specification for Air-Entraining Admixtures for Concrete

O. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

P. ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete
Q. ASTM C535 – Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Abrasion Machine
R. ASTM C595/C595M – Standard Specification for Blended Hydraulic Cements
S. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
T. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
U. ASTM C858 – Standard Specification for Underground Precast Concrete Utility Structures
V. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
W. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
X. ASTM C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
Y. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
Z. ASTM C989/C989M – Standard Specification for Slag Cement for Use in Concrete and Mortars
AA. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
BB. ASTM C1012/C1012M – Standard Test Method for Length Change of Hydraulic Cement Mortars Exposed to a Sulfate Solution
CC. ASTM C1240 – Standard Specification for Silica Fume Used in Cementitious Mixtures
DD. ASTM C1260– Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
EE. ASTM C1293– Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
FF. ASTM C1567– Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
GG. ASTM C1602/C1602M – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Production
HH. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
II. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
JJ. ASTM D4101 - Standard Specification for Polypropylene Injection and Extrusion Materials
KK. ASTM E329– Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
LL. AWS D1.4/D1.4M – Structural Welding Code – Reinforcing Steel
MM. Concrete Reinforcing Steel Institute - 10MSP, Manual of Standard Practice
NN. AASHTO HB-17, Standard Specifications for Highway Bridges (17th Edition)

OO. Precast/Prestressed Concrete Institute (PCI) – Manual for Quality Control for Plants and Production of Structural Precast Concrete Products (MNL-116)

1.4 DESIGN REQUIREMENTS

A. All precast units shall be constructed of the shapes and sizes as shown on the Drawings, with interlocking shiplap joints.

B. Base sections shall be designed and constructed with the floor slab cast monolithically or integrally with the bottom riser section. A two-piece base consisting of separate precast slab and riser sections with a sealed joint between the two is not permitted.

C. In addition to the requirements specified herein, all precast units shall meet the following:
   1. Circular units shall meet ASTM C478.
   2. Rectangular or square utility units (excluding water and wastewater structures), monolithic or assembled vertically, shall meet ASTM C858.

D. Structural design calculations shall be in accordance with ACI CODE-318 “load and resistance factor design” and include the following loading conditions:
   1. For all load cases, the weight of soil shall be taken as 125 pounds per cubic foot.
   2. Rectangular or square utility structures shall be designed to the requirements of ASTM C857, except using lateral earth pressure coefficient of 0.50 and AASHTO HS-20 vehicle load.
   3. Rectangular or square water and wastewater structures shall be designed to the requirements of ASTM C890, except using lateral earth pressure coefficient of 0.50 and AASHTO HS-20 vehicle load.
   4. Circular units shall be designed for an AASHTO H-20 vehicle load plus impact. Wheel loads may be distributed through earth cover in accordance with AASHTO HB-17, ASTM C857, or ASTM C890 provisions. The lateral earth pressure coefficient shall be 0.50, and lateral vehicle surcharge shall be 125 pounds per square foot applied over a minimum depth of 8 feet below the wheel.
   5. The following load cases shall be included for all structures, including those designed to the requirements of ASTM C857, ASTM C890, and ASTM C478:
      a. For all structures:
         i. Structure full of liquid with no backfill and no load applied to top slab (leak test condition).
         ii. Empty structure with cumulative maximum external vertical and horizontal loads including lateral earth pressure, maximum groundwater elevation, and lateral vehicle surcharge.
         iii. The forces and distortions applied during curing, stripping, storage, transportation, lifting and erection so that precast members are not overstressed or otherwise damaged.
   6. Unless the design high groundwater or flood elevation is noted on the Drawings, the maximum groundwater level shall be assumed at finished grade.

E. Concrete admixture for microbiologically induced corrosion control shall be included.

F. Reinforcement:
   1. For rectangular and square precast structures and for flat slab tops and bases of circular structures: the minimum steel reinforcement in each direction in slabs and walls shall not be less than 0.003 times the gross area of the concrete section.
G. Concrete clear cover on reinforcement: 2 inches minimum.
H. The interior dimensions of the precast concrete structures shall be as shown on the Drawings. Walls, top slabs and base slabs shall be a minimum of 8” thick.
I. The precast concrete structure shall be designed to resist flotation:
   1. A minimum factor of safety of 1.15 shall be used against flotation based on weights of empty structure and soil directly over footing extensions and above the top slab (if any). Neglect frictional resistance.
   2. Unless the design high groundwater or flood elevation is noted on the Drawings, the maximum groundwater level shall be assumed at finished grade.
   3. The base slab may be extended beyond the face of the wall to provide additional resistance to flotation.
   4. Unless otherwise indicated on the Drawings, additional cast-in-place concrete base slabs will not be permitted for flotation resistance.
J. Segmental structure joints:
   1. Provide waterstop sealants and external sealing bands in all joints to create watertight joints.

1.5 SUBMITTALS

A. Manufacturer's Data:
   1. Submit manufacturer's specifications and instructions for all manufactured materials and products including hatches, sealants, sealing bands, dampproofing, pipe sleeves, flexible wall boots, anchorage hardware and other items. Include manufacturer's certifications and laboratory test reports as required.
   2. Submit the proposed erection procedure for precast units, sequence of erection, and required handling equipment.
B. Shop Drawings:
   1. Submit shop drawings showing complete information for the fabrication and installation of precast concrete units.
   2. Submit layout drawings prepared and stamped by a Professional Engineer registered in the Project state. Drawings shall include the following information:
      a. Overall layout drawings of the assembled precast concrete structure including overall dimensions. Provide identification of each precast unit corresponding to the sequence and procedure of installation.
      b. Drawings of individual members indicating plan and cross section dimensions, locations, sizes, types and details of reinforcement.
      c. Location and details of anchorage devices that are to be embedded in the precast concrete sections.
      d. Locations and details of joints including shiplaps and details of mechanical connections.

e. Locations of wall penetrations for pipes. All openings shall be cast-in-place at the manufacturing plant. Field coring of pipe penetrations shall not be allowed.

3. Submit structural design and buoyancy calculations. Calculations and Drawings shall be prepared and stamped by a Professional Engineer registered in the Project state. Calculations will be reviewed for consistency with the project intent only. The Professional Engineer stamping the shop drawings and calculations shall be responsible for the design.

4. Submit Concrete Mixture designs including:
   a. Proportions for all ingredients, 28-day design compressive strength, water to cementitious materials ratio, admixture dosages, slump, air content and density.
   b. Cement Manufacturer's Certificates of conformance with ASTM C150/C150M or C595/595M taken during the last 90 days.
   c. Supplementary Cementitious Materials: Source and test reports with certificates of conformance with ASTM C618 for fly ash and ASTM C989/C989M for slag cement for actual material to be used in the Work taken during the last 90 days.
   d. Fine and coarse aggregate data shall include test results from within the last 90 days, except test results for soundness, abrasion, and alkali reactivity shall be from within the last 12 months:
      i. Sources
      ii. Specific Gravity
      iii. Sieve analyses per ASTM C33/C33M, including fineness modulus of fine aggregate
      iv. Organic impurities per ASTM C40/C40M (fine aggregate)
      v. Aggregate reactivity (fine and coarse aggregate), one of the options provided in Part 2.
      vi. Soundness per ASTM C88/C88M tested with magnesium sulfate (fine and coarse aggregate).
      vii. Abrasion per ASTM C131/C131M or ASTM C535 (coarse aggregate).
   e. Product data and Safety Data Sheets for concrete admixtures.
      i. Microbiologically induced corrosion control (MICC) admixture.
         (1) Product data, dosage, and instructions for use including storage, preparation prior to dosing, batching sequence, dosing process, and concrete mixing procedures.
         (2) Letter from MICC admixture manufacturer attached to concrete mixture design stating that the concrete mixture design is compatible for use with the admixture. (MICC admixtures may not be compatible with some commercially available concrete admixtures.)
         (3) Letter of certification from precaster stating that all requirements of the admixture manufacturer were followed.
         (4) Concrete batch tickets for each batch of concrete, indicating inclusion of MICC admixture.

f. Field performance and/or laboratory test reports meeting the criteria specified in ACI SPEC-301, Section 4, by testing agencies meeting ASTM E329:
   i. Field test data used to determine the standard deviation used for establishing the required average design strength, and field test data documenting that the proposed concrete proportions will produce an average compressive strength equal or greater than the required average compressive strength, shall be from within the previous 12 months.
   ii. Laboratory trial batch data shall be from with the previous 12 months.

5. Submit past Project list with Owner contact information.
6. Submit letter from precast concrete manufacturer stating:
   a. That all segmental precast concrete structures have been shop assembled prior to shipment and all fabrication and construction and erection tolerances have been adhered to.
   b. For structures assembled vertically include statement that adjacent sections have been marked at the plant with match points to facilitate field assembly and correct alignment, and have been dry fit assembled at the plant to confirm that the required fit is obtained at each joint.

1.6 QUALITY ASSURANCE

A. The manufacturer shall exhibit satisfactory performance on projects of similar magnitude under similar or equal service conditions for a period not less than five (5) years.

B. For structures specified to meet ASTM C913 the concrete manufacturing plant shall be certified by the Precast/Prestressed Concrete Institute (PCI) Plant Certification Program for Group C1 products. For structures specified to meet ASTM C478 or ASTM C858, the concrete manufacturing plant shall be certified by the National Precast Concrete Association (NPCA).

C. The precast concrete manufacturing plant shall implement a Quality Control Plan and maintain a permanent Quality Control Manual outlining the quality control procedures used by the plant. The Quality Control Plan and Manual shall adhere to the requirements of MNL-116.

D. Engineer (or Independent Testing Laboratory) may perform a plant inspection at any time during casting of precast concrete components during the construction period. General Contractor shall notify the Engineer a minimum of 14 days prior to the availability of specific precast components for inspection. After notification, Engineer will notify the General Contractor a minimum of 72 hours prior to the inspection.

E. Structures assembled vertically: adjacent sections shall be marked at the plant with match points to facilitate assembly and achievement of correct alignment. Adjacent sections shall be dry fit assembled at the plant to confirm that the required fit is obtained at each joint prior to shipment to the project site.

1.7 WARRANTY

A. The Contractor shall provide a one (1) year warranty (from the Date of Substantial Completion) for the following:
   1. Cracking, spalling or other surface and structural defects.
   2. Separation of joints or misalignment of adjacent units due to faulty precast concrete sections.
   3. Leakage through all joints between concrete sections due to faulty materials or improper installation.
   4. Microbiologically induced corrosion.

B. The manufacturer shall repair or replace all defective work at no additional cost to the Owner within warranty period.

1.8 DELIVERY, STORAGE AND HANDLING

A. All materials shall be inspected at the project site by the General Contractor for surface and structural defects at the time of delivery. All damaged materials shall be replaced by the Contractor at no additional cost to the Owner.

B. Store precast concrete units at the project site to ensure against cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at the designated lift points only.

C. All precast concrete units shall be placed on supports such that they are stored off the ground.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Precast of Maine, Topsham, ME
B. American Concrete (Superior Concrete, LLC), Auburn, ME, PCI (B2, C1)
C. George R. Roberts, Sanford, ME, NPCA
D. Or equivalent

2.2 MATERIALS

A. Concrete mixture design shall conform to the following:
   1. Minimum compressive strength of concrete at 28-days, (f'c) = 5000 psi.
   2. Maximum water/cementitious materials ratio = 0.42
   3. Cement for all units shall be:
      a. For wastewater structures: ASTM C150/C150M Type II or Type III .portland cement.
   4. Supplementary Cementitious Materials:
      a. Slag Cement: ASTM C989/C989M - Grade 100 or 120.
      b. Silica Fume: ASTM C1240
      c. Fly Ash: ASTM C618 - Type F, and alkali content not to exceed 4.0%
   5. Supplementary cementitious materials may be included as a percentage of total cementitious materials weight as follows. (Supplemental cementitious materials in ASTM C595/C595M cement shall be included in determination of percentages.):
      a. Portland cement: not less than 50%.
      b. Slag cement: if used, not less than 25% nor greater than 35%.

c. Fly ash: if used, not less than 15% nor greater than 25%.
d. Silica fume: if used, not less than 5% nor greater than 10%.
e. Fly ash + slag + silica fume: no more than 50%.
f. Fly ash + silica fume: no more than 35%.

6. Entrained air content of concrete: 6% ± 1.5%.
7. Admixtures:
   a. MICC: Con^{mic}Shield, as manufactured by ConShield Technologies, Inc. or Xypex Bio-San C500, as manufactured by Xypex Chemical Corporation. Verification of compatibility of all admixtures with the MICC admixture shall be required.
   b. Low Range Water Reducer: ASTM C494/C494M Type A.
   c. High Range Water Reducer (superplasticizer): ASTM C494/C494M Type F.
   d. Air entraining agent, visol resin based: ASTM C260/C260M.
8. Aggregates
   a. Prohibited: crushed hydraulic cement concrete and recycled aggregate.
   b. Fine and Coarse aggregates shall be in accordance with NSF 61.
   c. Coarse aggregate shall consist of a well graded crushed stone or a washed gravel conforming to the requirements of ASTM C33/C33M as follows:

	PERCENT PASSING			
SIEVE	NO. 8 (3/8")	NO. 67 (3/4")	NO. 57 (1")	NO. 467 (1 1/2")
1-½ inch	-	-	100	95-100
1 inch	-	100	95-100	-
¾ inch	-	90-100	-	35-70
½ inch	100	-	25-60	-
3/8 inch	85-100	20-55	-	10-30
No. 4	10-30	0-10	0-10	0-5
No. 8	0-10	0-5	0-5	-
No. 16	0-5	-	-	-
No. 50		-	-	-

   d. Fine aggregate shall consist of washed inert natural sand, free from mineral or other coatings, soft particles, clay, loam, organic and other deleterious materials, conforming to the requirements of ASTM C33/C33M as follows:

SIEVE NO.	PERCENT PASSING
4	95 to 100
8	80 to 100
16	50 to 85
30	25 to 60
50	5 to 30
100	0 to 10
200	0 to 3.0

The Fineness Modulus shall be between 2.3 to 3.1. The percentage retained between any two consecutive sieves shall not exceed 45%.

e. Fine Aggregate testing: Perform the following tests on samples of the fine aggregate:
   i. Organic Impurities (ASTM C40):
      (1) Color of supernatant liquid above test sample tested in accordance with ASTM C40 shall not be darker than standard (Organic Plate No. 3/Gardner Color Standard No. 11).
      (2) Use of a fine aggregate failing when tested in accordance with ASTM C40 is not prohibited, provided that, when tested for the effect of organic impurities on strength of mortar, the relative strength at 7 days, calculated in accordance with ASTM C87/C87M, is not less than 95 %.
   ii. Soundness (ASTM C88/C88M):
      (1) Fine aggregate sample tested in accordance with ASTM C88/C88M for five cycles using magnesium sulfate (not sodium sulfate) shall have a weighted average loss not greater than 15%.
   iii. Alkali Reactivity - Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted. Use one of the following options:
      (1) Test aggregate in accordance with ASTM C1293. Aggregate having an expansion less than 0.04% at 1-year is acceptable for use.
      (2) Test aggregate in accordance with ASTM C1260. Aggregate having an expansion less than 0.10% at 16 days is acceptable for use.
      (3) Test concrete mixture with the aggregates and cementitious materials combination submitted, in accordance with ASTM C1293. Aggregates in mixtures having an expansion of less than 0.04% at **2-years** are acceptable for use. (This option also satisfies coarse aggregate requirements.)
      (4) Test concrete mixture with aggregates and cementitious materials combination submitted, in accordance with ASTM C1567. Aggregates in mixtures having an expansion less than 0.10% at 16 days are acceptable for use. (This option also satisfies coarse aggregate requirements.
      (5) Test aggregate in accordance with ASTM C1293 at 1-year. If the coarse and fine aggregates are of different reactivity, the level of protection shall be based on the more reactive aggregate.
         (a) For (moderately reactive) aggregate with expansion greater than or equal to 0.04% and less than 0.12%:

(i) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***or***

(ii) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or

(iii) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(iv) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(b) For (highly reactive) aggregate with expansion greater than or equal to 0.12% and less than 0.24%:

(i) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(ii) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement, or

(iii) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***and***

(iv) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or

(v) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or

(vi) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(c) The use of aggregate with expansion greater than or equal to 0.24% shall not be permitted.

(6) Test aggregate in accordance with ASTM C1260 at 16 days if ASTM C1293 aggregate test data is not available. If the coarse and fine aggregates are of different reactivity, the level of protection shall be based on the more reactive aggregate.

(a) For (moderately reactive) aggregate with expansion greater than or equal to 0.10% and less than 0.30:
  (i) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***or***
  (ii) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplementary cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or
  (iii) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or
  (iv) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(b) For (highly reactive) aggregate with an expansion greater than or equal to 0.30% and less than 0.45%:
  (i) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or
  (ii) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement, or
  (iii) Alkali content contributed by the portland cement shall not exceed 3.0 lbs per cubic yard of concrete, ***and***
  (iv) If alkali content of the portland cement is less than 0.70%, a minimum amount of supplemental cementitious material shall be provided as follows: 25% fly ash or 35% slag cement, or
  (v) If alkali content of portland cement is between 0.70 and 1.0, a minimum amount of supplemental cementitious material shall be provided as follows: 30% fly ash or 50% slag cement, or
  (vi) If alkali content of portland cement is between 1.0 and 1.25, a minimum amount of supplemental cementitious material shall be provided as follows: 40% fly ash or 65% slag cement.

(c) The use of aggregate with expansion greater than or equal to 0.45% shall not be permitted.

f. Coarse Aggregate testing: Perform the following tests on samples of the coarse aggregate:
  i. Abrasion (ASTM C131/C131M or ASTM C535):

(1) Coarse aggregate shall be tested in accordance with either ASTM C131/C131M (aggregate smaller than 1 1/2") or ASTM C535 (aggregate larger than ¾").
(2) Loss of the mass of the coarse aggregate by abrasion shall not exceed 50%.

ii. Soundness (ASTM C88/C88M):
(1) Coarse aggregate sample tested in accordance with ASTM C88/C88M for five cycles using magnesium sulfate (not sodium sulfate) shall have a weighted average loss not greater than 18%.

iii. Alkali Reactivity:
(1) Test coarse aggregate according to the same requirements specified above for testing of fine aggregate. Evidence of a satisfactory service record in lieu of testing for alkali reactivity is not permitted.

9. Water:
a. Potable, from a municipal water supply

B. Reinforcement:
1. Bars: ASTM A615/A615M Grade 60; deformed new materials. Cold-bent in accordance with CRSI 10MSP.
2. Welded wire fabric: ASTM A1064/A1064M. Flat sheets are required; rolls are not permitted.
3. Tie wire: ASTM A1064/A1064M, annealed.

C. Plates and inserts:
1. Plates:
a. Provide cast-in-place plates as shown on the Drawings. Plates shall be either:
i. ASTM A36/A36M, hot-dip galvanized in accordance with ASTM A123/A123M, or
ii. AISI Type 316 stainless steel.
2. Inserts:
a. Provide inserts as required for lifting, connections, etc.
i. ASTM A123/A123M or A153/A153M hot-dip galvanized, or
ii. AISI Type 316 stainless steel.

D. Manhole Steps:
1. Provide manhole steps as shown on the Drawings.
2. Steps shall be constructed of steel reinforced copolymer polypropylene. Steps shall conform to ASTM C478 and the polypropylene shall conform to ASTM D4101.
3. The top surface shall have a molded non-slip surface
4. Step widths shall be between 13.75 inches – 14 inches. Step projects from face of concrete shall be between 5 inches – 6 inches.
5. Steps shall be able to support the following loads in accordance with ASTM C478:
a. Minimum pullout load of 300 pounds
b. Minimum vertical load of 800 pounds with a maximum permanent deflection of ½ inch

6. Thoroughly clean all surfaces to be embedded with a suitable cleaning agent to ensure that the surfaces are free from all foreign matter such as dirt, oil and grease.
7. All steps shall be cast into walls of the precast section to form a continuous ladder with a distance of 12-inches between steps. Step inserts may be cast into the walls if reviewed with No Exceptions Taken by the Engineer.
8. Acceptable products:
    a. Model ML-13-NCR by American Step Company, Inc.
    b. Model P-14938 by Parson Environmental Products, Inc.
    c. Model PS2-PF by M. A. Industries, Inc.
    d. Or equal

E. Pipe Openings:
1. Provide formed cast-in-place holes, shop-cored holes, or cast-in sleeves.
    a. Flexible rubber watertight connectors shall conform to ASTM C923.
        i. Connectors shall either be cast into the concrete or fastened to the structure with stainless steel expansive sleeves.
        ii. Pipes shall be fastened to the connector with stainless steel bands.
        iii. Products:
            (1) Kor-N-Seal (106-406 Series) by Trelleborg Pipe Seals
            (2) PSX: Positive Seal by Press-Seal Corporation
            (3) Z-Lok Connector made by A-Loc Products Inc.
            (4) Or equal
    b. Hot-dipped galvanized steel sleeves with a welded waterstop ring centered in the wall.
    c. Expansive rubber and stainless steel ring to seal annular space between pipe and pipe opening.

F. Precast Section Joints:
1. Provide sealant and sealing bands at all precast concrete section joints.
2. Sealants:
    a. Install solid, continuous, flexible sealants in all joints to achieve watertight joints. Install a double row of joint sealants at every manhole joint.
    b. Sealant shall conform to ASTM C990.
    c. Sealant shall be sized such that it compresses a minimum of 50% within the joint.
    d. Sealant shall maintain stability at all temperatures and not shrink or harden over time.
    e. Acceptable products:
        i. Kent Seal No. 2 by Hamilton Kent
        ii. RN 101 Ram-Nek Joint Sealant by Henry
        iii. EZ-STIK or PRO_STIK Butyl Sealant by Press-Seal Corporation
        iv. Conseal CS-102 (CS-202 when the temperature during installation is less than 30˚F) by Concrete Sealants, Inc.
        v. Or equal
3. Joint Sealing Bands:
    a. Shall be 12” wide
    b. Shall conform to ASTM C877 Type III

c. Acceptable products:
   i. EZ-WRAP by Press-Seal Corporation
   ii. ConWrap CS-212 by ConSeal
   iii. MacWrap C877 Type III by MarMac Construction Products Co.
   iv. Or equal

G. Liquid Asphalt Dampproofing:
1. Apply a one- or two-coat waterborne emulsified asphalt dampproofing system for all below grade exterior wall surfaces.
2. Meet ASTM D1187/D1187M, Type 1 and ASTM D1227/D1227M, Type 2, Class I.
3. Two coat system: fiber-reinforced, brush or spray applied.
   a. Acceptable products:
      i. MasterSeal 615 by Master Builders
      ii. Sealmastic Type II Emulsion by W.R. Meadows
      iii. Or equal
4. One coat system: fiber-reinforced, trowel applied.
   a. Acceptable products:
      i. MasterSeal 614 by Master Builders
      ii. Sealmastic Type III Emulsion by W.R. Meadows
      iii. Or equal

H. Hatches: Provide hatches as shown on the Drawings. Integral hatches are furnished under this Section and specified in Specification Section 08310.

I. Manhole covers, frames, and steps: Provide manhole covers, frames, and steps as shown on the Drawings. Integral manholes covers, frames and steps are furnished under this Section, and specified in Specification Section 02601 Manholes, Covers and Frames.

J. Concrete Repair Materials:
1. Grout Paint: Mix 1-part Type II portland cement, 1-part fine sand, and enough water to the consistency of thick paint.
2. Patching Mortar: 1-part of a mixture of white and grey Type II portland cement to 2.5 parts of damp loose sand. Cement type to match substrate.
3. Epoxy Adhesive:
   a. Two or three-part water-based epoxy bonding agent with cementitious components
   b. Acceptable products:
      i. Armatec 110 Epocem by Sika Corporation
      ii. Corr-Bond by Euclid Chemical Co.
      iii. MasterEmaco P 124 by Master Builders
      iv. Or equivalent
4. Repair of random cracks (dry – free of liquid or moisture):
   a. 2-component, 100% solids, moisture-tolerant, low-viscosity, high-strength, multipurpose, epoxy resin adhesive.
   b. Acceptable products:
      i. Sikadur 35 Hi-Mod LV by Sika Corporation
      ii. Eucopoxy Injection Resin by Euclid Chemical Co.
      iii. MasterInject 1500 by Master Builders
      iv. Or equivalent

5. Repair of random cracks (wet - presence of liquid or moisture):
    a. Low viscosity polyurethane resin that expands and forms a closed cell foam when it comes in contact with water.
    b. All cracks that are wet (either damp or leaking) at the time of repair shall be repaired with a material that is specifically intended for wet repair as recommended by the manufacturer.
    c. Acceptable products:
        i. SikaFix HH Hydrophilic by Sika Corporation
        ii. Dural Aqua-Fil by Euclid Chemical Co.
        iii. MasterInject 1210 IUG by Master Builders
6. Repair of minor spalls, honeycombs areas and air voids and cementitious overlays:
    a. Polymer modified, non-sag cementitious repair mortar with corrosion inhibitor.
    b. Repair material shall include peastone for repairs of greater depth as required by the manufacturer. For repair areas involving depths generally in excess of three (3) inches, utilize a repair material suitable for the depth of repair.
    c. Acceptable products:
        i. SikaTop 122 Plus or 123 Plus by Sika Corporation
        ii. Tamms Structural Mortar by Euclid Chemical Co.
        iii. MasterEmaco N 400 MasterEmaco N 400
        iv. Or equivalent

PART 3 - EXECUTION

3.1 FORMWORK

A. Forms for manufacturing precast concrete products shall be of the type and design consistent with industry standards and practices.
B. Forms shall be capable of consistently providing uniform products and dimensions.
C. Forms shall be constructed so that the forces and vibrations to which the forms will be subjected can cause no product damage

3.2 FABRICATION AND PLACING REINFORCEMENT

A. Detailing and fabrication of reinforcement shall conform to the CRSI Code of Standard Practice unless otherwise indicated on the Drawings.
B. Reinforcement shall be clean and free from loose mill scale and rust and from coatings that reduce bond.
C. Place reinforcement of structural members on accessory bolsters and chairs. Accessories shall be stainless steel or have plastic tips.
D. All reinforcement shall have concrete cover specified.
E. Do not weld reinforcement unless the Engineer takes no exceptions in writing. When permitted, welding shall be in accordance with AWS D1.4/D1.4M.

3.3 PRODUCTION, CURING, FINISHING, REPAIRS AND STORAGE

A. Production, curing and storage of the precast units shall conform to the provisions of MNL 116.

B. Production:
1. Each precast concrete unit shall be an integral placement without any construction or cold joints. Base slabs shall be a monolithic or integral placement with the bottom wall section. A two-piece base consisting of separate precast slab and riser sections with a sealed joint between the two is not permitted.
2. Structures shall be fabricated from the minimum number of precast sections to minimize the number of joints. Joints shall be located such that penetrations do not intersect joints.
3. Tolerances: Fabricate precast units without exceeding the tolerances specified below:
    a. Rectangular or square utility, water and wastewater units:
        i. Interior length, width, or height:
            (1) Less than 5'-0": +/- 1/4"
            (2) 5'-0" to 10'-0": +/- 3/8"
            (3) Greater than 10'-0": +/- 1/2"
        ii. Wall and slab thickness: -3/16", +1"
        iii. Variation in length of opposite surfaces:
            (1) Per foot of internal span: +/- 1/8"
            (2) Span = 7' or less: +/- 5/8"
            (3) Span > 7': +/- ¾"
        iv. Variation from End Squareness (difference in interior diagonal measurements):
            (1) Measured length less than 10'-0": ½"
            (2) Measured length 10'-0" to 20'-0": ¾"
        v. The inside joint seam gap between two adjacent sections before joint sealant is applied shall not exceed 3/8".
        vi. Offsets in alignment of adjacent members at any joint +/- ¼".
    b. Circular structures meeting ASTM C478:
        i. Interior diameter: +/- 1.0%
        ii. Thickness of wall and slabs: -3/16", +1"
        iii. Offsets in Alignment of Adjacent Members at Any Joint: +/- ¼"
        iv. The inside joint seam gap between two stacked sections before joint sealant is applied shall not exceed 3/8"

C. Curing:
1. All exposed precast concrete shall be cured by either:
    a. Moist curing (steam, ponding or application of burlap kept continuously wet)
    b. Covering the exposed surface with polyethylene sheets
    c. Covering the exposed concrete with membrane curing compounds
    d. Application of steam. This method may only be used after the initial set of the concrete.
2. Alternate wetting and drying shall not be permitted

D. Finishing:
   1. Unless otherwise indicated all surfaces shall be cast with an "As Cast" finish.
   2. All exposed surfaces shall be free of form defects and joint marks.
   3. Slight color variations, small surface holes (up to ¼ inch diameter) caused by air bubbles will be accepted but no major imperfections, excessive honeycombing, sand streaks or other major defects shall be permitted.

E. Repairs of Defects at the Plant:
   1. Minor defects:
      a. Surface defects not impairing the functional use or expected life of a precast concrete product as determined by the Engineer shall be considered minor defects.
      b. Minor defects shall be repaired by a method that does not impair the product and approved in writing by MICC admixture manufacturer.
      c. All repairs shall be made and identified prior to shipment to the Project site.
   2. Major defects:
      a. Structural defects in precast concrete products that impair the functional use or the expected life of products as determined by the Engineer shall be considered major defects.
      b. All precast units with major defects shall be rejected and not delivered to the Project site

F. Storage:
   1. Areas used for storage of products shall be firm enough and level enough to avoid causing damage to stored products.
   2. Products shall be stored on level surfaces in a manner that will minimize damage caused by uneven bearing, improperly located dunnage blocks, stacking products too high or difficulty in handling.

3.4 HANDLING, AND TRANSPORTATION

A. All precast concrete units shall be lifted using designated pick points and lifting inserts. Extreme caution shall be exercised so as not to damage the units during handling.

B. Prior to shipment:
   1. All precast products shall be inspected by plant personnel to assure design conformance, that all defects have been repaired, that all units have proper identification.
   2. For horizontally installed sections: that all units have proper match marks to facilitate assembly, and units have been dry fit assembled at the plant to ensure proper fit at each joint.
   3. For vertically assembled sections: that all units have proper match marks to facilitate assembly, and units have been dry fit assembled at the plant to ensure proper fit at each joint
   4. Products not conforming to requirements shall be clearly labeled and the defects noted on the inspection report. Only products conforming to the requirements shall be shipped.

C. Transportation:
   1. Precast concrete units shall be properly supported during transportation to minimize potential for damage.
   2. Transport units in a position consistent with their shapes to avoid excessive stresses that may cause damage. Unique shipping instructions or special stacking may be required for irregularly shaped pieces.
   3. Do not transport units until they have been cured for a minimum of 5 days or have reached 75% of their 28-day design strength.

3.5 REPAIR OF UNITS AT PROJECT SITE

A. Minor defects, as determined by the Engineer, shall be repaired by a method that does not impair the product, and shall be at no additional cost to the Owner. Minor defects:
   1. Form tie holes
   2. Air voids (bugholes)larger than those specified for the required surface finish
   3. Honeycomb areas with a depth less than 1 inch
   4. Blisters
   5. Delaminations
   6. Crusting
   7. Visible construction joints, fins and burs
   8. Non-uniform concrete color and appearance
   9. Floors that are not level

B. Major defects, as determined by the Engineer, shall not be repaired. Precast units with major defects shall be rejected and removed from the Project site and replaced at no additional cost to the Owner. Major defects:
   1. Random cracks
   2. Excessive cracking (crazing)
   3. Spalls
   4. Air voids (bugholes) and honeycombed areas with a depth greater than or equal to 1 inch

3.6 REPAIR OF SURFACE DEFECTS

A. Form Tie Holes: After cleaned and thoroughly dampened, apply grout paint and fill holes solid with patching mortar.

B. Air voids (bugholes): After cleaned and thoroughly dampened, apply grout paint and fill holes solid with patching mortar.

C. Honeycomb areas:
   1. All honeycombed areas shall be removed to sound concrete by means of hand chisels or pneumatic chipping hammers or hydrodemolition.
   2. Saw cut a 1-inch minimum square groove around the edges of the defective area perpendicular to the surfaces to serve as the boundary for concrete removal. Saw cut the edges perpendicular to the surface. No feather edges shall be allowed.
   3. Remove all loose aggregate paste and debris and scrub clean. Thoroughly wet area to be repaired. Brush and scrub grout paint into the substrate of the area to be repaired.
   4. Mix patching mortar using as little water as possible. Allow to stand with frequent manipulation of trowel to achieve stiffest consistency. Blend white and gray portland cement to achieve color match with surrounding concrete.

5. Prior to the set of grout paint (but after it has cast its water sheen), apply a stiff consistency of patching mortar to the area with a trowel. Leave patched surface slightly higher than surrounding surface. Do not finish for 1 hour minimum. Cure in same manner as adjacent concrete.

D. Blisters, delaminations and crusting: Repairs shall be similar to those for honeycomb areas. Depth of saw cut shall match the depth of the defective concrete.

E. Visible construction joints, fins and burrs: Remove by grinding until a smooth uniform surface is attained.

F. Concrete with an overall non-uniform color or appearance as determined by the Engineer shall be repaired with a complete cementitious overlay. Application of the overlay shall be in strict accordance with the manufacturer's written instructions and recommendations.

3.7 ERECTION OF PRECAST STRUCTURES

A. The General Contractor shall carefully inspect the precast units delivered to the project site prior to commencing installation, and immediately notify the fabricator of any and all deficiencies such as the absence of marked match points on adjacent sections, sections out of specified tolerances, and improperly fabricated sections so that the fabricator can correct such deficiencies, including replacing sections as required.

B. Install all precast structures level, plumb and aligned to the elevations and in the locations shown on the Drawings. All precast concrete units shall be lifted using designated pick points and lifting inserts in accordance with the written instructions from the Precast Concrete supplier.

C. Installation Tolerances: Install precast units without exceeding the tolerances specified in Section 3.3.

D. Attach precast concrete units to concrete foundations as indicated on the Drawings or as required by the Precast Concrete manufacturer.

E. Connect adjacent precast concrete units as required by the manufacturer. All units shall fit tight to their adjacent units.

F. Joints: All joints shall be watertight and shall be sealed as indicated below:

1. Install sealants in all joints. A minimum of 2 rows of sealants shall be applied at each joint.
2. Install sealing bands around the exterior face of all horizontal and vertical joints to achieve watertight joints.
3. All sealants and sealing bands shall be installed in accordance with the manufacturer's recommendations.
4. Install primer as required by the sealing band manufacturer. Primer and sealing band shall be installed within the temperature range recommended by the manufacturer.
5. Sealing bands shall be installed directly over the joints prior to installation of any other straps or anchors and prior to application of field-applied dampproofing.
6. Apply concrete repair material to all offsets of 1/8" to 1/4" between adjacent precast sections to provide a smooth transition from one precast section to the next prior to applying the joint sealing band.

7. Joints shall be clear of dirt, snow, ice and other debris prior to installing sealing bands.

G. After erection is complete, all surface damages to the precast concrete units shall be properly repaired in accordance with this Section. All lifting inserts and holes shall be patched after final installation.

3.8 LIQUID ASPHALT DAMPPROOFING APPLICATION

A. Apply dampproofing to the exterior surfaces all below grade precast concrete walls and on the top surface of below grade top slabs.

B. Apply in strict accordance with manufacturer's printed instructions and as specified herein. Clean and prepare surfaces as required.

C. Do not apply dampproofing at temperatures below 40° F or when temperature is expected to fall below 40° F within 12 hours.

D. Do not place backfill for at least 48 hours after application.

E. All damproofing materials spilled on adjacent structures shall be cleaned with a material recommended by the dampproofing manufacturer.

3.9 TESTING

A. General:
   1. Perform leakage tests on all precast concrete structures indicated below prior to application of dampproofing and installing backfill around the structures.
   2. All testing must be performed in the presence of the Engineer.
   3. Suitably plug all pipes entering structure and brace plugs to prevent blow out.

B. Leakage Tests:
   1. Fill precast concrete structure with potable water to within one foot below the underside of the top slab. Contractor shall be responsible for providing potable water for the tests.
   2. A period of up to 12 hours may be permitted, if the Contractor so wishes, to allow for absorption.
   3. At the end of the absorption period, refill structure with water to within one foot below the underside of the top slab and begin the 4-hour test period.
   4. At the end of the 4-hour test period, refill and measure the volume of water added. The test shall be considered passing if the following conditions are met:
      a. The drop in the liquid level does not exceed 1/8 inch
      b. There are no visible leaks on exterior surfaces of the structure or through joints.
   5. Contractor shall repair all leaks at no additional cost to the Owner. All repair materials shall be reviewed for information only by the Engineer.
   6. Precast concrete structures shall be retested subsequent to repairs.
   7. Additional tests and repairs will be performed until such time as the structures can demonstrate compliance with the testing requirements.
   8. Contractor shall dispose of water in accordance with all applicable local, State and Federal Regulations.

C. Test Schedule:
   1. The following structures shall be leak tested: All precast structures.

END OF SECTION

SECTION 03604

NON-SHRINK GROUT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cementitious non-shrink grout
B. Epoxy non-shrink grout

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM C33/C33M - Specification for Concrete Aggregates
B. ASTM C109/C109M - Test Method for Compressive Strength of Hydraulic Cement Mortars
C. ASTM C827 - Test Method for Changes in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
D. ASTM C1107/C1107M - Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
E. CRD-C611 - Test Method for Flow of Grout Mixtures
F. CRD-C621 - Specification for Non-Shrink Grout

1.4 SUBMITTALS

A. Submit product data and Safety Data Sheets for products to be used.
B. Submit test data when required.
C. Submit manufacturers installation instructions for products used.
D. Submit a list of at least five (5) similar installations of the product during the last 5 years.

1.5 QUALITY ASSURANCE

A. The grout manufacturer shall be ISO 9001 certified and have been in business of manufacturing similar products for over ten (10) years. The manufacturer shall maintain a strict quality assurance program, offer technical services and provide a representative at the jobsite for product training, prior to product installation, upon written request.
B. Conform to Army Corps of Engineers Specification CRD-C621 and ASTM C1107/C1107M (Grades B or C).
C. Grouts shall exhibit non-shrink characteristics when tested according to ASTM C827.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver in original sealed packages or containers, labeled with the manufacturer’s identification, printed instructions and batch code.
B. Store in dry conditions above freezing and below 90°F.
C. Keep unused portions of opened containers dry and warm.
D. Store aggregate covered and protected from the elements.

1.7 ENVIRONMENTAL CONDITIONS

A. Do not place grout when exposed to precipitation.
B. Place grout when temperature of substrate and ambient air are above 40°F and below 90°F.
C. Place grout outside these limits when approved by heating substrates, enclosing work, shading, cooling or other measure to mitigate adverse weather conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cementitious grout: consists of premeasured, prepacked flowable cement based grouting material with aggregate requiring only the addition of water.
B. Epoxy grout: consists of premeasured, prepacked epoxy based grouting material consisting of an epoxy resin, hardener and specially blended aggregates. The ratio of the weight of aggregate to the weights of the combined resin and hardener (fill ratio) shall be maintained.
C. Aggregates: ASTM C33/C33M fine aggregate, washed.
D. Pea Stone: ASTM C33/C33M coarse aggregate, size number 8 (max. size 0.375 inches), washed.
E. Water: Potable, from municipal water supply.
F. Epoxy resins shall not contain non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other volatile and hazardous diluents are not permitted.
G. Utilize proper grout for the intended application as recommended by the manufacturer.

2.2 TESTS

A. All grouts shall achieve a minimum 28 day strength of 6,000 psi according to ASTM C109/C109M.
B. Grouts when tested by flow cone according to CRD-C 611 shall take more than 20 seconds to flow as a maximum limit on fluidity.
C. Test grout when requested.

2.3 ACCEPTABLE PRODUCTS

A. Cementitious Grout
    1. Five Star Grout - Five Star Products, Inc
    2. Masterflow 928 - BASF / Master Builders
    3. NS Grout - Euclid Chemical Company
    4. Crystex - L&M Construction Chemical, Inc.
    5. Harris Construction Grout – A.H. Harris & Sons, Inc.
    6. Or equal
B. Epoxy Grout
    1. HP Epoxy Grout - Five Star Products, Inc.
    2. Masterflow 648 CP Plus - BASF / Master Builders
    3. E3-HP - Euclid Chemical Company
    4. Epogrout 758 - L&M Construction Chemicals, Inc.
    5. Or equal

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Unless otherwise indicated, Follow manufacturer's written instructions.
B. Concrete surfaces shall be a minimum 28 days old.
C. Completely remove all loose concrete, aggregate, dust, laitance, dirt, oil, grease and other contaminants by bush-hammering, chipping, brushing, concrete cleaners or degreasers.
D. Use acceptable mechanical means to obtain clean, sound and rough concrete surfaces, exposing coarse aggregate. Blow surfaces clean of dust and debris using oil-free compressed air.
E. Surface moisture:
    1. Cementitious grout: Soak concrete surfaces thoroughly for a minimum of 8 hours with potable water. Concrete shall be saturated and free of standing water at time of grout placement.
    2. Epoxy grout: Do not pre-soak concrete surfaces prior to grout placement. Surfaces shall be visibly dry.
F. Follow manufacturer’s cold and hot weather grouting procedures to maintain all materials and surfaces that contact grout within acceptable temperature ranges. Heat the substrate and surrounding environment to a minimum of 40° F.

3.2 FORMS

A. Formwork shall be constructed of rigid nonabsorbent materials, securely anchored, watertight and strong enough to resist forces developed during grout placement.
B. Formwork shall be constructed so that the grout is placed across the shortest distance whenever possible. The clearance between formwork and baseplate shall be sufficient to allow for headbox. The clearance for remaining sides shall be one to three inches.
C. Height of formwork shall extend a minimum of one inch above the highest point to be grouted.
D. All formwork shall be coated with a form release agent or plastic sheeting for easy removal. Care should be taken not to contaminate grouting surfaces where bond is required.

3.3 MIXING

A. Provide an adequate number of mortar mixers in good operating condition for uninterrupted placement. Do not exceed one-half the maximum capacity of the mortar mixer.
B. Cementitious grout:
    1. Pre-wet mortar mixer directly prior to mixing. Empty excess water.
    2. Start by adding the minimum amount of premeasured potable water to mixer. While mixing, slowly add grout and mix to a uniform consistency.
    3. Mix thoroughly for approximately four to five minutes. To achieve desired consistency, add remaining water as necessary. Do not exceed maximum water content as stated on product packaging or add an amount that will cause segregation.
    4. For pours requiring aggregate extension, add clean, damp coarse aggregate before final water adjustment.

5. Do not mix more material than can be placed within the working time of the grout. Do not retemper the mix by adding additional water.

C. Epoxy grout:
   1. Combine resin and hardener into pail containing resin. Mix thoroughly by hand with a paddle or by slow speed mixer until a uniform color (no streaks) is obtained. Avoid air entrapment while mixing. Immediately pour all mixed liquids into mortar mixer. While mixing at a slow speed, slowly add aggregate and mix only until aggregate is completely wet.
   2. Do not mix more material than can be placed within the working time of the grout.

3.4 PLACING

A. PouringCementitious and Epoxy Grout):
   1. A headbox or similar device is required for a continuous pour to avoid air pockets under baseplate. All grouting shall take place from one side to the other, maintaining contact with the bottom of the plate at all times.
   2. When pouring through grout holes, placement shall proceed continuously with a headbox until the grout has risen in the next hole. Maintain head pressure at initial hole so that grout stays in contact with the bottom of the baseplate at all times.
   3. Commence grouting at the next hole with an additional headbox. Continue process, alternating headboxes until grouting is complete.
   4. When pouring into the headbox, grout shall be introduced in a manner to avoid air entrapment. Care must be taken during grouting to keep the headbox at least half full of material to ensure even grout flow. If necessary to assist the flow, a plunger may be used. This procedure shall continue until the grout rises above the bottom edge of the baseplate on the opposite side.
   5. Throughout the pour, forms shall be constantly checked for leaks. All leaks shall be sealed immediately.

B. Pumping (Cementitious Grout):
   1. The type and size of pump and discharge line used are dependent on the parameters of each installation. Contact the pump and grout manufacturers for recommendations.
   2. Pumping raises the grout temperature and shortens the working time while reducing its consistency. Keep mix temperature as cool as necessary, except in cold weather.
   3. The grout shall be mixed to a consistency that will not segregate while pumping.
   4. The grout shall be passed through a #4 screen prior to placement into the pump hopper.
   5. Before pumping, determine the working time under jobsite conditions. Pumpability shall be determined by field testing.
   6. The pump shall be positioned to minimize the pumping distance. Keep the discharge line as close to horizontal as possible. All hose connections must be watertight.
   7. Immediately prior to pumping, the pump and lines shall be primed with a priming slurry leaving hopper empty to prevent overwatering.

8. Once the pumping has begun, it is important not to use any of the priming slurry from the discharge lines. Grout shall not be used until a uniform consistency is obtained at the discharge nozzle.
9. Provide an adequate volume of mixed grout to keep the pump hopper at least half full. The grout shall be placed into pump hopper in a manner to prevent air entrapment.
10. The discharge nozzle shall be withdrawn only while pumping, keeping it submerged within the grout at all times.
11. When a pump is needed to transport grout and the nozzle cannot be inserted into the cavity being grouted, a headbox is required. The headbox will allow the pour to be continuous, avoiding air pockets under the plate. The grout shall be discharged from the nozzle into the headbox in a manner to avoid air entrapment. The headbox shall be kept at least half full at all times.
12. All grouting shall take place from one side of the plate to the other. Maintain contact with the bottom of the plate at all times to maximize the effective bearing area (EBA).
13. When pouring through grout holes, placement shall proceed continuously until the grout has risen in the next hole. Maintain head pressure at initial hole so that grout stays in contact with the bottom of the baseplate at all times. Commence grouting at the next hole with an additional headbox. Continue process, alternating head boxes until grouting is complete.

C. Dry pack (Cementitious Grout):
1. A dry-pack consistency is achieved when the mixed grout can be squeezed into a ball by hand without crumbling. Only enough water should come to the surface to moisten the hands.
2. Use a ram with a square cut end and hammer to evenly compact the grout against solidly braced backing boards, combining each layer (approximately 1/2 inch thick) to the previously placed layer over its entire surface.
3. Each placed layer shall be visually inspected for placement uniformity.
4. Striking force should be sufficient for compaction of the grout without affecting plate alignment.
5. Placement shall be continuous until grouting is complete.

3.5 FINISHING AND CURING

A. Finishing:
1. Cut grout back from bottom of baseplate to the foundation at approximately a 45° angle. Formwork can be removed for cutback when grout offers stiff resistance, or when cut with a steel trowel, stands up without support. Epoxy grout may be finished flush with the edge of the base plate.
2. Provide smooth finish to exposed grout surfaces.
3. Grout shall not be allowed to remain above the bottom edge of the baseplate.

B. Curing:
1. Cementitious grout shall be moist cured for a minimum of three days. Epoxy grout does not require curing agents.
2. Cementitious Grout shall be protected from excessive evaporation with wet rags prior to set.
3. Grout shall be protected from wind, rain, freezing and vibration until a minimum compressive strength of 1000 psi is achieved.

4. Maintain temperature above 45° F until a minimum compressive strength of 1000 psi is achieved.

END OF SECTION

SECTION 04200

UNIT MASONRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of Existing Masonry
B. Face Brick
C. Concrete Masonry Units
D. Mortar
E. Reinforcement and Anchorage
F. Accessories
G. Thru-wall Flashing and Accessories
H. Modifications and/or Repairs to Masonry

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 03300 - Cast-in-Place Concrete: Deformed bar reinforcing in masonry.
B. Section 05500 - Metal Fabrications: Installation of steel lintels and embedded plates.
C. Section 07214 - Cavity Wall Insulation: Provide and install cavity wall insulation.
D. Section 15092 - Pipe Sleeves and Seals: Installation of pipe sleeves.

1.4 REFERENCES

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary
B. ASTM A82 - Cold-Drawn Steel Wire for Concrete Reinforcement
C. ASTM A153 - Specification for Zinc-Coating (Hot Dip) on Iron and Steel Hardware.
D. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
E. ASTM A641 - Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
F. ASTM C62 - Building Brick
G. ASTM C67 - Sampling and Testing Brick and Structural Clay Tile
H. ASTM C90 - Loadbearing Concrete Masonry Units
I. ASTM C91 - Masonry Cement
J. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars
K. ASTM C140 - Sampling and Testing Concrete Masonry Units
L. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
M. ASTM C150 - Portland Cement
N. ASTM C207 - Hydrated Lime for Masonry Purposes
O. ASTM C216 - Facing Brick
P. ASTM C270 - Mortar for Unit Masonry
Q. ASTM C404 - Standard Specification for Aggregates for Masonry Grout
R. ASTM C476 - Grout for Masonry

S. ASTM C1019 - Standard Method of Sampling and Testing Grout.
T. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry
U. ASTM C1623 - Standard Specification for Manufactured Concrete Masonry Lintels
V. ASTM D2240 - Test Method for Rubber Property - Durameter Hardness
W. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
X. ASTM E447 - Compressive Strength of Masonry Prisms
Y. NCMA TEK 17-02A - Precast Concrete Lintels for Concrete Masonry Construction
Z. TMS 402-13/ACI 530-13/ASCE 5-13- Building Code Requirements for Masonry Structures
AA. TMS 602-13/ACI 530.1-13/ASCE 6-13.1 Specification for Masonry Structures.

1.5 SUBMITTALS

A. Submit product data for each item under provision of Section 01340.
B. Submit masonry contractor's qualifications.
C. UL Certification that the components meet the fire rating or UL system indicated on the Drawings.
D. Cold Weather Construction Procedures as specified.
E. Hot Weather Construction Procedures as specified.
F. Mortar and Grout Mix Design.
G. Submit sieve analyses for mortar and grout aggregates taken within the last 3 months if field mixing mortar and grout components.
H. Submit compressive strength of the masonry block units tested by the masonry supplier or an Independent Testing Lab within the last 30 days in accordance with ASTM C140. The number of test units shall consist of 6 specimens of each size used on the Project.
I. Submit deformed bar reinforcing for masonry in accordance with Section 03300 – Cast in Place Concrete.
J. Submit shop drawings of precast concrete lintels and architectural precast concrete detailing each different item required on the project.
K. Face Brick Color Selection - Submit samples of actual material indicated for the work showing color, texture and extremes of color range from the manufacturers full range for color selection by Architect.
L. Architectural Precast Concrete Color Selection - Submit samples of actual material indicated for the work in all colors available from the manufacturers full range for color selection by Architect.
M. Mortar Color Selection - Submit mortar samples for color selection in all colors available from the manufacturers full range for color selection by Architect.

1.6 QUALIFICATIONS

A. Masonry Subcontractor: Company specializing in performing the work of this Section with a minimum of five years of experience.

1.7 PRE-MASONRY CONFERENCE

A. Prior to commencing with work of this Section, a meeting shall be held at the project site with Masonry Subcontractor, General Contractor, Owner's Representative, Resident Project Representative and independent testing laboratory. The General Contractor shall record discussions and agreements and furnish a copy to each participant. Provide at least ten working days advance notice to participants prior to convening conference.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials off the ground, under cover and in a dry location.
B. Store aggregates such that grading and other required characteristics can be maintained, and contamination avoided.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate work under provisions of Section 01050.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Interior and Back-up Concrete Masonry Units: Normal weight hollow concrete masonry units, ASTM C90.
B. Open top concrete masonry channel bond beam and lintel block: ASTM C90.
C. Knock out block: Concrete masonry units with cuts in webs down approximately two thirds the height of the block for creating reinforced bond beams at locations other than lintels, ASTM C90.
D. Bullnosed Concrete Masonry Units: Concrete masonry units factory formed with bullnose. Transition between bullnose and flat surfaces of the block to be smooth with no ridges, ASTM C90.
E. Solid Load Bearing Concrete Masonry Units: ASTM C90.

2.2 BRICK UNITS

A. Face brick: Match existing.

2.3 REINFORCEMENT AND ANCHORAGE

A. Unless noted otherwise, all masonry reinforcing shall be ASTM A153, hot dipped galvanized with a minimum thickness of 1.5 oz./ft. of wire and ASTM A123 for all other shapes.
B. Single wythe joint reinforcement: Ladder type; cold-drawn steel conforming to ASTM A82, nine (9) GA. side rods with nine gage cross ties.
C. Cavity wall joint reinforcement: Ladder type; cold-drawn steel conforming to ASTM A82, 9-gauge side rods and nine gage cross ties, prefabricated continuous joint reinforcement and adjustable tie system with wall tie eye sections welded on at 16 inches on center and 3/16-inch rectangular adjustable wall tie pintle sections.
D. Rectangular Wire Tie: 3/16-inch diameter wire with two-inch bends by length as shown on Drawings.

E. Corrugated ties: Corrugated, 16 GA., 7/8-inch-wide, of sufficient length to penetrate at least four inches into masonry or three inches into the veneer.
F. Rebar Positioner: Rebar positioner shall be nine gage hot dip galvanized, 1¼ “deep bends to diagonally lock into CMU cores.
G. Stone Anchors: Z-shaped stone anchor, Type 304 stainless steel, 3/16” thick, with hole on one leg to fasten to backup wall, and upturned leg on opposite end to sit in grove on underside of precast concrete sill. Length as required. Heckmann 275-Z, Hohmann & Barnard #444, Wire-Bond #3059, or equal.

2.4 ACCESSORIES

A. Weep/Vents: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
   1. Heckman Building Products Inc., No. 85 Cell Vent
   2. Hohmann & Barnard, Inc.; Quadro-Vent
   3. Wire-Bond Cell Vents
   4. Or equal
B. Cleaning Solutions: Provide an acid based cleaner designed for cleaning mortar smears and construction dirt off of masonry surfaces. Provide product suitable for masonry color and type to be cleaned with a pH of less than 1.0.
C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity. Provide strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
D. Termination Bar: Flat stainless-steel bar, 1/8-inch x 1 inch with slotted holes at 8 inches on center, type 304 stainless steel.
E. Drip Edge Flashing: Stainless steel drip plate, 3 inches wide with down turned, angled drip edge.

2.5 MORTAR AND GROUT MATERIALS AND MIXES

A. Acceptable Manufacturers
   1. Amerimix
   2. Quickcrete
   3. SpecMix
   4. Or equal
B. Mortar:
   1. Mortar used in the concrete blocks shall conform to ASTM C270 (Type S) with a minimum 28-day compressive strength of 1800 PSI when tested in accordance with ASTM C109.
   2. Mortar used in exterior veneer shall conform to ASTM C270 (Type N) with a minimum 28-day compressive strength of 750 PSI when tested in accordance with ASTM C109 and a maximum compressive strength of 2400 psi.
   3. The mortar materials shall have the following properties:
      a. Material Standard for Aggregate Type: ASTM C144 (Fine Aggregate).
      b. Material Standard for Portland Cement: ASTM C150.
      c. Material Standard for Hydrated Lime: ASTM C207.
      d. Material Standard for Masonry Cement: ASTM C91.

e. Material Standard for Mortar: ASTM C270.
f. Material Standard for Mortar Cement: ASTM C1329.

C. Grout:
1. Grout for all masonry components shall conform to ASTM C476 and have a minimum compressive strength of 2,500 psi at 28 days when tested in accordance with ASTM C1019.
2. The grout materials shall have the following properties:
a. Material Standard for Portland Cement: ASTM C150.
b. Material Standard for Aggregate Type: ASTM C404 (Fine Aggregate).

2.6 MORTAR COLOR AND ADMIXTURES

A. Pre-measured mineral pigment; color as selected by Engineer.

2.7 THRU-WALL FLASHING

A. Acceptable Manufacturers
1. Hohmann & Barnard, Inc.; Copper-Fabric NA
2. Wire-Bond; Copper Seal #4140
3. York Manufacturing, Inc.; Multi-Flash 500
4. Or equal.

B. Characteristics
1. Core: Copper core with fiberglass or polypropylene fabric laminated to both copper faces with non-asphalt adhesive compliant with ASTM B370.
2. Fabric: Fiberglass or polypropylene fabric; 5 oz laminated back face copper core with core weight and manufacturer identified on product with color coded laminate or printed on the material.
3. Size: Shall be as detailed on the Drawings from manufacturers available standard width rolls.
4. Polyether Sealant: Suggested manufacturers: York UniverSeal US-100, STS Coatings GreatSeal Lt-100, or equal.

PART 3 - EXECUTION

3.1 REMOVAL AND INFILL OF EXISTING MASONRY

A. Demolition of existing masonry shall be done in a careful manner to minimize damage to adjacent masonry that is not affected by the work.
B. Provide temporary support as required when removing masonry.
C. Provide protection, barriers, dust screens, etc. to minimize disruption to interior spaces.
D. Patch and repair any areas of wall remaining where wall surface is damaged or doesn’t provide a finished appearance such as locations where intersecting walls are removed.
E. Where new openings are created in existing masonry walls, remove existing masonry past the extents of the opening to create a new reinforced masonry opening. At sides of openings, remove existing masonry in a toothed pattern to existing mortar joints. Coordinate with drawings.

F. When infilling existing masonry openings with new masonry, provide horizontal and vertical reinforcing. Coordinate with drawings.
G. When infilling existing masonry openings with existing bullnosed edges, remove the bullnosed block and replace with new block.

3.2 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.
B. Verify items provided by other sections of work are properly sized and located.
C. Verify that built-in items are in proper location, and ready for roughing into masonry work.
D. Request inspection of spaces to be grouted.
E. Beginning of installation means installer accepts existing conditions.

3.3 PREPARATION

A. Direct and coordinate placement of metal anchors supplied in other sections.
B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
C. Install mortar and grout to requirements of the specific masonry sections.
D. Work grout into masonry cores to eliminate voids.
E. Do not displace reinforcement while placing grout. Reinforcement shall remain centered in the width of the cell.
F. Remove grout spaces of excess mortar.
G. Cover and protect the top of the masonry walls at the end of each workday and during inclement weather. Cover partially completed masonry when construction is not in progress.
    1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
    2. Where one wythe of multi wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
H. Stain Prevention: Prevent grout, mortar and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar and soil that come in contact with such masonry.
    1. Protect base of walls from rain-splashed mud and mortar splatter by covering spread on ground and over wall surface.
    2. Protect sills, ledges and projections from mortar droppings.
    3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
    4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt on completed masonry.

3.4 MORTAR MIXING

A. Mix mortar using a mechanical mortar mixer to ensure homogeneity and workability. Observe mixing times of 4-5 minutes, consistent from batch to batch.

B. Use clean, potable water; add the maximum amount consistent with optimum workability.
   1. Maintain a uniform proportioning.
   2. At the end of the day, thoroughly rinse the mixer to avoid contamination of future mortar.
C. Cure mortar a minimum of 28 days.
D. Do not use anti-freeze compounds to lower the freezing point of mortar.
E. Retemper mortar by adding additional mixing water only to replace water lost due to evaporation.
   1. Do not retemper colored mortars.
   2. Retemper no more than once and only within two hours of mixing.
F. Use mortar within two hours after mixing at temperatures of 80 degrees F, or 2½ hours at temperatures under 50 degrees F.
G. Use care when mixing to provide a consistent mixture.
H. Do not use anti-freeze compounds to lower the freezing point of mortar.

3.5 GROUT MIXING

A. Comply with manufacturer's printed instructions and the following:
B. Material should be mechanically mixed.
C. Do not mix more material that can be placed in 15 minutes. Do not re-temper with additional water.
D. Do not use anti-freeze compounds to lower freezing point of grout.

3.6 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness to provide a neat, uniform appearance.
C. Lay concrete masonry units in running bond unless indicated otherwise on the drawings. Course one unit and one mortar joint to equal eight inches. Form concave mortar joints to provide a neat, uniform appearance where exposed to view; strike the joints on exterior surfaces to receive an air barrier flush.
D. Place concrete masonry units of uniform surface pattern and do not place units with large voids or bug holes that can't be filled with block filler.
E. Build wall in tiers with a maximum height of 4-feet then grout prior to continuing with next tier.
F. Lay brick units in running bond unless indicated otherwise on the drawings. Course three brick and three mortar joints to equal eight inches. Form concave mortar joints to provide a neat, uniform appearance.

3.7 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
C. Remove excess mortar which has splashed or been smeared on finished surfaces with stiff bristle brushes as work progresses.
D. Place full mortar bed around each core that is to be grouted.
E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
G. Perform jobsite cutting of masonry units with electrically operated carborundum saws to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Do not break units with hammers or other tools.
H. Isolate masonry partitions from vertical structural framing members with a control joint.
I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
J. Install factory formed bullnose concrete masonry units at all external corners, doors and window jambs as detailed on Drawings. Creating bullnose block in the field by griding is not acceptable. If an applied floor base is called for, use a square nosed block for the first course and field grind in a transition to the bullnose block. If a finish ceiling will tie into the concrete block wall, provide a square nosed block at the course where the ceiling will tie in and field grind in a transition to the bullnose block.
K. Remove any sharp edges on finished concrete masonry unit surfaces prior to the application of block filler.
L. Use Ivany or open top channel blocks for bond beams.
M. Use open top channel blocks for masonry lintels.
N. Avoid mixing blocks of different textures on the same expanse of wall; use blocks from the same pallet when possible.
O. At rooms with ceramic tile base, use square-edged block for the first course at all outside corners and door jambs.

3.8 WEEPS AND VENTS

A. Install weep/vent products 24 inches on center horizontally at bottom of brick veneered walls.
B. Install weep/vent products 24 inches on center horizontally above all brick veneered wall openings with a minimum of two over every opening.

3.9 CAVITY WALL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep holes.
B. Build inner wythe ahead of outer wythe to receive air barrier. After back-up units have been installed, apply air barrier in accordance with Section 07270.
C. After air barrier has been installed, install cavity wall insulation in accordance with Section 07214.

3.10 JOINT REINFORCEMENT AND ANCHORAGES

A. Install horizontal joint reinforcement as shown on Drawings.
B. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place joint reinforcement continuous in first joint below top of walls.
D. Lap joint reinforcement ends minimum six inches.
E. Embed anchors attached to structural steel members. Embed anchorages in every second block joint.

F. Install eye and pintle type reinforcing at cavity walls.
G. Install horizontal joint reinforcing at 16" on center at all interior masonry walls.
H. Reinforce wall intersections with strap anchors or prefabricated Tee joint reinforcing 16 inches on center.
I. Install corrugated ties for load bearing masonry abutting or backed by concrete surfaces, spacing the anchors not more than 16 inches on centers, vertically, and not more than 16 inches on centers, horizontally.
J. Install corrugated anchors at new non-load bearing interior masonry walls abutting concrete or existing masonry.

3.11 THRU-WALL FLASHING INSTALLATION

A. General:
   1. Install where indicated, specified, or required in accord with flashing manufacturer's written instructions and as follows. Base of exterior walls, exterior door heads, window heads and sills, horizontal control joints. Same bed joint as weep hole, continuous, in accord with manufacturer's written instructions, other wall openings, other locations indicated.
   2. Splicing to achieve flashing width is prohibited unless flashing detail requires material wider than normally manufactured.
   3. Extend flashing 6" minimum, beyond opening, each side without stretching flashing material. Lap end joints 6" minimum; seal joints completely with specified flashing adhesive or tape. Fold flashing ends at end of openings or horizontal flashing terminations to form end dam.
   4. Install flashing tight against backup wall and veneer shelf or steel lintel and set in a continuous layer of polyether sealant.
   5. Top of flashing to be at least 2 inches above cavity drainage material and steel lintels.
   6. Install drip edge flashing and hold bottom of thru wall flashing back from face of veneer by ½ inch.
   7. Set termination bar into a bead of sealant at top of flashing and fasten through top of flashing.
   8. Fold ends of flashing at end of opening to form dam.
   9. Inside corners: Folded, not cut: Make in industry accepted manner using outside corner and splice material or buy from manufacturer.
   10. Outside corners: Make in industry accepted manner using outside corner and splice material or buy from manufacturer.
   11. Patch minor punctures with tape or adhesive and material in accord with manufacturer's installation instructions.
   12. Replace ripped, torn, or severely damaged flashing with new material.

3.12 LINTELS

A. Install lintels over openings as shown on Drawings.
B. Install reinforced unit masonry lintels over openings exceeding 16 inches, where steel or precast concrete lintels are not scheduled. Provide reinforcing as required to span the opening.
C. Provide a minimum of a shelf angle lintel at all openings in the veneer greater than 8 inches wide.

D. Use full length reinforcing bars only.
E. Support and secure reinforcing bars from displacement. Maintain position within ½ inch of dimensioned position.
F. Place and consolidate grout fill without displacing reinforcing.
G. See the Structural Drawings for the minimum bearing on each side of opening.
H. Use "A" type blocks to tie vertical reinforcing into the horizontal reinforcing at masonry lintels.
I. Allow masonry lintels to attain specified strength before removing temporary supports.

3.13 GROUTED COMPONENTS

A. Reinforce channel bond beam and lintel block with two bars, placed continuously, size as shown on the Drawings.
B. Support and secure reinforcing bars from displacement. Vertical reinforcing shall be centered in the width of the core.
C. Place and consolidate grout fill without displacing reinforcing.
D. At bearing locations, fill masonry cores with grout for a minimum 24 inches either side of opening unless otherwise indicated on the drawings.
E. All cells to receive epoxy or expansion anchors shall be grouted solid.
F. Grouting:
    1. Request the Engineer to inspect the cells. Allow three days' advance notice of inspection.
        a. Provide cleanout opening no less than four inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit.
        b. Clean out masonry cells with high pressure water spray. Permit complete water drainage.
    2. After cleaning and cell inspection, seal openings with masonry units.
    3. Place grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
    4. Limit grout lift to 48 inches, stop each lift at least one inch below the top of a masonry unit and rod for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.14 PLACING REINFORCING STEEL

A. Mason shall coordinate dowel placement and coordinate vertical reinforcing splices for constructability.
B. Install reinforcing before laying masonry. Installation shall be done per the Masonry Reinforcing Shop Drawing marked "No Exceptions Taken".
C. Prior to placing grout, clean all reinforcement of loose, flaky rust; scale; grease; mortar; grout; or other coating which might destroy or reduce its bond with grout. The details of reinforcement shall conform to ACI 315. Do not bend or straighten reinforcing. Do not use bars with kinks or bends not shown on the Drawings. Placement of reinforcement shall be inspected by the Engineer prior to placing grout.
D. Position vertical bars accurately at the centerline of the reinforced wythe within a tolerance of 1/2 inch. Maintain a minimum clearance between the bars and masonry units of 1/2 inch and between parallel bars of one diameter of the reinforcement.

Hold vertical reinforcing in place using metal supports, centering clips, spacers, or caging-devices located near the ends of each bar and at intermediate intervals of not more than 160 diameters of the reinforcement. Wire column and pilaster ties in position around the vertical steel, laying ties in mortar joints will not be permitted.

E. Stagger splices in adjacent bars. Lay bars a minimum of 48 diameters of the reinforcement or two feet whichever is greater. Welded or mechanical connections shall develop the full strength of the reinforcement.
F. Vertical reinforcing shall extend into the bond beam located at the top of the wall. The open top channel block shall be drilled to accommodate the vertical reinforcing.

3.15 BUILT-IN WORK

A. As work progresses, build in metal door and glazed metal frames, plates and other items furnished by other sections.
B. Build in items plumb and level.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout or batt insulation as shown on the Drawings.
D. Do not build in organic materials subject to deterioration.

3.16 TOLERANCE

A. Maximum variation from alignment of columns and pilasters: 1/4 inch.
B. Maximum variation from unit to adjacent unit: 1/8 inch.
C. Maximum variation from plane of wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
D. Maximum variation from plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
E. Maximum variation from level coursing: 1/8 inch in three feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
F. Maximum variation of joint thickness: 1/8 inch in three feet.
G. Maximum variation from cross sectional thickness of walls: 1/4 inch.

3.17 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, grounds and other penetrations. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain Engineer approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.18 QUALITY CONTROL

A. Inspect all units prior to releasing masonry for painting.
B. Remove and replace all defective masonry units including those that are loose, chipped, broken, stained or otherwise damaged or if units do not match adjoining units including those with large voids and bug holes that can’t be filled by block filler. Install new units to match adjoining units; install in fresh mortar or grout, pointed to eliminate evidence of replacement.
C. Replace defective mortar. Match adjacent work.

3.19 MODIFICATIONS OR REPAIRS TO MASONRY

A. Rehabilitate and repoint existing masonry in the areas indicated on the Drawings.
   1. Remove all weakened, damaged, or disintegrated mortar to sound mortar or a depth of 1 inch, whichever is greater.
   2. Lightly wet the mortar and brick work surface prior to placing pointing.
   3. Use mortar mixing as described in this section.
   4. Face finishing of the re-pointed joints shall be rodded (concave faced).
   5. Cleaning and construction procedure as described elsewhere in this section.

3.20 CLEANING

A. Clean work under provisions of Section 01710.
B. Remove excess mortar and mortar smears.
C. Remove any sharp edges and protrusions.
D. Clean soiled surfaces of unpainted surfaces with cleaning solution.
E. Use non-metallic tools in cleaning operations.

3.21 COLD WEATHER CONSTRUCTION PROCEDURE

A. Where ambient temperatures are below 40 degrees F or anticipated to drop below 40°F within 24 hours, provide "weather protection" for the masonry under construction and use heat sources to maintain temperatures above 40 degrees F within the enclosure. Maintain the heated enclosure for a minimum of 24 hours after construction.
B. Heat mortar sand or mixing water to produce mortar temperatures between 40 degrees F and 90 degrees F at the time of mixing. Maintain mortar above freezing until used in masonry.
C. Temperature of stored masonry units shall not be less than 20 degrees F when laid in the masonry.
D. Provide a High/Low thermostat within the enclosure or at the work.

3.22 HOT WEATHER CONSTRUCTION PROCEDURE

A. When the ambient temperature exceeds 90 degrees F:
   1. Lightly wet the mortar bedding surface areas.
   2. Keep mortar moist, and do not string out on the wall so far ahead of units being placed that drying will take place prior to placement of units.
   3. After the units are in place, a very light fog spray shall be applied sufficient times during the first 24 hours for proper curing.
B. Provide a High/Low thermostat within the enclosure or at the work.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Welded aluminum guards and handrails
B. Aluminum shapes
   1. Sump cover
   2. Bar rack
C. Aluminum grating treads
D. Aluminum nosings
E. Aluminum grating
F. Aluminum ladders
G. Aluminum safety gate
H. Steel shapes
   1. Monorail support beams
   2. Floodproofing reinforcement beams
   3. Generator platform framing
I. Steel lintels
J. Anchor rods for steel that is included in this section
K. Steel edge angles
L. Steel bollards
M. Floor plates
N. Embedded plates
O. Miscellaneous fabrications
   1. Stainless steel lifting lugs and hooks
P. Concrete anchors (post installed)
Q. Fasteners
R. Surface preparation, shop coatings and galvanizing

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
B. Curved S-shape monorails and connections shall be supplied under specification section 14320. Supports for monorail shall be supplied under specification section 05500.

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Steel lintels
B. Steel bollards
C. Anchor rods
D. Embedded stair nosings
E. Embedded edge angles
F. Grating and floor plate embedded support angles
G. Embedded plates

1.4 REFERENCES

A. ASTM A29/A29M – Standard Specification for General Requirements for Steel bars, Carbon and Alloy, Hot-Wrought
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
C. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless
D. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
E. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron & Steel Products
F. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
G. ASTM A276/A276M – Standard Specification for Stainless Steel Bars and Shapes
H. ASTM A467/A467M – Standard Specification for Machine and Coil Chain
I. ASTM A500/A500M – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
J. ASTM A563/A563M – Standard Specification for Carbon and Alloy Steel Nuts
K. ASTM A572/A572M – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
L. ASTM A588/A588M – Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi Minimum Yield Point, with Atmospheric Corrosion Resistance
M. ASTM A780/A780M – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
N. ASTM A847/A847M – Standard Specification for Cold-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
O. ASTM A992/A992M – Standard Specification for Structural Steel Shapes
P. ASTM A1011/A1011M – Standard 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
Q. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus
R. ASTM B209/B209M – Standard Specification for Aluminum and Aluminum - Alloy Sheet & Plate
S. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
T. ASTM B244 - Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
U. ASTM B308/B308M – Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
V. ASTM D523 - Standard Test Method for Specular Gloss
W. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test
X. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test
Y. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
Z. ASTM F436/F436M – Standard Specification for Hardened Steel Washers

AA. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs
BB. ASTM F594 – Standard Specification for Stainless Steel Nuts
CC. ASTM F1554 – Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength
DD. ASTM F3125/F3125M – Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 Mpa Minimum Tensile Strength
EE. Research Council on Structural Connections - Specification for Structural Joints Using High-Strength Bolts
FF. SSPC Steel Structures Painting Council
GG. SSPC-SP6 Commercial Blast Cleaning
HH. Aluminum Association Near-White Blast Cleaning
II. Aluminum Association Aluminum Design Manual (2010)
JJ. Aluminum Association Aluminum Standards and Data (2009)
KK. AWS D1.1/D1.1M Structural Welding Code – Steel - American Welding Society
LL. AWS D1.2/D1.2M Structural Welding Code – Aluminum -American Welding Society
MM. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel
NN. American Institute of Steel Construction (AISC) - Manual of Steel Construction (14th Edition)
OO. AISC 303 – Code of Standard Practice for Steel Buildings and Bridges
PP. AISC 360 - Specification for Structural Steel Buildings
QQ. AISC Design Guide 27: Structural Stainless Steel
RR. OSHA Occupational Safety and Health Standards, 29 CFR Part 1910

1.5 DESIGN REQUIREMENTS

A. Aluminum Grating Stairs, Platforms, and Walkways: 100 PSF live load or as indicated on the Drawings; Treads - 100 PSF live load and non-simultaneous load of 300lb over 4"x4" area in center of tread.
B. Aluminum Grating: Live Loads indicated on the Drawings.
C. Steel Beam Connections: All bolted connections not detailed on the Drawings shall be sized to support one-half the total uniform load capacity as shown in Table 3-6, of the AISC Steel Construction Manual. If standard connections from Tables 10-1, 10-2 or 10-10b from the AISC Manual of Steel Construction are used, references may be made to these tables for each beam with the appropriate connection load in lieu of design calculations.

1.6 SUBMITTALS

A. Photocopies of Drawings in whole or part will not be accepted as shop drawings.
B. Submit complete shop drawings showing the following information: ,
    1. Plan layouts showing building grid lines, dimensions, piece designations, and other pertinent information.
    2. Isometric views of framing systems showing building grid lines and piece designations.
    3. Elevations, sections, and details showing general arrangement of pieces with piece designations, dimensions, connections, and other pertinent information.

4. Details of each piece with designation, length, bolt holes, bolts, copes, welded components, and welds with AWS symbols.
5. Bill of Materials for all pieces including:
    a. Piece designation
    b. Quantity
    c. Description
    d. Length
    e. Material and grade
    f. Finish
    g. Weight
6. To facilitate the review process, piece designations shall not be revised in subsequent submittals. Added pieces are to be given designations that do not affect previously submitted piece designations.

C. Submit product data in accordance with the provisions of Section 01340.
D. Submit statement that manufactured guard and handrail mounts meet OSHA loading requirements.
E. Submit certification from hot-dipped galvanizing plant stating that hot-dipped galvanizing is in accordance with Specification.
F. Submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificates shall be accompanied by a current certificate by the welder attesting to the fact that they have been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

1.7 QUALITY ASSURANCE

A. Conform to AISC Manual of Steel Construction for the design, fabrication, and erection of steel.
B. Conform to AWS D1.1/D1.1M for welding of steel.
C. Conform to the Aluminum Design Manual for the design, fabrication, and erection of aluminum shapes.
D. Conform to AWS D1.2/D1.2M for welding of aluminum.
E. Conform to AWS D1.6/D1.6M for welding of stainless steel.

1.8 COORDINATION

A. The Contractor shall coordinate with the work of other Sections. Verify at the site both the dimensions and the work of other trades adjoining items before fabrication and installation of items herein specified.
B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.

1.9 FIELD MEASUREMENTS

A. Field measurements shall be taken at the site to verify or supplement indicated dimensions and conditions and to ensure proper fitting of all items.
B. Templates of channel and tank configuration shall be made for the installation of grating or checkered plate for the areas to be covered.

1.10 DELIVERY, STORAGE, HANDLING

A. Coordinate delivery of products.
B. Protect products from damage prior to and after installation.
C. Remove damaged material from the site.

PART 2 - PRODUCTS

2.1 WELDED ALUMINUM GUARDS AND HANDRAILS

A. Material
   1. Rails: Nominal 1½" schedule 40, Aluminum Alloy 6061-T6 or 6063-T6
   2. Posts: Nominal 1½" schedule 80, Aluminum Alloy 6061-T6
   3. Toe Plate: ¼" x 4" plate or extruded formed shape, Aluminum Alloy 6061-T6
   4. Miscellaneous Plates: Aluminum Alloy 6061-T6
   5. Hinges: AISI Type 316 Stainless Steel. Provide a minimum of 2 hinges per plate section.
   6. Wall Mounted Handrail Brackets: Extruded aluminum
      a. Wagner Company - Model 1937
      b. Julius Blum & Co. - Model 498
      c. Or equal

B. Fabrication
   1. Provide for thermal expansion and contraction.
   2. Cuts shall be squared and free of burrs.
   3. Post spacing not to exceed 4'-0" on center.
   4. Terminate rails and guards with smooth radius end loops with no irregularities, exposed mitered edges or post end caps.
   5. All guards labeled as "removable" shall be fabricated in sections no greater than 8'-0" in length or in shorter lengths as practical for the given guard layout.
   6. Provide side mounted or top mounted post connection brackets as indicated on the Drawings. Minimum bolt and anchor spacing as shown on the Drawings shall be maintained.

C. Welding
   1. Miter and cope intersections of posts and rails and weld all around. All corners at end loops shall be fabricated with a radius (mitered corners shall not be permitted)
   2. Fuse without undercutting or overlap.
   3. Weld corners and seams continuously in accordance with AWS. Welds to be smooth.
   4. Remove splatter, grind exposed welds where necessary and contour and blend surfaces to match those adjacent.
   5. Discoloration of finished surfaces will not be acceptable.
   6. Welding electrode; filler alloy 5356.

D. Finish:
   1. Clear anodized (AA M12C22A41) in accordance with the Aluminum Association, after fabrication and welding.
   2. All railings and posts shall be plastic wrapped. The plastic wrap shall be removed after all adjacent construction is completed.

E. Toe Plates:
   1. Provide toe plates on all railing sections (except at stair stringers) unless otherwise noted on the drawings.
   2. All toe plates shall be attached to all guard posts.
   3. Toe plates shall be continuous and connected together with splice plates. Corners shall be connected together with angles.
   4. Provide support for extended ends as indicated on the Drawings.

2.2 ALUMINUM SHAPES
A. Material: Aluminum Alloy 6061-T6: ASTM B308/B308M.
B. Welding: filler alloy 5356.
C. Finish: Mill.

2.3 ALUMINUM GRATING TREADS
A. Material: Aluminum Alloy 6063-T6 (ASTM B221), or Aluminum Alloy 6061-T6 (ASTM B308/B308M).
B. Provide grooved nosing.
C. Treads shall be fabricated from load banded non-skid serrated bar grating.
D. Tread thickness:
   1. For tread widths 3'-0" and under: 1-1/2" thick treads
   2. For tread widths greater than 3'-0": 1-3/4" thick treads

2.4 ALUMINUM NOSINGS
A. For Cast-in-Place Concrete Stairs: Alumogrit Treads Type 101, with concealed integral anchors by Wooster Products, Inc. or equal. Nosing shall extend to within 3-inches at each side of stair.
B. For Cast-in-Place Concrete Curbs and Slabs: Curb Bar Type 250 by Wooster Products, Inc. or equal.

2.5 ALUMINUM GRATING
A. Material: Aluminum Alloy 6063-T6 (ASTM B221) or Aluminum Alloy 6061-T6 (ASTM B308/B308M).
B. Finish: mill
C. Type:
   1. Rectangular bar grating with non-skid serrated surface.
   2. Bearing bars:
      a. Thickness and depth shall be as indicated on the Drawings.
      b. Spaced at 1-3/16" on center with recessed cross bars at 4" center.
D. Grating sections:
   1. Provide grating sections in the largest size as practical but no greater than 40 pounds for sections intended to be removable.
   2. Grating sections for elevated platform walking surfaces where the grating will not be removed may be provided in larger sections.
   3. All edges of grating, including bearing and non-bearing edges and around all penetrations, shall be banded by welding a continuous bar to the ends of each bearing bar.

4. Provide sections to allow grating removal without disturbing items penetrating grating. Edges of grating sections shall be aligned with centerlines of pipes penetrating grating.

E. Provide a minimum of 4 stainless steel saddle clips and hardware for anchorage per each section of grating.

F. Maximum gap between adjacent grating sections and between edges of grating and support members: 0.25 inches

G. Manufacturers:
   1. Barnett Bates – Type 19-4
   2. Ohio Grating – Type 19-SG-4
   3. Or equivalent

2.6 ALUMINUM LADDERS

A. Material: Aluminum Alloy 6063-T6 (ASTM B221) or Aluminum Alloy 6061-T6 (ASTM B308/B308M).

B. Finish: Clear Anodized (AA M12C22A41)

C. Welding: filler alloy 5356

D. Rails: Minimum sizes L3x3x1/4 with 2'-0" clear opening unless indicated on the Drawings.

E. Rungs:
   1. 1-inch square or 1-inch diameter extruded aluminum bar with serrated, corrugated or knurled non-slip surface. Grit tape or grit paint shall not be permitted.
   2. Prefabricated aluminum rungs with serrated, corrugated or knurled non-slip surface:
      a. Type 950 Ladder Tread by Wooster Products, Inc.
      b. Diamondback by McNichols
      c. Traction Tread by McNichols
      d. Or equal
   3. Maximum rung spacing 1'-0".

2.7 ALUMINUM SAFETY GATE

A. Safety gate shall be a prefabricated, spring-assisted, self-closing safety gate intended to be a physical continuation of adjacent guard systems or to cover openings in step through ladders.

B. Construction Details:
   1. Safety gate shall consist of a 3-sided continuous loop with a minimum of 2 spring-activated hinge brackets welded to a hinge plate on one side and a striker plate on the opposite side.
   2. All gates shall be designed to meet or exceed OSHA requirements for dimensions and load requirements.
   3. Gate shall have a minimum of 3.75 inches of width adjustment to ensure proper fit.
   4. Gate dimensions:
      a. Nominal opening width = 24". Reduction in clear width will be required for face mount applications.
      b. Height = 22.25 inches

5. Gate shall come fully assembled, including hardware and brackets for mounting to either circular guard posts or angles as indicated on the Drawings. Mounting shall be by either clamping to guard posts (with U-bolts) or bolting through the ladder rail. Pop rivet connections shall not be permitted.
6. Provide a “safety first” placard on the hinge plate.
7. All safety gate assemblies shall be from a single manufacturer.
8. Manufacturer must demonstrate a minimum of five (5) years of successful experience in design and manufacture of similar products.

C. Materials:
1. Gate loop: Minimum 1.25-inch square tube. Aluminum Alloy 6061-T6
2. Springs: Type 316 Stainless Steel
3. Hardware: Type 316 Stainless Steel
4. Hinge plate assembly and brackets: Aluminum Alloy 6061-T6
5. Striker plate: Aluminum Alloy 6061-T6
6. Finish: Mill

D. Warranty: The manufacturer shall provide a warranty on this product and components to be free from manufacturing defects for a period of one (1) year from Date of Substantial Completion.

E. Acceptable manufacturers:
1. PS Doors (Model LSG-24-ALU)
2. Fabenco (Model A82-24), by Tractel
3. Or equivalent

2.8 ALUMINUM BAR RACK

A. Material: Aluminum alloy 6061-T6 (ASTM B209/B209M)
B. Finish: Mill
C. Fabricate bar racks to the size and configuration indicated on the Drawings.

2.9 STEEL PIPE GUARDS AND HANDRAILS

A. Material:
1. Posts and Rails: Nominal 1½" Diameter Schedule 40 Standard Weight, ASTM A53/A53M Grade B.
2. Toe Plate: ¼" x 4" plate or extruded formed shape, ASTM A36/A36M
3. Miscellaneous Plates: ASTM A36/A36M
4. Hinges: AISI Type 316 Stainless Steel
5. Wall Mounted Handrail Brackets: Extruded steel.
   a. Wagner Company - Model 1929
   b. Julius Blum & Co. - Model 626
   c. Or equal

B. Fabrication
1. Provide for thermal expansion and contraction.
2. Unspliced rails to be attached to a minimum of three (3) posts.
3. Cuts shall be squared and free of burrs.
4. Post spacing not to exceed 4'-0" on center.
5. Terminate rails and guards with smooth radius end loops with no irregularities, exposed mitered edges or post end caps.

6. Provide side mounted or top mounted post connection brackets as indicated on the Drawings. Minimum bolt and anchor spacing as shown on the Drawings shall be maintained.

C. Welding
1. Miter and cope intersections of posts and rails and weld all around. All corners at end loops shall be fabricated with a radius (mitered corners shall not be permitted)
2. Fuse without undercutting or overlap.
3. Weld corners and seams continuously in accordance with AWS. Welds to be smooth.
4. Remove splatter, grind exposed welds where necessary and contour and blend surfaces to match those adjacent.
5. Discoloration of finished surfaces will not be acceptable.
6. Welding electrode E70XX.

D. Finish:
1. Hot dip galvanized, primed, painted in accordance with 09900 and 09905.
2. All railings and posts shall be plastic wrapped. The plastic wrap shall be removed after all adjacent construction is completed.

E. Provide toe plates on all railing sections (except at stair stringers) unless otherwise noted on the drawings. All toe plates shall be attached to all guard posts. All toe plate corners shall be connected together. Toe plates shall be continuous.

F. Installation shall be in accordance with manufacturer's instructions.

2.10 STEEL SHAPES

A. Materials:
1. Wide flange beams (including lintels) ("W" Shapes): ASTM A992/A992M
2. Standard beams (“S” shapes):
   a. ASTM A992/A992M – all S12 sizes
   b. ASTM A36/A36M – all other sizes
3. Channels (“C” and “MC” shapes): ASTM A36/A36M, A572/A572M Grade 50 or A992/A992M
4. Angles (“L” shapes): ASTM A36/A36M, A572/A572M Grade 50 or A992/A992M
5. Plates: ASTM A572/A572M (Grade 50)
6. Hollow Structural Shapes ("HSS" Shapes):
   a. Rectangular: ASTM A500/A500M, Grade C (50 ksi yield strength)
   b. Round: ASTM A500/A500M, Grade C (46 ksi yield strength)
7. Pipe: ASTM A53/A53M, Grade B

B. Finish: Hot-Dipped Galvanized: ASTM A123/A123M and painted per Specification Section 09900. After galvanizing, lintels shall be shop primed for field painting.

2.11 STEEL GRATING

A. Material: ASTM A36/A36M
B. Finish: Hot-Dipped Galvanized (ASTM A123/A123M)
C. Type:
1. Rectangular bar grating with non-skid serrated surface.

2. Bearing bars:
    a. Thickness and depth shall be as indicated on the Drawings.
    b. Spaced at 1-3/16" on center with recessed cross bars at 4" center.

D. Grating sections:
1. All edges of grating, including bearing and non-bearing edges and around all penetrations, shall be banded by welding a continuous bearing bar to the ends of each bearing bar

E. Maximum gap between adjacent grating sections and between edges of grating and support members: 0.25 inches.

F. Provide galvanized or stainless steel saddle clips and hardware for anchorage, 4 per grating section.

G. Manufacturers
1. Barnett Barnes – Type 19-4
2. Ohio Grating – Type 19-W-4
3. Or equivalent

2.12 STEEL GRATING TREADS

A. Material: ASTM A36/A36M

B. Finish: Hot-Dipped Galvanized (ASTM A123/A123M)

C. Provide cast steel abrasive nosing.

D. Treads shall be fabricated from banded non-skid serrated bar grating.

E. Tread thickness:
1. For tread widths 3'-0" and under: 1-1/2" thick treads
2. For tread widths greater than 3'-0": 1-3/4" thick treads

2.13 STEEL BOLLARDS

A. Material: ASTM A53/A53M Grade B

B. Finish: Hot-Dipped Galvanized (ASTM A123/A123M)

C. Size as indicated on the Drawings

2.14 FLOOR PLATES

A. Aluminum:
1. Material: Alloy 6061-T6 (ASTM B209/B209M)
2. Finish: Mill

B. Steel:
1. Material: ASTM A36/A36M
2. Finish: Hot-Dipped Galvanized (ASTM A123/A123M)

C. Style: Checkered (diamond) type with raised lug pattern with stiffeners as indicated on the Drawings.

D. Lift Handles: Provide 2 per plate section unless otherwise noted.

E. Maximum gap between adjacent plate sections and between edges of grating and support members: 0.125 inches

F. Fabrication Tolerances:
1. Camber - Plate span / 360 - maximum 1/8 inch.
2. Differential camber between adjacent plates: 1/16 inch.
3. Other tolerances as specified in ASTM B209/B209M.

2.15 PLATES

A. Includes plates embedded in concrete and other miscellaneous plates not specified elsewhere.
B. Aluminum:
   1. Material: Alloy 6061-T6 (ASTM B209/B209M)
   2. Finish: Mill
C. Steel:
   1. Material: ASTM A572/A572M (Grade 50)
   2. Finish: Hot-Dipped Galvanized (ASTM A123/A123M)
D. Stainless Steel:
   1. Material: AISI 316
   2. Finish: Mill

2.16 MISCELLANEOUS FABRICATIONS

A. Includes other miscellaneous metal fabrications and assemblies shown on the Drawings but not specified elsewhere.
B. Stainless Steel Fabrications:
   1. Structural shapes (beams, angles and channels)
      a. Material: AISI Type 316
      b. Finish: Mill
   2. Bars, plates and sheets
      a. Material: AISI Type 316
      b. Finish: Mill
C. Lifting Hooks: Rods, bars and plates: AISI Type 316 Stainless Steel

2.17 FASTENERS

A. Concrete anchorage:
   1. Expansion and Epoxy Anchors are specified in Section 03155.
   2. Anchor Rods:
      a. Material: ASTM F1554 Grade 55, S1, threaded and headed
      b. Finish: Hot-Dipped Galvanized per ASTM A153/A153M
B. Bolted Joints:
   1. Aluminum Fabrications: Stainless Steel ASTM F593 & F594 Alloy Group 2 (Type 316)
   2. Steel Fabrications (specified in this Section):
      a. Bolts: ASTM F3125/F3125M Grade A325 Type 1, Style Heavy Hex
      b. Nuts: ASTM A563/A563M Heavy Hex.
      c. Washers: ASTM F436/F436M.
      d. Finish: Painted for painted steel fabrications and hot-dipped galvanized for hot-dipped galvanized steel fabrications (ASTM A153/A153M)
   3. Stainless Steel Fabrications: Stainless Steel ASTM F593 & F594 Alloy Group 2 (Type 316).
C. Provide all fasteners with nuts, flat washers and lock washers of the same material as the anchors or bolts. Provide beveled washers for sloped surfaces.
D. Provide a minimum of 2 fasteners per connection.

PART 3 - EXECUTION

3.1 FABRICATION

A. All miscellaneous metal members shall fit closely together and shall be straight and true, and the finished work shall be free from burrs, bends, twists, and open joints.

B. Tolerances:
   1. Squareness: 1/8-inch maximum difference in diagonal measurements.
   2. Maximum Offset between faces: 1/16-inch.
   3. Maximum misalignment of adjacent members: 1/16-inch.
   4. Maximum Bow: 1/8 inch in 48 inches.
   5. Maximum Deviation from Plane: 1/16 inch in 48 inches.

C. All holes, angles, supports, and braces shall be provided as required.

D. Except as otherwise indicated on the drawings, gusset plates shall have a minimum thickness of 3/8 inch.

E. Holes shall be made in steel members for attachment of wood blocking, nailers, etc. Holes shall be sized to suit the fasteners indicated on the drawings: where size and spacing are not indicated, holes shall be 9/16-inch diameter, at 3 feet o.c.

F. Sheared and thermal cut edges shall be true to line and free from rough corners and projections.

G. Re-entrant cuts/corners shall be filleted to a radius of not less than ½ inch.

H. Holes shall be punched, subpunched and reamed, or drilled in accordance with AISC "Specifications for Structural Steel." Holes shall not be made by torch cutting.

I. Holes shall be 1/16 inch larger than the nominal bolt diameter, except holes for cast-in-place anchor bolts which shall be 5/16 inch larger than the nominal bolt diameter and as otherwise shown on the Drawings.

J. The use of oversize or slotted holes not shown on the Drawings shall be subject to prior review by the Engineer.

K. Bent plate shall be in accordance with AISC "Minimum Radius for Bending."

L. Welding shall be done in a sequence which minimizes distortion and shrinkage.

M. Fabrication holes, notches, etc. not required by nor shown on the Drawings shall be subject to prior review by the Engineer.

3.2 CONNECTIONS (GENERAL)

A. All steel framing connections not detailed on the Drawings shall be either shop-welded, field-bolted or all field-bolted connections designed by the fabricator subject to the provisions of the design drawings, specifications and AISC 360. All connections shall be designed to support one-half the total uniform load capacity of the framing member as shown in Table 3-6 of the AISC Manual of Steel Construction. Fabricator shall use the ASD (Allowable Stress Design) in the connection designs. Connections shall be one of the following:
   1. All-bolted double angle connections (Table 10-1)
   2. Bolted/welded double-angle connections (Table 10-2)
   3. Bolted/welded shear end-plate connections (Table 10-4)
   4. Single-plate connections (Table 10-10b)

B. All aluminum framing connections not detailed on the Drawings shall be bolted connections designed by the fabricator subject to the provisions of the design drawings, specifications and the referenced Aluminum Design Manual. All connections shall consist of a minimum of 2 – L3x3x1/4 angles with 2 – ¾ inch diameter AISI Type 316 bolts between each angle and framing member.

C. The axes of axially loaded members which meet at a point shall intersect at the point (unless otherwise indicated).

D. Except as otherwise shown, where three or more members are joined, their centroidal lines of action shall meet at a common point, and there shall be no eccentricity.

E. Accessory material not indicated on the design drawings, intended to be left in place on the completed structure by the erector, shall be indicated on the shop drawings. Where so indicated by the Engineer on the shop drawings, such items shall be removed before acceptance of the completed work.

F. At the time of connecting, all contact surfaces shall be free from loose or non-adherent rust, loose mill scale, oil, grease, dirt, mud, and any foreign matter, coating, or defect that might adversely affect the connection.

3.3 CONNECTIONS (BOLTED)

A. All bolted connections shall conform to the following:
   1. Steel bolts with steel framing - RCSC Specification.
   2. Stainless steel bolts with aluminum framing – Aluminum Design Manual by the Aluminum Association.
   3. Stainless steel bolts with stainless steel framing – AISC Design Guide 27.

B. All connections shall have a minimum of two bolts and the minimum bolt size shall be ¾ inch (unless otherwise indicated).

C. Bolts shall be of proper length, and the end of the bolt shall be at least flush with the outer face of the nut. Bolts projecting more than 5/8-inch beyond the face of the nut in exposed work shall be cut off close to the nut as directed by the Engineer.

D. All bolts shall have washers between the tightened element and the structural member. Beveled washers shall be used where flange slope exceeds 1:20.

E. All bolts or nuts once tightened shall not be loosened then re-used. Care shall be taken not to damage the threads of high strength bolts during installation. Joints shall be properly aligned and drifted and holes reamed, if required, to permit bolts to be slipped into place by hand. No burning is allowed for hole adjustment.

F. Snug-Tightened Connections:
   1. Snug-Tightened condition shall be defined as that tightness attained with a few impacts from an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the connected elements into firm contact.
   2. All bolts identified as Snug-Tightened shall be tightened to a Snug-Tight condition with either spud wrenches or pneumatic impact wrenches.
   3. All bolted connections shall be Snug-Tightened N-type bearing unless otherwise indicated on The Drawings.
   4. This type of connection applies to both steel and stainless steel bolts.

G. Finger-Tightened Connections:
   1. Where connections are indicated to be “finger-tight”, the connection is to first be snugged up to ensure that all plies are in contact. The nuts shall then be backed off between one-half and one turn to permit the intended movement of the connection. The bolts shall be provided with double nuts to prevent loosening.
   2. This type of connection applies to both steel and stainless steel bolts.

H. Epoxy anchors shall be tightened to 80% of the epoxy manufacturers recommended maximum torque using a calibrated torque wrench.

I. The Contractor shall inspect the bolted connections in accordance with Section 9 of the RCSC Specification as follows:
   1. Snug-Tightened Connections: The Inspector will visually inspect the Snug-Tightened bolted connections. The visual inspections shall consist of the following (in accordance with Section 9.1 in the RCSC Specification):
      a. Verification that the proper components were used in the connection.
      b. Verification that the plies of connecting elements have been brought into firm contact.
      c. Additional non-destructive tests as required by the Engineer.
   2. After inspection, if the joint is satisfactory it shall be marked by the Contractor with a symbol which indicates that the work is completed and is satisfactory. If the joint is unsatisfactory, it shall be repaired or removed and replaced with a new bolted connection to the Engineer’s satisfaction.
   3. If it is discovered that bolts marked as approved by the Inspector are not in compliance with the requirements of this section and the referenced specification, codes, or authorities, the erector's bolting and inspecting procedures shall be revised as required by the Engineer before any of the remaining bolts are installed.
   4. The Engineer reserves the right to inspect and test all bolted connections. The costs for this additional testing will be borne by the Owner.

3.4 CONNECTIONS (SHOP AND FIELD WELDING OF FERROUS METALS)

A. Welding shall be only for the connections and assemblages shown on the drawings or specified herein, and shall be performed in the shop, except where specifically noted to be done in the field.

B. All welding shall be done only by certified welders using welding procedures and welding equipment in accordance with AWS D1.1/D1.1M. Welders employed on the work shall be experienced structural welders, previously qualified by tests as prescribed in AWS D1.1/D1.1M using the base metals and electrodes specified herein.

C. Welding materials and workmanship shall conform to AWS D1.1/D1.1M. All welds shall be considered Prequalified if they conform to the Pre-qualified joints specified in Chapter 3 of AWS D1.1/D1.1M.

D. Welding electrodes shall conform to the requirements of AWS D1.1/D1.1M and shall be the E70XX series.

E. Welding shall be by the manual shielded metal arc process. If the fabricator wishes to use other processes, full details of materials, equipment, and procedures shall be submitted to and approved by the Engineer before any welding, other than as specified herein, is performed.

F. All welds shall be free of undercut, unfilled craters, and cracks, and shall have smoothly faired contours. Flux and loose scale shall be removed from previous weld bead before succeeding bead is laid. Exposed welds shall be ground smooth.

G. All temporary (tack) welds shall meet all the specified requirements of the final welds. Tack welds that will be incorporated into the final weld shall be cleaned and thoroughly fused with final weld. Defective, cracked or broken tack welds shall be removed before final welding. Tack welds not incorporated into the final weld shall be removed.

H. No welding shall be performed during the following weather conditions:
   1. Ambient temperature in the immediate vicinity of the weld is below 0°F,
   2. If the welded surfaces are wet or are exposed to rain or snow,
   3. High wind velocity. A temporary wind shelter may be used in order to reduce the wind directly exposed to the weld to a maximum of 5 mph,
   4. Other inclement conditions that will hamper good workmanship.

I. Welds other than those indicated on the design drawings may be used only if reviewed and no exceptions are taken by the Engineer.

J. Welding of shear studs shall be in accordance with Section 7 of AWS D1.1/D1.1M.

K. When welding is unsatisfactory or indicates inferior workmanship as determined by the Engineer, the welds shall either be repaired or removed and rewelded. Where requirements prescribe the removal of part of the weld or a portion of the base metal, such removal shall be by machining, grinding, chipping or machining. All weld repairs shall be proposed by the General Contractor and reviewed by the Engineer with No Exceptions Taken. Defective or unsound welds shall be corrected either by removing and replacing the entire weld, or as follows:
   1. Overlap, excessive convexity or excessive reinforcement: Reduce to size by removal of excess weld metal.
   2. Cracks in weld or base metal: The extent of the crack shall be verified by acid etching, MT or PT methods. The crack and sound metal 2 inches beyond each end of the crack shall be removed and re-welded.
   3. Excessive concavity of weld or crater, Undersize welds, Undercutting: Clean and deposit additional weld metal.
   4. Incomplete fusion, excessive weld porosity or slag inclusions: Remove and replace the defective portions of weld.
   5. Removal of adjacent base metal during welding: Clean and reform base metal full size by depositing additional weld metal.
   6. Base metals distorted from welding: Straighten by mechanical means or by application of a limited amount of localized heat.

L. Where work performed subsequent to the making of a deficient weld has rendered the weld inaccessible or has caused new conditions which would make the correction of the deficiency dangerous or ineffective, the original conditions shall be restored by removal of welds or members or both before making the necessary corrections, or else the deficiency shall be corrected by additional work according to a revised design approved by the Engineer.

M. If faulty welding or its removal for re-welding damages the base metal such that in the judgment of the Engineer it’s not in accordance with the intent of the Drawings and Specifications, the Contractor shall remove and replace the damaged material at no additional cost to the Owner.

N. Erector shall perform the following inspection of the welding operation and welds:
   1. Verification inspection of the welding materials and procedures and the welder's qualifications,
   2. Visual inspection of all shop and field welds at the jobsite,
   3. UT (Ultrasonic Testing) of all complete penetration welds
   4. Magnetic Particle (MT) of all fillet welds
   5. Additional testing, such as PT (Liquid Penetrant Testing), Dye Penetrant Testing (DP), MT or UT may be performed at the discretion of the Independent Testing Firm.
   6. Acceptance of welds shall be based on Chapter 6 of the AWS Structural Welding Code.

3.5 CONNECTIONS (WELDING ALUMINUM)

A. Structural welds shall be made by qualified welders and shall conform to AWS D1.2/D1.2M.

B. All aluminum welding shall be done by the inert gas shielded arc or fluxless resistance techniques.

C. Welded assemblies to be anodized shall be designed so that faying surfaces are free-rinsing and will not trap anodizing solutions.

D. Where at all possible, welds in assemblies to be anodized shall be located so as to conceal visible discoloration in the heat-affected zone.

E. Where weld metal must be exposed after anodizing, filler alloys shall be selected to closely match the composition of the base metal. Follow parent metal manufacturer's recommendations for such filler alloys.

F. Where weldments are to be made on materials that have been previously anodized, the area of fusion shall be free of the anodic film prior to welding. Parts to be so welded shall be masked during anodizing or sanded clean in the weld areas. Only weldments that will be concealed may be so made. Crazing or discoloring of the anodic coating in the weld area will not be acceptable in exposed areas.

G. Weldments on exposed finished surfaces shall be ground and/or polished to match and blend with finish of adjacent parent metal.

H. Dirt, grease, lubricant, or other organic material shall be removed by vapor degreasing or suitable solvent prior to welding.

I. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.

J. When welding is unsatisfactory or indicates inferior workmanship as determined by the Engineer, corrective measures shall be required. Where requirements prescribe the removal of part of the weld or a portion of the base metal, such removal shall be by machining, grinding, chipping or machining. All weld repairs shall be proposed by the General Contractor and reviewed by the Engineer with No Exceptions Taken.

K. Joints rejected because of welding defects may be repaired only by re-welding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be used.

L. The Contractor shall perform the following inspection of the welding operation and welds:
   1. Verification inspection of the welding materials and procedures and the welder's qualifications,
   2. Visual inspection of all shop and field welds at the jobsite,

3. Ultrasonic Testing (UT) of all complete penetration welds
4. Additional testing, such as Liquid Penetrant Testing (PT), Dye Penetrant Testing (DP), MT or UT may be performed at the discretion of the Independent Testing Firm.
5. Acceptance of welds shall be based on Chapter 6 of AWS D1.2/D1.2M.

3.6 ERECTION AND INSTALLATION

A. All metals shall be properly located, aligned, leveled and plumbed. All items embedded in or connected to other substrates shall be properly coordinated and installed.

B. General Contractor shall verify elevations of concrete, masonry or other bearing surfaces and locations of anchor rods, bearing plates, and other embedded items. Anchor rod templates shall be used to set anchor rods.

C. Structural grouting shall be non-shrink and conform to the requirements of Section 03604. No load shall be applied to grout until five days after the plate has been grouted.

D. Camber of beams shall be that indicated on the Drawings. Where no camber is indicated, any minor camber resulting from rolling or shop assembly shall be upward.

E. The use of a gas cutting torch in the field for correcting fabrication errors will not be permitted upon any primary member of the structural framing. The use of a gas cutting torch will be permitted only on secondary members, and then only after the review and no exceptions taken by the Engineer.

F. Coat surfaces of the following metals in contact with masonry, concrete, grout or dissimilar metals with Polyamide Epoxy Primer:
   1. Cast iron
   2. Aluminum

G. Guards:
   1. Splice pipe rails in field with internal sleeves fastened at one end and free at the other end.
   2. Install railing in accordance with manufacturer’s recommendations.
   3. Provide smooth end loops to all cut guards.
   4. Provide expansion sleeves in guards for continuous runs greater than 20 feet in length.

H. Install grating and floor plate angle supports at all perimeters of covered openings. All angles shall be embedded in the concrete unless indicated otherwise.

I. Attach ladders to structures at a maximum of 4 feet on center unless otherwise indicated.

J. Safety Gates:
   1. Protect installed product and finish surfaces from damage during handling, storage, and installation.
   2. Install safety gates in accordance with manufacturer’s recommendations. Ensure proper fit of the gates within the ladder rails or guard posts.

3.7 GALVANIZING

A. Acceptable manufacturers:
   1. Duncan Galvanizing, Everett, MA
   2. Connecticut Galvanizing, Glastonbury, CT
   3. V&S Taunton Galvanizing, LLC, Taunton, MA

B. All galvanizing processes, materials and systems described herein are based on Duncan Galvanizing, Everett, MA. Equivalent systems by other galvanizing plants will be permitted provided they meet the requirements of the Specification.

C. Provide hot-dipped galvanizing coatings to all structural steel and hardware as indicated on the Drawings and herein. Galvanizing coating shall consist of one of the following products:
   1. Duragalv
   2. Primergalv

D. Duragalv
   1. Duragalv coating shall consist of a zinc rich galvanized coating surface without additional finishes.
   2. Hot-dip galvanize all fabricated items in accordance with ASTM A123/A123M and hardware items in accordance with ASTM A153/A153M.
   3. Prior to galvanizing, drill vent and drain holes in hollow steel shapes as required by the galvanizer.
   4. Galvanizing process shall consist of the following steps:
      a. Degreasing - Immerse the steel in an acid degreasing bath or caustic solution in order to remove the dirt, oil, and grease from the surface of the steel. After degreasing, the steel is rinsed with water.
      b. Pickling – Immerse the steel in an acid tank filled with either hydrochloric or sulfuric acid, which removes oxides and mill scale. After all oxidation has been removed from the steel, it is again rinsed with water.
      c. Fluxing - Immerse the steel in an acid tank filled with a combination of zinc chloride and ammonium chloride. The flux shall clean the steel of all oxidation developed since the pickling of the steel and to create a protective coating to prevent the steel from any oxidizing before entering the galvanizing kettle.
      d. After being immersed in the Degreasing, Pickling, and Fluxing tanks, the surface of the steel shall be completely free of any oxides and any other contaminants that might inhibit the reaction of the iron and liquid zinc in the galvanizing kettle.
      e. Galvanizing – The galvanizing process shall include the following steps:
         i. Immerse the steel in a galvanizing kettle containing liquid zinc.
         ii. The zinc shall be at least 98% pure and shall be heated to a temperature ranging from 820-860 F, at which point the zinc is in its liquid state.
         iii. The steel products shall be immersed into the galvanizing kettle and remain in the kettle until the temperature of the steel has reached the temperature required to form a hot-dip galvanized coating.
         iv. Once the inter-diffusion reaction of iron and zinc is completed, the steel product is withdrawn from the zinc kettle.
         v. Excess zinc shall be removed by draining or vibrating.
         vi. The finished product shall be inspected by using a variety of simple physical and laboratory tests to determine thickness, uniformity, adherence and appearance.
   5. Fill vent holes after galvanizing, if applicable, and grind smooth.
   6. Galvanize items after assembly when possible.

7. Galvanizing shall provide a visually acceptable coating and shall be free of lumps, globules, sharp edges or heavy deposits which will interfere with intended use or aesthetic appearance of materials. The Galvanized surface shall exhibit a rugosity (smoothness) of 4 rug or less (16-20 microns of variation) when measured by a profilometer over a 1-inch straight line on the surface of elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
8. Warranty: Provide galvanizer's standard warranty stating that finished galvanized surfaces will be free from 10 percent or more visible rust for 20 years.

E. Primergalv
1. Primergalv coating shall consist of a zinc rich galvanized coating surface with an additional factory applied primer finish.
2. Apply Duragalv coating to the steel as specified above.
3. Apply primer within 12 hours after galvanizing at the same galvanizer's plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Primer shall have a two year re-coat window for application of finish coat.
4. Primer shall be certified to have a VOC limit less than 2.8 lbs/gal and conform to EPA and local requirements. Primer shall meet or exceed the following performance criteria:
   a. Abrasion Resistance: ASTM D4060 (CS17 Wheel, 1,000 grams' load) 1 kg load, 200 mg loss.
   b. Adhesion: ASTM D4541, 1050 psi.
   c. Corrosion Weathering: ASTM D5894, 13 cycles, 4,368 hours, 10 per ASTM D714 for blistering; 7 per ASTM D610 for rusting.
   d. Direct Impact Resistance: ASTM D2794, 160 in. lbs.
   e. Flexibility: ASTM D522, 180 degrees' bend, 1-inch mandrel, Passes.
   f. Pencil Hardness: ASTM D3363, 3H.
   g. Moisture Condensation Resistance: ASTM D4585, 100 degrees F, 2000 hours, Passes with no cracking or delamination.
   h. Dry Heat Resistance: ASTM D2485, 250 degrees F.
   i. Accelerated Weathering: QUV- ASTM D4587 QUV A 5000 Hours: Passes.
   j. Salt Fog Resistance: ASTM B117, 5,600 hours No cracking or blisters.
5. Primer shall exhibit a rugosity (smoothness) of 4 rug or less (16-20 microns of variation) when measured by a profilometer over a 1-inch straight line on the surface of elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.
6. Warranty: Provide galvanizer's standard warranty stating that finished galvanized and primed surfaces will be free from 10 percent or more visible rust for 20 years.

F. Galvanizing Thickness
1. The minimum thickness of zinc coating (in ounces/square foot) on steel shapes shall conform to Table 1 below:

Table 1 - Zinc Coating Thickness (oz/sf)				
	Metal Thickness (in)			
Steel Shape	1/16-1/8	1/8-3/16	3/16-1/4	>1/4
Shapes and Plates	1.0	1.7	2.0	2.3
Strips and Bars	1.0	1.7	2.0	2.3
Pipe and Tube	1.0	1.7	1.7	1.7

2. The minimum thickness of zinc coating (in ounces/square foot) on steel fasteners shall conform to Table 2 below:

Table 2 - Zinc Coating Thickness (oz/sf)		
Fastener	Average of Specimen	Individual Specimen
Class A – Castings: Malleable Iron and Steel	2.0	1.8
Class B – Rolled, pressed and forged articles		
B1 - 3/16-inch and over in thickness and over 15 inches in length	2.0	1.8
B2 - Under 3/16-inch in thickness and over 15 inches in length	1.5	1.25
B3 – Any thickness and 15 inches and under in length	1.3	1.1
Class C - Fasteners over 3/8-inch diameter. Washers 3/16 inch and ¼-inch thick	1.25	1.0
Class D - Fasteners 3/8-inch and under in diameter, rivets and nails. Washers under 3/16-inch in thickness	1.0	0.85

G. Touch up and repair: After erection, touch-up all damaged galvanized and coated surfaces and field welds as follows:
1. Unless otherwise indicated, all touch up and repairs to galvanized surfaces shall be in strict accordance with the manufacturer's recommendations.
2. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease and corrosion.
3. Areas to be repaired shall be power disc sanded to bright metal. To ensure that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
4. At galvanized surfaces, apply organic zinc repair paint complying with requirements of ASTM A780/A780M. Galvanizing repair paint shall have 65-95 percent zinc by weight.
5. The paint shall be spray applied in multiple coats until a dry film thickness of 4-6 mils minimum has been achieved.
6. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

7. Repair Paint:
    a. ZIRP by Duncan Galvanizing
    b. Tneme-zinc by Tnemec
    c. Or equivalent

3.8 SURFACE PREPARATION AND SHOP COATINGS

A. Provide Surface Preparation and Shop Coatings in accordance with specification Section 09905.
B. The following surfaces shall not be shop coated:
    1. Galvanized steel not specified to be painted.
    2. Steel surfaces embedded in concrete or masonry, except that steel lintels specified to be painted and are partially encased in masonry are shop primed.
    3. Surfaces that will receive fireproofing material.
C. Shop coats shall be compatible with and made by the same manufacturer as the field topcoats as specified in Section 09900. Contractor shall coordinate the installation of the topcoats with the shop coats.
D. After erection touch-up all abrasions and field welds with same material used on shop coating.

3.9 CLEANING

A. Clean surfaces of all work of this section as well as the areas in the vicinity.

3.10 PROTECTION

A. Protect installed work from:
    1. Splatter or debris from adjacent construction.
    2. Excess construction loading and use.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Temporary enclosures.
B. All rough lumber, including wood nailers, posts, plates, blocking, strapping, and lumber bases for mechanical and electrical equipment
C. Plywood Sheathing
D. Wood Trim
E. PVC Trim.
F. Rough hardware, such as nails, bolts, screws, clips, as required to install rough carpentry work.
G. Lumber Preservatives
H. Sill Sealer

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. American Wood Protection Association (AWPA) u1 - Use Category System - User Specification for Treated Wood.
B. Plywood shall conform to American Plywood Association APA Grade trademark and Product Standard PS-l.

1.4 QUALITY ASSURANCE

A. All lumber except as otherwise specified herein shall:
   1. Be new, dressed 4 sides (S4S), clean, and free from warping and other defects.
   2. Conform to U. S. Department of Commerce Simplified Practice Recommendations R-l6 for sizes and use Classifications.
   3. Have a moisture content not exceeding l9 percent when delivered to the project.
   4. National Forest Products Association - "National Design Specification for Wood Construction - 2005 including Design Values for Wood Construction".
B. Plywood shall conform to American Plywood Association APA Grade Trademark and Product Standard PS-1.

1.5 SUBMITTALS

A. Submit product data under provision of Section 01340.
B. Submit PVC trim.
C. Submit hardware and hangers indicated on the Drawings.
D. Submit each type of fastener to be used with the location for use.
E. Submit sill sealer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store all materials in an elevated dry location, protected by waterproof coverings. Do not store within the building until masonry, concrete, and other such wet work has been completed and allowed to dry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. PVC Trim
   1. AZEK Exteriors
   2. Kleer Trimboards
   3. Versatex Trimboards
   4. Or equal

2.2 LUMBER TREATMENTS

A. Preservative Treatments: All dimension lumber, wood blocking and nailers which will be embedded in or in contact with concrete and masonry or concealed by roofing, flashing and the air barrier system and any wood indicated on the drawings as preservative treated (PT) shall be treated with waterborne preservatives in accordance with AWPA Standard U1 to the requirements of Category 2 (UC2).
B. Brush Preservative Treatment: Brush coat all end cuts after cutting with treatment equal to above. Apply in two heavy coats on all surfaces prior to installation of lumber.

2.3 FRAMING AND BLOCKING

A. All dimensional lumber to be Spruce-Pine-Fir No. 2 or better unless indicated otherwise on the Structural Drawings.
B. All preservative treated dimensional lumber to be southern yellow pine, No. 1 or better, unless indicated otherwise.
C. Blocking less that 1-1/2" in thickness to be exterior grade plywood.

2.4 WOOD PANELS

A. Plywood Panels for Electrical Panel Mountings to be INT DFPA A-C, 3/4 inch thick.
B. MDO plywood base for exterior mounted electrical equipment.
C. Interior Finish Plywood to be APA ACX in thickness indicated on the Drawings.

2.5 WOOD TRIM

A. Interior Wood Trim to be White Pine No. 2 or better. The longest lengths available shall be used and shall be 10 foot minimum.

2.6 PVC TRIM

A. Material: Free Foam Cellular PVC material with a small-cell microstructure and density of .55 grams/cm³.
B. Performance and physical characteristic requirements:
   1. Density: 0.55 g/cm³, ASTM D 792
   2. Water Absorption: <0.70 %, ASTM D 570

3. Tensile Strength: 1889 psi, ASTM D 638
4. Tensile Modulus: 107,000 psi, ASTM D 638
5. Flexural Strength: 4019 psi, ASTM D 790
6. Flexural Modulus: 164,200 psi, ASTM D 790
7. Modulus of Elasticity: 97,400 psi, ASTM D 638
8. Elongation: 10.2 %, ASTM D 638
9. Nail Hold: 108 Lbf/in of penetration, ASTM D 1761
10. Screw Hold: 442 Lbf/in of penetration, ASTM D 1761
11. Staple Hold: 69 Lbf/in of penetration, ASTM D 1761
12. Gardner Impact: 98 In-lbs, ASTM D 5420
13. Notched Izod Impact: 0.250 Ft-lbs/inch, ASTM D 256
14. Coefficient of Linear Expansion: 3.25 x 10-5 in/in/˚F, ASTM D 696
15. Burning Rate: Failed to Ignite, ASTM D 635
16. Flame Spread Index: 25, ASTM E 84
17. Heat Deflection Temp (264 psi): 153 ˚F, ASTM D 648
18. Oil Canning (@ 140 ˚F): Passed, ASTM D 648

C. Sizes as indicated on the drawings and in the longest lengths available.

2.7 HANGERS

A. Joist hangers, wood construction connectors, nail plates, straps and ties, and other fasteners as indicated on Drawings. Truss Seismic and Hurricane Anchors are specified in Section 06175 Prefabricated Wood Trusses.

2.8 ANCHORS

A. Expansion anchor, anchor bolts, epoxy anchors, and other anchors shall be as shown on the Drawings and as specified in Section 05500. For other non-specified conditions the following minimums shall apply:
   1. Blocking in excess of 7/8 inch thick - 3/4-inch diameter galvanized steel anchor bolts or expansion bolts, as applicable.
   2. Blocking 7/8 inch thick or less attached to concrete or masonry- 5/16 inch diameter galvanized steel anchor bolts or expansion bolts.
   3. Secure other non-specified lumber with galvanized steel fasteners, of a type most suitable for the application.

2.9 FASTENERS

A. Fasteners for PVC trim shall be stainless steel.
B. Adhesives for PVC trim shall be as recommended by the PVC Trim manufacturer.
C. Hardware and fasteners in contact with pressure treated lumber shall be stainless steel or coated fasteners specifically intended for preservative treated wood.

PART 3 - EXECUTION

3.1 TEMPORARY BRACING

A. Provide and maintain, until such time as permanently built into the structure, all temporary bracing for walls, door frames, sills, and other work requiring bracing and which is not specified as being provided under other SECTIONS of the specifications.

3.2 PROTECTION

A. Do such work as is necessary to cover and protect all finishes and other work from damage during construction.

3.3 NAILERS AND BLOCKING

A. Fasten nailers and blocking to concrete and masonry with specified bolts, as shown on Drawings or as specified above. Space bolts not over 32 inches on center. Stagger lines of bolts on nailers wider than nominal 3-1/2 inch width. Use not less than two (2) bolts per piece of nailer length. Counterbore nailers so that nut and ends of bolts are recessed below top surface. Install wood shims behind nailers and blocking against masonry, as required, to ensure completely true surface.

END OF SECTION

SECTION 07150

DAMPPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Penetrating Dampproofing (above grade).

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM D449 - Specification for asphalt used in dampproofing and waterproofing.
B. VOC’s shall not exceed the ozone transport commission regulations.

1.4 SUBMITTALS

A. Submit product data and application instructions for all materials in accordance with Section 01340.
B. Submit Manufacturer's specification and installation instructions.

1.5 ENVIRONMENTAL CONDITIONS

A. Do not apply dampproofing at temperatures below 40 degrees F or when temperature is expected to fall below 40 degrees F within 12 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Penetrating Dampproofing
   1. Sika Corporation
   2. Euclid Chemical Company
   3. W. R. Meadows
   4. Or equal

2.2 MATERIALS

A. Penetrating Dampproofing
   1. General: Deep penetrating, solvent based, siloxane type, water repelling sealer formulated to provide an integral barrier against ingress of moisture and water-borne salts.
   2. Formulation: 100% active silane sealer.
   3. Products:
      a. Euclid; Euco-Guard 100
      b. Sika; Sikagard SN-40
      c. W. R. Meadows; Penetreat 244-100
      d. Or equal

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect elements surrounding the work of this Section from damage or disfiguration.

3.2 PENETRATING DAMPPROOFING APPLICATION

A. Apply in strict accordance with manufacturer's printed instructions and as specified herein. Clean and prepare surfaces as required.
B. Ensure surface is clean, sound and dry. High pressure water blast surface and ensure surface is free of all grease, curing compounds, surface treatments, coatings, oils, etc.
C. Apply to above grade, exterior, masonry and concrete walls where indicated in the "Schedule for Applications".
D. Apply in two (2) coats at a rate not to exceed 100 sq.ft./gal. for each coat.

3.3 CLEANING

A. Clean any adjacent materials affected by the application of the penetrating dampproofing with a material recommended by the dampproofing manufacturer.

3.4 PROTECTION

A. Protect below grade dampproofing from damage during backfilling.

3.5 SCHEDULE FOR APPLICATION

A. Penetrating Dampproofing:
    1. Apply no sooner that 30 days after the building is closed in.
    2. All new above grade exterior masonry walls.
    3. All new above grade exterior concrete walls where not covered by other materials and are exposed to view and to 6” below grade.
    4. At surfaces of existing buildings, where indicated on the Drawings.
    5. At exterior concrete pads located at building entrances.

END OF SECTION

SECTION 07214

RIGID INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES
A. Cavity Wall Insulation

1.2 REQUIREMENTS SPECIFIED ELSEWHERE
A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES
A. ASTM C272 - Test Method for Water Absorption of Core Materials for Structural Sandwich Construction.
B. ASTM C518 - Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter.
C. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics.
D. ASTM E96 - Test Method for Water Vapor Transmission of Materials.
E. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace @ 750 degrees C.
F. FS-HH-1-585C

1.4 SUBMITTALS
A. Submit product data under provision of Section 01340.
B. Submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials to project site in manufacturer's original unopened packaging.
B. Identify contents, manufacture, brand name, thermal values, and applicable standards.
C. Store materials in area protected from weather, and moisture.
D. Remove damaged materials from site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Dupont
B. Hunter Panels
C. Johns Manville
D. Or equal

2.2 RIGID INSULATION
A. Insulation: Polyisocyanurate foam with reflective aluminum foil facers.
B. 15 year aged "R" Value - "R" = 6.1 (minimum) per inch ASTM C518.

C. Water Vapor Permeance - 0.03 Perm (Max) ASTM E96.
D. Adhesive: As recommended by the Manufacturer.
E. Joint Tape: As recommended by the Manufacturer.
F. Z-furring: Cold-rolled, 25 gauge, galvanized, Z-shaped sections, 1 ¼-inch wide flanges by depth indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install rigid wall insulation at all locations indicated on the Drawings.
B. Cut insulation to fit tightly around all penetrations and seal.
C. Use adhesive on concrete and masonry surfaces as recommended by the manufacturer.
D. Tape all joints with a foam joint tape as recommended by the insulation manufacturer to be compatible with their product.
E. Install Z-furring with fasteners appropriate for substrate and as recommended by the manufacturer.

END OF SECTION

SECTION 07311

ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Removal of Existing Roofing
B. Asphalt Shingles
C. Underlayment
D. Vent stack roof flashing
E. Drip Edge
F. Rain Diverter
G. Aluminum Roof Flashing

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron-Alloy-Coated (Galvannealed) by the Hot-Dip Process
B. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C. ASTM B 370 – Standard Specification for Copper Sheet and Strip for Building Construction.
D. ASTM D 225 – Standard Specification for Asphalt Shingles (Organic Felt) Surfaced with Mineral Granules.
E. ASTM D 226 – Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
F. ASTM D 1970 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials used as Steep Roofing Underlayment for Ice Dam Protection.
G. ASTM D 3018 – Standard Specification for Class A Shingles Surfaced with Mineral Granules.
H. ASTM D 3161 – Standard Test Method for Wind Resistance of Asphalt Shingles (Fan-Induced Method).
I. ASTM D 3462 – Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
J. ASTM D 4586 – Standard Specification for Asphalt Roof Cement, Asbestos-Free.
K. ASTM D-4869 – Standard Specification for Asphalt-Saturated Organic Felt Shingle Underlayment Used in Roofing.
L. ASTM D 6757 – Standard Specification for Inorganic Underlayment for Use with Steep Slope Roofing Products.
M. ASTM D7158 – Standard Test Method for Wind Resistance of Asphalt Shingles (Uplift Force/Uplift Resistance Method)

N. ASTM E 108 – Standard Test Methods for Fire Test of Roof Coverings
O. ASTM G 21 – Determining Resistance of Synthetic Polymers to Fungi

1.4 SUBMITTALS

A. Submit product data for all roofing products and accessories under provisions of Section 01340.
B. Submit samples of actual material indicated for the work in all colors and textures available from manufacturers full range of color options for selection by Architect.
C. Manufacturer's printed literature for review (CSI "Spec-Data" sheet or equivalent) stating product information correlated to specified requirements.
D. Submit certification that the roofing system and installation resists the wind loads indicated on the structural drawings.
E. Copies of the manufacturer's specifications and installation instructions.

1.5 QUALITY ASSURANCE

A. Installer Minimum Qualifications: Installer shall be licensed or otherwise authorized by all federal, state and local authorities to install all products specified in this section. Installer shall perform work in accordance with NRCA Roofing and Waterproofing Manual. Work shall be acceptable to the asphalt shingle manufacturer.
B. Maintain one copy of manufacturer’s application instructions on the project site.
C. Store Products in manufacturer’s unopened packaging until ready for installation.
D. Deliver shingles to site in manufacturer’s unopened labeled bundles. Promptly verify quantities and conditions. Immediately remove damaged products from site.

1.6 PROJECT CONDITIONS

A. Proceed with installing asphalt shingles only when existing and forecasted weather conditions will permit work to be performed according to manufactures’ recommendations and warranty requirements, and when substrate is completely dry. Roofing shall not be applied when ambient air and substrate temperatures are less than 40 deg F.
B. Do not begin roofing installation until substrate has been inspected and determined to be in satisfactory condition in accordance with manufacturer’s warranty requirements. All surfaces shall be smooth, dry, clean and free of sharp edges, loose or foreign materials, oil or grease. No work shall proceed when moisture is present on the roof or substrate material.
C. Underlayment shall not be left exposed for more than 30 days per the manufacturer’s requirements. Material left exposed for more than 30 days shall be removed and replaced.

1.7 WARRANTY

A. Manufacturer’s Warranty: Furnish shingle manufacturer’s warranty for the product listed below:
    1. Lifetime limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Certainteed
B. Owens Corning
C. GAF
D. Or equal.

2.2 MATERIALS

A. Shingles - Fiberglass Asphalt Base ASTM D3018 Type 1 – Self-Sealing UL Certification of ASTM D3462, ASTM D3161/UL997 " Class "H" Wind Resistance and UL Class A Fire Resistance, glass fiber mat base, ceramically colored/UV resistant mineral surface granules across entire face of shingle; algae-resistance; two-piece laminate shingle; Color as selected by Architect.
   1. Certainteed Corporation; Landmark Premium
   2. Owens Corning; Duration
   3. GAF; Timberline HD

B. Underlayment:
   1. Ice and Water Shield: ASTM D1970 sheet barrier of self-adhering rubberized asphalt membrane shingle underlayment having internal reinforcement and “split” back plastic release film; provide material warranty equal in duration to that of shingles being applied as recommended by manufacturer.
   2. Synthetic Underlayment: Synthetic underlayment designed for use on roof decks as a water-resistant layer below roofing, meeting ASTM D4869, ASTM E108 and ASTM E96.

C. Nails – Standard round wire type roofing nails; Hot dipped galvanized of length adequate to penetrate plywood deck, and having a minimum 11 or 12 gauge shank diameter and minimum head diameter of l/2 inch.

D. Drip Edge – ASTM B209 0.025 thick aluminum, prefinished, formed as detailed on the Drawings.

E. Rain Diverter - 0.024 - thick aluminum as detailed on the Drawings, color by Engineer.

F. Vent Pipe Flashing – Pipes penetrating shingle roof shall have self-sealing neoprene collar with aluminum flashing.

G. Roof Flashing - Copper, Domestic manufacture, conforming to ASTM Designation B152, rolled from copper conforming to ASTM Designation B5. Unless otherwise shown on the Drawings or specified, the weight of copper shall be 16 ounces per square foot. All copper to be lead-coated shall be in accordance with ASTM B101, Class A, Standard.

H. All formed sheet metal flashing and trim shall conform to "Sheet Metal and Air Conditioning Contractors National Association, Inc. - Architectural Sheet Metal Manual".

I. Hem all exposed edges.

PART 3 - EXECUTION

3.1 REMOVAL OF EXISTING ROOFING

A. Remove existing roofing, flashing, underlayment, etc. complete down to existing roof decking.
B. Only remove amount of roofing that can be made watertight at end of day.
C. Protect existing construction from damage and maintain watertightness. All work shall be watertight at end of day.

3.2 PRE-INSTALLATION CONDITIONS

A. The Contractor shall be responsible for the providing of proper receiving surfaces for roofing and flashing items. Inspect all surfaces receiving roofing and flashing work and correct all defects or other characteristics in the new receiving surfaces which may be detrimental to the installation and performance of the items to be furnished and installed hereunder. Do not commence work until defects have been corrected. Commencement of roofing and flashing work shall constitute acceptance by the Contractor of surface conditions. The Contractor shall be responsible for leakages in roof and flashed surfaces and any other defects in these surfaces.
B. Ensure that all openings through the roof decks for fans, vents, and other such items, have been either temporarily or permanently covered, to prevent the entry of water into the building, prior to commencing the Work.
C. Have sufficient materials on the project to complete each day's work. The complete roofing system for any one section of the roof, must be finished by the end of each day. Phased roofing operations will not be permitted. Do not leave shingles exposed to the weather overnight or when inclement weather is imminent.

3.3 UNDERLAYMENT INSTALLATION

A. Comply with underlayment manufacturer’s written installation instructions applicable to products and applications indicated.
B. Install ice and watershield per manufactures requirements and with 3 ½ inch side lap and 6-inch head a lap. Stagger 24 inches between courses; and as indicated below.
    1. At eaves, provide 66-inches (two rows with 6-inch side laps).
    2. At rakes, provide 36-inches (one row).
    3. At valleys, provide 96-inches centered on the valley (three rows with 6-inch side laps).
    4. At ridges and hips provide 66-inches centered on the ridge (two rows with 6-inch side laps).
    5. At all roof penetrations, 36 inches an all directions.
    6. At additional locations, as indicated on the Drawings.
C. Where ice and watershield is not required, install synthetic underlayment laid in a shingled pattern overlapping half the width of each sheet. Install with a six-inch lap over ice and watershield. Nail with specified nails spacing not to exceed l2 inches in any direction.

3.4 FLASHING INSTALLATION

A. Drip Edge: install beneath underlayment and fasten to roof deck.

B. Pipe Flashing: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to shingles as recommended by the manufacture.
C. Install ice and water shield 12-inches around the base of all roof curbs and full height of the curb.

3.5 SHINGLE INSTALLATION

A. Apply shingles in strict accordance with the shingle manufacturer's instructions and recommendations.
B. Install starter strip along lowest roof edge, consisting of asphalt shingle strip with tabs removed with self-sealing strip face up at roof edge.
C. Extend asphalt shingles ¼-inch over fascia drip edge at eaves and rakes.
D. Install asphalt shingles stair-stepping across the roof deck with manufactures recommended offset pattern, maintaining uniform exposure.
E. Fasten asphalt shingles with a minimum of six nails per shingle, nails long enough to penetrate plywood sheathing. Ridge Vent: Install continuous ridge vent over asphalt shingles according to manufactures instructions. Run full length of ridge. Fasten with roofing nails of sufficient length to penetrate sheathing.
F. Ridge Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing. Fasten ridge cap shingles to cover ridge vent without obstructing airflow.
G. Rain Diverter: Install a rain diverter above all doors below eaves.

3.6 CLEANING

A. At the completion of the Work, clean and remove from the site, all rubbish and accumulated materials and leave the Work in a satisfactory condition.
B. Clean, remove, or replace, as directed by the Engineer, all stains and/or damage to the exterior finish of building caused by faulty workmanship and/or improper handling of materials in regard to the installation of roofing and flashing work.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Preparing sealant substrate surfaces.
B. Sealant and backing.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM C790 - Recommended Practices for Use of Latex Sealing Compounds.
B. ASTM C920 - Specification for Elastomeric Joint Sealant
C. ASTM C834 - Specification for Latex Sealing Compounds
D. FS-TT-S-227 - Sealing Compound: Elastomeric Type, Multi-Component
E. FS-TT-S-230 - Sealing Compound: Elastomeric Type, Single Component
F. FS-TT-S-001543 - Sealing Compound: Silicone Rubber Base

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01340.
B. Submit manufacturer's installation instructions.
C. Submit Joint Sealant Schedule on contractor’s letterhead indicating each specific item/location to be sealed and sealant manufacturer and product name to be used at that item/location.
D. Submit samples of actual material indicated for the work in all colors and textures available from manufacturers full range for color selection by Architect.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years’ experience.
B. Applicator Qualifications: Company specializing in applying the work of this Section with minimum five years’ experience.
C. Compatibility: Verify sealants used are compatible with joint substrates.
D. Joint Tolerance: Compliance with the manufacturer's limitation is required.
E. Conform to Sealant and Waterproofers Institute requirements for installation.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
B. VOC Standards - All sealants shall be in accordance with all applicable State and Federal VOC standards.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate work in this Section with related sections.

1.8 WARRANTY

A. Installer to provide five-year warranty to include coverage of installed sealants, caulking and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Polyurethane Sealant: Typical horizontal and vertical joints up to 1-inch at openings, control joints in masonry, penetrations through walls and ceilings, etc.
   1. Moisture cured, single component, polyurethane-based, non-sag elastomeric, paintable sealant, ASTM C920, Grade NS.
   2. Max joint size: 1-inch.
   3. Movement capability: 35% joint movement.
   4. Products:
      a. Bostik 915 Polyurethane Sealant
      b. Sika Sikaflex 1A
      c. Tremco Dymonic 100
      d. Or equal

B. Self-leveling Polyurethane Sealant: Self-leveling sealant for horizontal joints in concrete.
   1. Multi-component, self-leveling, polyurethane sealant, ASTM C920, Grade P.
   2. Max joint size: 1-inch.
   3. Movement capability: 25% joint movement.
   4. Products:
      a. Pecora DynaTrol II-SL
      b. Sika Sikaflex 1C-SL
      c. Tremco Vulkem 445SSL
      d. Or equal

C. Acrylic Latex Sealant: Acrylic latex sealant for interior applications at joints in wood finish, wood trim, drywall, etc.
   1. Single component, non-sag, non-staining, non-bleeding, acrylic latex sealant, ASTM C834, Grade NS.
   2. Movement capability: 7 1/2% joint movement.
   3. Products:
      a. DAP ALEX PLUS
      b. Pecora AC-20 +Silicone
      c. Tremco Tremflex 834
      d. Or equal

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: ASTM D1056; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width; as recommended by sealant manufacturer.
D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

2.3 COLORS
A. As selected by engineer from manufacturers full range of color options.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.
B. Beginning of installation means installer accepts existing conditions.

3.2 PREPARATION
A. Clean and prime joints in accordance with manufacturer's instructions.
B. Remove loose materials and foreign matter which might impair adhesion of sealant.
C. Verify that joint backing and release tapes are compatible with sealant.
D. Perform preparation in accordance ASTM C790 for latex base sealants.
E. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION
A. Install sealant in strict accordance with manufacturer's instructions.
B. Measure joint dimensions and size materials to achieve required width/depth ratios.
C. Install joint backing to achieve a neck dimension no greater than 1/3 the joint width.
D. Install bond breaker where joint backing is not used.
E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot apply within these temperature ranges.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
G. Tool joints concave.

3.4 CLEANING AND REPAIRING
A. Clean work under provisions of Section 01710.
B. Clean adjacent soiled surfaces.
C. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 PROTECTION OF FINISHED WORK
A. Protect sealants until cured.

END OF SECTION

SECTION 08310

FLOOR ACCESS DOORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Floor Hatches
B. Floor Hatch Safety Net

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM B 117 - Standard Test Method of Salt Spray (Fog) Testing.
B. ASTM D 714 - Standard Test Method for Evaluating Degree of Blistering of Paints.
C. ASTM D 1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
D. ASTM D 2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
E. ASTM D 4541 - Method for Pull-Offs Strength of Coatings Using Portable Adhesion - Testers.
F. ASTM E 74 - Practice for Calibration of Force Measuring Instruments for Verifying the Load Indication of Testing Machines.
G. ASTM E 96 - Test Methods for Water Vapor Transmission of Materials.
H. ASTM E 119 - Fire Tests of Building Construction and Materials.
I. ASTM G 53 - Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV - Condensation Type) for Exposure of Nonmetallic Materials.

1.4 SUBMITTALS

A. Submit product data under provision of Section 01340.
B. Submit large scale details of all items furnished hereunder, and details of installation to the surrounding conditions.
C. Submit manufactures specification and installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver fabricated assemblies as job progress requires in the largest sections permitted, properly labeled for field erection.
B. Store in original packaging on site under protective coverings and out of the way of normal construction activities. Provide special storage in accordance with the manufacturer's instructions and recommendations.
C. Handle fabricated assemblies to prevent damage of any nature.

1.6 WARRANTIES

A. Floor Hatches (including fire rated): Manufacturer shall guarantee against defects in material or workmanship for a period of five years.

B. Insulated Scuttles: Manufacturer shall guarantee against defects in material or workmanship for a period of five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Floor Hatches
   1. Acudor
   2. The Bilco Company
   3. Babcock-Davis Hatchways, Inc.
   4. Nystrom
   5. Or equal.

B. Floor Hatch Safety Net
   1. Safe Approach, Inc Auburn, Maine
   2. US Netting
   3. USF Fabrication
   4. Or equal

2.2 FLOOR HATCHES

A. Flush Mount Hatches:
   1. Style: Access hatch with channel frame with drain connection for casting into concrete slabs such that the surface of the door is flush with concrete slab surface.
   2. Door Leaf: 1/4-inch aluminum diamond pattern plate.
   3. Load Capacity: 300 psf.
   4. Deflection: 1/150th of the span maximum.
   5. Frame: 1/4-inch aluminum with an anchor flange around the perimeter and have a minimum cross-section area of 7½ square inches to allow adequate water drainage.
   6. Hardware: Type 316 stainless steel hardware including all parts of the latch and lifting mechanism assemblies, hold open arms and guides, and all brackets, hinges, pins and fasteners.
   7. Operation: Compression spring operators enclosed in telescopic tubes shall be provided for smooth, easy and controlled door operation throughout the entire arc of opening and closing. The springs shall be of sufficient size to partially open the hatch when the latch is released.
   8. Lock: Type 316 stainless steel snap lock with a gasketed cover plug and removable turn handle.
   9. Drainage Coupling: 1-1/2" drainage coupling located in the front right corner of the channel frame.

2.3 SAFETY NET

A. Slide Rails; 1½" diameter; Schedule 40 stainless steel pipe.
   1. Yield: 8 KSI
   2. Shear: 12 KSI

B. Corner Brackets: Aluminum.
   1. Ultimate Tensile Strength: 40 KSI
   2. Shear: 27.45 KSI
C. Pear Shaped Rings: 316 stainless steel load tested to 13,500 pounds.
D. Eye Corner Hooks: 316 stainless steel.
E. Netting: Dupont Type 728 high density nylon.
F. System shall be Hatch Net 120S as manufactured by Safe Approach, Inc. and shall be designed to meet loadings required by law.

2.4 FINISHES

A. Mill finish aluminum, polyamide epoxy primer at steel hatches.
B. Polyamide epoxy (5 mils) or manufacturer's standard bituminous coating applied to exterior of the frame in contact with concrete.
C. All coatings shall comply with Local, State and Federal regulations.

PART 3 - EXECUTION

3.1 FLOOR HATCH INSTALLATION

A. Installation shall be in accordance with manufacturer's instructions.
B. Coordinate the hatch installation with the drain piping.
C. Install the ladder safety post in the middle of the top two rungs of the ladder.
D. Cover and protect the installed hatches from splatter or debris and from damage or staining by adjacent work until accepted by the owner.

3.2 SAFETY NET INSTALLATION

A. Install factory prepared brackets to hatch drainage channel with stainless steel bolts. Each bracket has four factory installed reference points. Drill 9/16-inch diameter holes in bracket using opposite corners of the reference points. Do not drill holes directly above or below one another. Place and support safety net system in opening. Using the bracket as a guide, drill through hatch drainage channel and bolt with ½-inch diameter stainless steel bolt and nylon lock nut. Place silicone sealant on bolt threads before tightening nuts.

END OF SECTION

SECTION 08392

PEDESTRIAN FLOOD DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single Swing and Paired Swing with removable-mullion Pedestrian Flood Doors with Frames.
B. Door Hardware.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions.
B. Shop Drawings: Provide shop drawings showing layout, profiles, and product components, including anchorage, hardware, and finishes. Include dimensional plans, applicable material specifications, elevations and sections detailing mounting and connections, and load diagrams.
   1. Contractor to provide manufacturer with field measurements and mounting structure prior to commencement of shop drawings.
C. Factory Testing Documentation: Furnish independent party witnessed factory testing documentation of the same model/type pedestrian flood door demonstrating a maximum leakage rate of 0.040 gallon per hour per linear foot of wetted perimeter, tested in accordance with the procedure set forth by the American National Standard for Flood Mitigation Equipment in ANSI/FM Approvals 2510-2020 section 4.3.3 for a minimum of 22 hours. Maximum leakage rate shall be published as the greater of the leakage rates recorded at both 10% and 100% of the maximum test water height. Leakage shall be collected through all portions of the product assembly which are below the test water depth, including hardware and lockset.
D. Calculations: Upon signed finalization and approval of dimensions, mounting location material and configuration, and load requirements;
   1. Submit stamped calculations by a registered professional engineer from within the state or territory where the project will be constructed or substantially improved, to verify the flood door’s ability to withstand the design loading.

1.4 CLOSEOUT SUBMITTALS

A. Provide Operation and Maintenance data to include methods for maintaining installed products, precautions against cleaning materials and methods detrimental to finishes and performance.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer must demonstrate a minimum of five (5) years successful experience in design and manufacture of similar flood related closures. Upon request, provide supporting evidence including list of installations, descriptions, name, and method of contact.

B. Minimum Qualifications: Manufacturer must demonstrate compliance and certification of a Quality Management System administered by the International Organization for Standardization (ISO). Documentation of current certification status to be provided upon request.

C. Welder Qualifications: Welders Certified in accordance with American Welding Society Procedures for applicable material used in production of specified product.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging container with identification markings intact until ready for installation.

B. Protect materials from exposure to moisture during storage.

C. Store materials in a dry, warm, ventilated weathertight location. If outdoor storage is required, block materials to store at an incline, to prevent pooling of any moisture and promote runoff. Tarp materials in a tent-like arrangement, elevated above the product with open sides to allow airflow. Store loose or high value components in a dry, controlled environment.

D. Use caution when unloading and handling product to avoid bending, denting, crushing, or other damage to the product.

E. When using forklifts, use forks of proper length to fully support product being moved. Consult "Approved for Construction" drawings or consult with factory for proper lift points.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's indicated limits.

1.8 COORDINATION

A. Conduct site survey and provide to flood door manufacturer, prior to manufacturer’s commencement of shop drawings, the actual site conditions of the mounting location, to include; material type, dimensions and configuration, interferences with mounting surface, or any other condition that may impact the ability of the flood door to be properly installed.

B. Coordinate work with other operations and installation of adjacent materials to avoid damage.

1.9 WARRANTY

A. Manufacturer’s Standard Warranty: Product to be free from defects in material and workmanship for a period of one (1) year from date of shipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design flood resistance doors to support, solely or in combinations of, temporary super-imposed live loads as indicated below. All applied types of flood related loadings are transferred from the flood product barriers, solely or in combinations of, by mullion anchorage to structural floor slabs and/or jamb anchorage and direct pressure contact to structural walls or other structural elements.
   1. Hydrostatic Loading
   2. Hydrodynamic Loading
   3. Debris Impact Loading
   4. Wave Loading (Dynamic/ Non-Breaking or Broken Wave)
   5. Wave Loading (Impact/ Breaking Wave – Below & Above DFE)
   6. Wind Loading

B. Engineer Code Practices: Engineer flood products to conform to the design requirements that are based on the latest adopted building code of the project location. LFRD and/or ASD methodologies are applied as appropriate to align with specific project specifications and/or limited published material data.

C. Factory Testing Documentation: Furnish independent party witnessed factory testing documentation of the same model/type pedestrian flood door demonstrating a maximum leakage rate of 0.040 gallon per hour per linear foot of wetted perimeter, tested in accordance with the procedure set forth by the American National Standard for Flood Mitigation Equipment in ANSI/FM Approvals 2510-2020 section 4.3.3 for a minimum of 22 hours. Maximum leakage rate shall be published as the greater of the leakage rates recorded at both 10% and 100% of the maximum test water height. Leakage shall be collected through all portions of the product assembly which are below the test water depth, including hardware and lockset.

D. Water Density: 64 pcf, unless otherwise noted on drawings.

2.2 PEDESTRIAN FLOOD DOOR WITH FRAME

A. Description: Hinged, Pedestrian Flood Door including door frame, door panel, threshold, and door hardware.

B. Manufacturers:
   1. Orange Flood Barriers
   2. PS Flood Barriers
   3. Or equal

C. Single Source Responsibilities: Obtain all watertight doors and flood protection barriers from single manufacturer.

2.3 EQUIPMENT

A. Products Details:
   1. Sealing Requirements: Flood Door and compression gasket design shall provide an effective barrier against short-term high-water situations, to the protection level indicated on drawings.
   2. Operation: Provide with latching operable from both sides.

3. Mounting/Load Transfer: Anchor to existing structure. Flood Door designed for specified hydrostatic pressure (and other loads as specified) and will transfer loads to adjacent structure.
4. Frames to be anchored utilizing mechanical, chemical or other framing methods as designed. Manufacturer to include all anchors, water-stop, and sealants, as designed.
5. Loading Direction: Positive Pressure Loading, (direction of loading against flood door so as to further compress gaskets against flood door frame - "seating").
6. Provide rectangular door opening with square corners to facilitate easy passage.
7. Provide continuous, compression gasket which does not require air inflation.

2.4 MATERIALS

A. Exposed sheet metal of door panel and door frame to be formed of commercial quality, low carbon steel of appropriate size and strength, welded and structurally bonded.
B. Flood door internal structure and mullion tube to be structural tubes, plates, and formed shapes of commercial quality, low carbon steel of appropriate size and strength with welded construction.
C. Door Frame to be manufactured of the same material type and finish as door panel. Frame to include jambs, header jamb, and threshold members for field locating and installation on structure. Jamb members to be designed and fabricated with appropriate material as required for the loading.

2.5 HARDWARE

A. Gaskets: Factory mounted, continuous, compressible rubber type, field replaceable. Gasket does not require air inflation.
   1. Material: UV resistant EPDM, neoprene and rubber unless otherwise noted.
   2. Location: Recessed into door perimeter, no gasket along threshold/walking surface.
B. Thresholds:
   1. Aluminum: 6000 Series Alloy.
      a. ADA Compliant threshold (no more than ½" high).
      b. Gasket-Free walking surface.
C. Frame Mounting Hardware: Provide anchors, sealant, and water stop, as required.
D. Operating Hardware: Provide hardware appropriate for the size and weight of the flood door and loads.
E. Exit Devices:
   1. All exit devices for this project shall be of the same series and design and shall be manufactured by one manufacturer.
   2. Exit devices shall be certified to meet or exceed the requirements of ANSI/BHMA A156.3 Grade 1.
   3. Exit devices shall comply with UL10C positive pressure requirements.
   4. All exit devices shall have a 14-gauge, stainless steel continuous horizontal mounting rail with a 16-gauge, stainless steel touch pad with a Lexan touch pad protection plate and shall be of the same design, and of similar configuration, for all doors throughout.

5. The chassis shall be a solid cast pressure formed almag or non-ferrous alloy and shall be mounted directly to the door with four (4) wood screws, machine screws, or, through bolted where required for positive attachment for wood fire rated doors.
6. All exit devices for this project shall have the chassis, end cap, and horizontal mounting rail, mount directly to, and flush with, the door surface. No gaps or space shall be permitted between the back of the horizontal mounting rail and the door surface. If required, a continuous solid stainless steel or bronze dull chrome plated spacer bar shall be used to fill the space between the back of the devices and the door surface.
7. The chassis cover shall be 16-gauge, cold formed stainless steel, fastened to the solid cast pressure formed chassis, by four (4) Phillip head machine screws, at the side of the chassis cover.
8. The rail assembly shall be 14-gauge, heavy wrought stainless steel. The rail assembly shall consist of a stainless steel case with a 16-gauge, heavy wrought stainless steel touch pad with a Lexan touch pad protection plate.
9. The end cap shall be a high impact resistant black lexan, fastened to the rail assembly by means of two, stainless steel Phillip head machine screws.
10. The touch pad shall retract the latch bolt by means of a sliding motion of the touch pad towards the lock stile, activating the lever arm for easy operation and reduced friction.
11. All exit devices, regardless of function, except for fire rated devices, shall have one-point cylinder dogging. The cylinder for cylinder dogging shall be a six (6) pin cylinder keyed to the building master key system as specified under Section, "Keying"
12. Trim for exit devices shall be one of the following as specified:
    a. Cast stainless steel lever handle with cast escutcheon.
13. Exit devices, meeting all of the specification requirements set forth above, Precision 2100 Series, Sargent 8800 Series, Corbin Russwin 5200 Series, Von Duprin 9800 Series, or equal.
14. Provide rim exit devices for single doors and mortise lock devices with open back strike and vertical rod devices for pairs of doors.
15. Key Lock Function.

F. DOOR CLOSERS

1. All door closers for this project shall be the product of one manufacturer and shall have heavy cast cases with full cover and be full rack and pinion type construction, non-handed and non-sized with adjustable back-check effective at 70 degrees for both standard and parallel arm mounting.
2. The closers shall meet or exceed the requirements of ANSI/BHMA A156.4, Heavy Duty Grade 1.
3. The following products will be acceptable:

Manufacturer	Model
Dorma	8900
LCN	4111/4011
Sargent	280

4. The hardware contractor shall insert in the hardware schedule, beside each door listing, the required degree of opening for each door. If the door swing is over 140 degrees, parallel arm type closers shall be used. Door closers mounted on corner brackets, or top jamb application, shall not be permitted.
5. Door closers with Cush-N-Stop arms shall be provided for all exterior, out-swing doors and other openings as specified under hardware sets. They shall have heavy forged steel parallel arms and soffit plates attached to the frame by six (6) screws.
6. The installing contractor shall be responsible for proper installation of door closers in accordance with degree of opening indicated on hardware schedule. Adjustment of all valves, for proper control of closing speed, latching speed, delayed action, back check, and spring power adjustments, shall be the responsibility of the installing contractor as set forth in Part III Execution.
7. Where top rail of door is insufficient in height to mount the closer directly to the rail, drop brackets shall be provided.

G. Finish: One shop coat of manufacturer's standard shop primer.
H. Labeling: Each watertight door and frame will be individually identified for matched installation.

2.6 KEYING

A. Provide cylinder housings to accept permanent cores conforming to the Owner’s existing key system and following requirements:
1. Provide construction cores with construction master keying for use during construction. The temporary construction cores are to be returned to the hardware supplier.
2. Contractor to provide permanent cores keyed by the factory to the Owner’s requirements. The Owner or Owner’s security agent shall install permanent keyed cores upon completion of the project.
3. The hardware supplier, accompanied by a qualified factory representative for the manufacturer of the cores and cylinders, shall meet with Owner and Architect to review keying requirements and lock functions prior to ordering finish hardware.
4. Provide keys as follows
   a. Six keys per each lock and/or cylinder type.
   b. Six master keys.
5. Deliver all keys and permanent cores from the factory or authorized distributor directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be cause to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.

2.7 FABRICATION

A. Fit and factory assemble items in largest practical sections, for shipment to site.
B. Fabricate items with joints tightly fitted and secured.
C. Supply components required for anchorage of fabrications, unless otherwise noted.

D. Conduct shop operational test with factory installed gaskets to verify flood door assembly components operate as designed and flood protective gasket alignment and contact surfaces interact as intended.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until mounting substrates have been properly prepared.
B. If substrate preparation is the responsibility of another subcontractor, notify Architect of uncompleted preparation before proceeding.
C. Inspect opening for compliance with door manufacturer requirements. Verify open conditions are within required tolerances.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's installation instructions, "Approved for Construction" drawings, shipping, handling, and storage instructions, and product carton instructions for installation.
B. Frames must be installed level, square, plumb, and rigid.
C. Perform chalk test for gasket alignment, continuity contact and pre-compression prior to field grouting.
D. Sealants, water-stop, and grouting to be applied per product application directions and in accordance with manufacturer's instructions, and "Approved for Construction" drawings.
E. Field Grouting to be completed by appropriate personnel, and in accordance with product application directions, manufacturer's instructions, and "Approved for Construction" drawings.
F. Tolerances: All dimensional requirements must be in accordance with manufacturer's installation instructions and "Approved for Construction" drawings.
G. Products to be operated and field verified that sealing surfaces maintain contact at the correct sealing points.
H. Inspect gaskets for damage, wear, and adhesion. Replace compromised gaskets immediately.
I. Verify that latching assemblies operate freely and correctly.
J. Verify all anchorage is in accordance with manufacture's installation instructions and applicable data sheets.
K. Inspect installation sealants to ensure a watertight juncture.

3.4 FIELD QUALITY CONTROL

A. Field Testing: Installer to construct temporary water barrier and test installed flood barrier under hydrostatic conditions.

3.5 CLEANING

A. Touch-up, repair or replace damaged products or components before Substantial Completion.

B. Clean all sealing surfaces.

3.6 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION

SECTION 08540

FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Factory assembled fiberglass windows.
B. Anchorage, attachments and accessories.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Submit product data under provision of Section 01340.
B. Submit Shop Drawing indicating pertinent dimensions, general construction, component connections and locations, anchorage methods and locations, and installation details.
C. Submit test data as specified in Performance Requirements.
D. Submit samples of actual material indicated for the work in all colors and textures available from manufacturers full range for color selection by Architect.

1.4 QUALITY ASSURANCE

A. Qualification of Manufacturer - Fabrication shall be by a manufacturer who can furnish evidence to the Engineer that they are and have been for not less than three consecutive years, regularly engaged in the manufacture of the window units herein specified. The manufacturer shall have been continuously in the sales and service of commercial windows for a period of not less than five years and demonstrate financial strength consistent with the size of this project.

1.5 REFERENCES

A. ASTM C1036: Standard Specification for Flat Glass.
B. ASTM E90: Standard Test Method for Laboratory Means.
C. ASTM E283: Standard Test Method for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors.
D. ASTM E330: Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Door by Uniform Static Air Pressure Difference.
E. ASTM E547: Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
F. ASTM E2090: Standard Specification for Window Fall Prevention Devices with Emergency Escape (Egress) Release Mechanisms.
G. ASTM E2190: Standard Specification for Insulating Glass Unit Performance Evaluation.
H. Insulating Glass Manufacturer’s Alliance/Insulating Glass Certification Council (IGMA/IGCC).

I. AAMA/WDMA/CSA 101/I.S.2/A440: North American Fenestration Standard/Specification for windows, doors, and skylights.
J. AAMA/WDMA/CSA 101/I.S.2/A440: North American Fenestration Standard/Specification for windows, doors, and skylights.
K. AAMA 450: Voluntary Performance Rating Method for Mulled Fenestration Assemblies.
L. AAMA 624: Voluntary Specification, Performance Requirements and Test Procedures for Organic Coatings on Fiber Reinforced Thermoset Profiles.
M. Window and Door Manufacturer's Association (WDMA): Hallmark Certification Program.
N. NFRC 100: Procedures for Determining Fenestration Product U-factors.
O. NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence.

1.6 SYSTEM DESCRIPTION

A. Design and Performance Requirements:
1. Air tested to 1.57 PSF.
2. Water tested to 6.0.
3. Design Pressure: DP-40.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in manufacturer's or distributor's packaging, undamaged, complete with installation instructions.
B. Store off the ground, under cover, protected from weather and construction activities.

1.8 WARRANTY

A. Clear insulating glass with stainless steel spacers is warranted against seal failure caused by manufacturing defects and resulting in visible obstruction through the glass for twenty (20) years from the original date of purchase. Glass is warranted against stress cracks caused by manufacturing defects from ten (10) years from the original date of purchase.
B. Hardware and other non-glass components are warranted to be free from manufacturing defects for ten (10) years from the original date of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Marvin
B. Milgard
C. Pella
D. Or equal

2.2 MODEL

A. Essential by Marvin
B. Ultra by Milgard
C. Impervia by Pella
D. Or equal

2.3 CONSTRUCTION

A. Factory assembled, pultruded reinforced fiberglass, interior and exterior frame with .050-inch to .077-inch wall thickness.
B. Window type as indicated on the drawings.
C. Egress shall meet egress requirements having a minimum net clear opening of 5.7 SF,
D. Withoutnailing flange.
E. Overall frame depth: 3-inches to 3.25-inches.
F. Frame and sash corners: Mitered and joined and bonded with thermoset polyurethane adhesive

2.4 GLAZING

A. Windows shall be glazed with 11/16" insulating glass, Low E coated with argon, tempered where required and float glass otherwise.
B. Glazing seal: Silicone bead at exterior; glazing boot at interior.
C. Perimeter spacer: Mill finish stainless steel.
D. Float glass: ASTM C 1036, Quality 1.
E. Tempered glass: ASTM C 1048.
F. Insulated glazing: SIGMA/IGCC when tested in accordance with ASTM E 2190.
G. Energy performance values must be equal to or better than the following values.
    1. Visible Light Transmission: 60 percent
    2. Winter nighttime U-value: 0.29
    3. SHGC: 0.33

2.5 WEATHER-STRIPPING

A. Provide manufacturers standard weather stripping to limit intrusion of water from wind driven rain.

2.6 HARDWARE

A. Manufacturer’s standard, factory installed hardware.
B. Egress hinges to meet egress requirements.

2.7 SCREENS

A. Screens shall be color-coordinated box frames made of rigid aluminum with 18 x 16 rewireable fiber glass mesh held by vinyl spline.

2.8 GRILLES

A. Grilles between the glass of 3/4-inch contoured profile aluminum, color coordinated with the window frames.

2.9 FINISH

A. Factory applied powder coat or baked on acrylic finish meeting AAMA-623 or better.
B. Exterior color: Selected by architect from a minimum of 5 color options.
C. Interior color: White.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install windows in accordance with manufacturer's recommendations, to achieve weathertight and freely operating installation.
B. Maintain alignment with adjacent work, plumb, square, and without distortion.
C. Create a sill pan with self-adhered flashing tape prior to installation of window.
D. Seal top and sides of windows with self-adhered flashing tape to the window flange and the air barrier.

3.2 FINAL CLEANING

A. Clean window frames and glass.
B. Remove labels and visible markings.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and field painting of the following surfaces of new items unless specified elsewhere to be prefinished. This includes pre-primed surfaces.
   1. Painting of all submerged surfaces.
   2. Painting of all exposed interior surfaces.
   3. Painting of all exposed exterior surfaces.

B. Painting of existing items:
   1. Existing floors, walls and ceilings to receive surface preparation and field painting are indicated on the drawings and in the specifications.
      a. All previously painted items located within floors, walls and ceilings indicated to be painted will also receive surface preparation and field painting.
   2. Any other existing items on the drawings or in this specification indicated to be painted will receive surface preparation and field painting.

C. This Section also includes:
   1. Piping runs above finished ceilings shall be considered exposed and shall be painted.
   2. Back prime, with specified interior first coat, all surfaces of wood finish and trim which will be concealed after installation.
   3. All surfaces of ferrous metal fabrications built into concrete and masonry shall be shop primed or receive a primer coat in accordance with this section. All surfaces exposed to view shall receive intermediate and finish coats.
   4. Pipe, pump and valve identification markers.
   5. Secondary containment coatings.
   6. Motors and equipment which are pre-finished shall receive an intermediate coat if required for compatibility between shop coat and field applied finish coat and shall receive one finish coat to provide a color matching the system color indicated in the pipe identification schedule.
   7. Load rating identification markings for monorails and lifting hooks.
   8. Paint all items modified or relocated in the existing facility.

D. Definitions:
   1. Submerged surfaces are defined as:
      a. Those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3-feet above the maximum water surface for uncovered tanks.
      b. All surfaces contained within covered tanks.
      c. The full height of all partially submerged items such as sluice, slide and weir gates, piping, etc.
      d. All surfaces contained within underground vaults, structures and manholes such as valve pits, dry wells, etc.

2. Exposed interior surfaces shall be non-submerged surfaces exposed to view that are enclosed and/or protected in such a manner that they cannot be exposed to UV light or weather conditions.
3. Exposed exterior items shall be all other surfaces which don't fall under the definition of "submerged" or "exposed interior surfaces".
4. Sheen and gloss:
    a. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
    b. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
    c. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
    d. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
    e. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

E. Items not requiring surface preparation and field painting under this section:
1. Items and equipment that are specifically specified to receive the manufacturer's standard primer and finish coats in the factory, except as noted for color and touch-up painting.
2. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals (unless otherwise noted).
3. Unprimed galvanized metals not indicated to be painted shall remain unfinished.
4. Face brick.
5. Concrete slabs and walls unless indicated elsewhere to be painted, stained, or receive secondary containment coatings.
6. Windows specified in Division 8.
7. Electrical conduit.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.
B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.
D. DASTM D6386 - Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Products for Painting
E. Federal Test Method No. 141 - Method 6141, Stain Removal.
F. ANSI A13.1 - Scheme for the Identification of Piping Systems.
G. SSPC - Steel Structures Painting Council.
H. SSPC-PA1, "Standard for Shop, Field, and Maintenance Painting."
I. SSPC-PA2, "Measurement of Dry Paint Thickness with Magnetic Gauges."

J. SSPC-SP1, “Solvent Cleaning.”
K. SSPC-SP2, “Hand Tool Cleaning.”
L. SSPC-SP3, “Power Tool Cleaning.”
M. SSPC-SP6, “Commercial Blast Cleaning.”
N. SSPC-SP7, "Brush Off Blast."
O. SSPC-SP10, “Near-White Blast Cleaning.”
P. SSPC-SP16, "Brush Blast Cleaning of Non Ferrous Metals"
Q. SSPC-PA Guide 3, Standard “A Guide to Safety in Paint Application,” latest revision.
R. VOC Standards - All coatings shall be in accordance with all applicable State and Federal VOC Standards.
    1. OSHA 29 CFR 1925.55 Gases, Vapors, Fumes, Dusts and Mists.
    2. Ozone Transportation Commission (OTC) 2005 VOC Regulation.
    3. 38 MRSA: Section 584A; Air Protection and Improvement Law.
S. OSHA 29 CFR 1926.62 Lead.
T. SSPC - Guide 61 (COH) Guide for Containing Debris Generated during Paint Removal Operations.
U. SSPC - Guide 71 (DIS) Guide for Disposal of Lead-Contaminated Surface Preparation Debris.
V. SSPC Publication 91-18 Industrial Lead Paint Removal Handbook.
W. USEPA 40 CFR Part 261 Identification and Listing of Hazardous Waste.
X. USEPA 40 CFR Part 262 Standards Applicable to Generators of Hazardous Waste.
Y. USEPA 40 CFR Part 263 Standards Applicable to Transporters of Hazardous Waste.
Z. USEPA 40 CFR Part 268 Land Disposal Restrictions.
AA. USDOT 49 CFR Parts 173, 178 and 179.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01340 including tested performance characteristics.
B. Submit manufacturer’s color chips showing the full range of colors available for each type of finish coat material specified.
C. Submit schedule on manufactures letter head with list of items to be coated, type and manufacturer of shop coating and type of field coating, including primers, details on surface preparation methods, application procedures and dry mil thickness.
D. Submit a letter from the manufacturer certifying that the products submitted are applicable for the applications indicated.
E. Submit coating manufacturer’s certification that the proposed coatings meet all state and federal VOC regulations.

1.5 QUALITY ASSURANCE

A. The Contractor shall obtain the services of a painting contractor with 5 years experience on similar projects.

B. All materials used on work shall be exactly as specified in brand and quality. No claim by the Contractor as to unsuitability or unavailability of any material specified, or their unwillingness to use same, or their inability to produce first class work with same, will be entertained unless such claims are made in writing and submitted to the Engineer.
C. Before purchasing materials for the work, the Contractor shall submit to the Engineer a list of the products they propose to use, and the list shall be reviewed by the Engineer with a status of no exceptions taken before commitment for materials is made.
D. Materials selected for coating systems for each type of surface shall be the products of a single manufacturer.
E. Include on label of all containers:
    1. Manufacturer's name
    2. Type of paint
    3. Manufacturer's stock number
    4. Color
    5. Instructions for reducing, where applicable
    6. Label analysis
    7. Shelf life dates
F. Field Quality Control:
    1. Contractor shall request review by the Engineer, of first finished room, space or item of each color, texture and method of applications, prior to proceeding with additional painting.
    2. Use first acceptable room, space or item as the project standard for each color scheme.
    3. For spray application, when applicable, paint a surface not smaller than 100 square feet as the project standard.
    4. Repainting of materials failing to meet the requirements of the Specifications or Drawings, shall be performed by the Contractor, at no additional cost to the Owner.
    5. The number of coats and total mil thickness specified in the paint schedule are minimums. If the specified minimum film thickness is not achieved, additional coats shall be applied to achieve the total film thickness specified.
G. Paints submitted shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance, and be in accordance with OTC 2005 Standards.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver coating materials in sealed containers with labels legible and intact.
B. Store only acceptable project materials on the project site.
C. All painting materials shall be stored and mixed in a single location coordinated with the Engineer. The Contractor shall not use any plumbing fixture or pipe for mixing or for disposal of any refuse. The Contractor shall carry all necessary water to the mixing room, and shall dispose of all waste outside of the building in a suitable receptacle.
D. Restrict storage location to paint materials and related equipment and supplies.
E. Keep storage location neat and clean.

F. Remove all soiled and used rags, waste and trash from the storage location and building at the end of each work day.
G. Repair all damage to the storage location, caused by painting materials and equipment at no additional cost to the Owner.
H. Comply with all applicable health and fire codes and regulations including safety precautions recommended by the manufacturer. Storage space shall be provided with a suitable fire extinguisher fully charged at all times.
I. Heat shall be provided in the storage area if paints are to be stored during winter months. The temperature shall be maintained above 40 degrees F at all times.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems shall be applied.
B. Do not apply coatings in areas where dust is being generated.
C. Do not apply coatings when the air or material surface temperature is below 50 degrees Fahrenheit and unless the temperature is at least 5 degrees Fahrenheit above the dew point.
D. Do not apply interior coatings until building is weather tight and conditioned.
E. Do not apply exterior coatings in frosty, damp or rainy weather or while surfaces are exposed to hot sunlight.

1.8 EXTRA MATERIALS

A. For all materials with a shelf life of greater than 12 months, provide one gallon of each type and each color of touch-up paint shall be provided to the Owner by the Contractor in unopened containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. PPG
B. Sherwin Williams
C. Tnemec Company, Inc.
D. Or equal

2.2 MATERIALS

A. Refer to the paint schedule in Part 3 for specific products and application.

2.3 COMPONENTS

A. All finish coats shall be compatible with shop prime coats.
B. Turpentine shall be pure spirits of turpentine.
C. Shellac shall be four pounds and shall meet the U.S. Government specifications as issued by the Bureau of Commerce.
D. When items are primed in the mill or shop as part of the painting contract, use the materials specified in every case for such surfaces and use in accordance with manufacturer's directions for first or priming coat.

2.4 MIXING AND TINTING

A. Deliver paints and enamels ready-mixed to project site.
B. Accomplish job mixing and job tinting only when required.
C. Mix only in mixing pails placed in suitably sized nonferrous or oxide resistant metal pans.
D. Use only tinting colors recommended by the manufacturer for the specific type of finish.
E. Fungicidal agents, when applicable, shall be incorporated into the paints and stains by the manufacturer.
F. Mix and prepare paints in strict accordance with Manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence or quality of work and which cannot be put into an acceptable condition through preparatory work as included in Part 3.2, Surface Preparation.
B. Immediately notify the Engineer in writing when a surface to be finished cannot be put into an acceptable condition.
C. Do not proceed with surface preparation or coating application until conditions are suitable.
D. The Contractor shall be responsible for and shall rectify, at no additional cost to the Owner any unsatisfactory finish resulting from the application of coatings on surfaces not in acceptable condition.

3.2 SURFACE PREPARATION

A. At a minimum, all surfaces must be prepared and cleaned in accordance with the manufactures written specifications and pertaining to the intended substrate to be coated. The contractor must be fully read and understand all of these requirements and all other required product recommendations prior to commencing any work.
B. Wood and Plywood to be Painted:
    1. Clean soiled surfaces.
    2. Except when rough surface is specified, sand to smooth and even surface, then dust off.
    3. Apply shellac to all knots, pitch and resinous sapwood after washing with mineral spirits and, before priming coat is applied.
    4. Fill nail holes, cracks, open joints and other defects with paste wood filler before priming coat surface and color to match finish color. When wood filler is applied on open grain wood, allow the grain to secure a smooth, clean surface.
    5. Tint filler to match finished wood to be stained.
C. Concrete and Masonry:
    1. Clean all dust, dirt, oil and efflorescence from surfaces.
    2. Repair cracks and concrete defects in accordance with Specification Section 03346 prior to installing coating system. Finished concrete surface to have a smooth, uniform texture.

3. Etch dense and smooth concrete, or concrete that has had a hardener applied, with a five percent solution (by weight) of muriatic acid.
4. Ensure concrete masonry units have a smooth, uniform texture and are free of voids and bug holes in the surface prior to installing coating systems.
5. Fill concrete masonry unit surfaces with block fillerin sufficient thickness to produce a final result which shall fill all voids and pin holes.
6. Allow surfaces to thoroughly dry prior to application of first coat.

D. Ferrous Metal Surfaces (Items not shop primed):
1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP10 immediately prior to priming.
2. All other ferrous metals shall be sandblast cleaned in accordance to SSPC-SP6 immediately prior to priming.
3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
5. Feather edges of sound existing paint by grinding, if necessary.
6. Clean and touch up weathered, worn or damaged shop coats of paint with the specified primer.
7. Restore shop coats of paint with identical materials if removed for welding and fabrication.

E. Galvanized metals indicated to be painted:
1. Solvent clean in accordance with ASTM D6386.
2. Surfaces shall receive SSPC-SP-16 and shall be surfaced prepared in accordance with ASTM D6386.
3. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
4. Restore shop coats of paint with identical materials if removed for welding and fabrication.

F. Previously Coated Surfaces (including existing items and new items that are shop primed):
1. The areas of the coated surface that are blistered, eroded, brittle or otherwise failed shall be completely removed before beginning the specified surface preparation.
2. The areas where the existing coating is intact shall be sanded to dull the finish.
3. Before applying the new coating over an existing coating, a test section must be done to ensure compatibility of the new and old coatings.
4. All other existing coatings shall be prepared as recommended by the manufacturer and as specified in this section.
5. Ferrous metals arriving at the job site with shop primers other than the polyamide epoxy or rust inhibitive primers specified shall be provided with an intermediate coat as necessary for compatibility with specified topcoats.
6. Special attention shall be paid to the potential for epoxy shop and intermediate coats to chalk upon exposure to sunlight. The Contractor shall follow the manufacturer's required surface protection/covering and surface preparation recommendations before any intermediate or top coats can be applied over chalked surface. Epoxy primers and intermediate coats shall be top coated no

later than 45 days after the application of the epoxy coating. If topcoats are to be applied later than 45 days, the following surface preparation shall be provided:

a. The existing finish shall be etched by sanding with 80 grit paper or cloth.
b. Surfaces shall be pressure washed with 3000 to 5000 pounds of pressure.
c. The Engineer, at their discretion, can require the Contractor to conduct adhesion tests of the topcoats.

7. The following shall be the minimum surface preparatory for existing surfaces that are to be painted, unless indicated otherwise:
   a. Existing submerged ferrous metals.
      i. Clean
      ii. Sandblast in accordance with SSPC-SP10.
   b. Non-submerged ferrous metals.
      i. Clean
      ii. Sandblast in accordance with SSPC-SP6.
   c. Existing Concrete and Masonry
      i. Clean
      ii. Scrape existing paint to a sound surface.
      iii. Sand with 80 grit paper or cloth to provide anchor profile for new coating.
      iv. Pressure wash all existing epoxy coated surfaces.

3.3 APPLICATION

A. Workmanship:
   1. Employ skilled workmen to insure workmanship of the highest quality.
   2. Materials shall be applied only by craftsmen experienced in the use of the specific products involved.

B. General Requirements:
   1. Apply all coatings under adequate illumination.
   2. Perform no work in the rain, dew, or fog, when the temperature is below 50 degrees Fahrenheit and at least 5 degrees Fahrenheit above the dew point, or before the other coats have thoroughly dried.
   3. Do not apply coatings until the material surfaces are thoroughly dry.
   4. Apply coatings with suitable brushes, rollers or spraying equipment.
      a. The rate of application shall not exceed that as recommended by the coating manufacturer for the surface involved.
      b. Keep brushes, rollers and spraying equipment clean, dry and free from contaminates and suitable for the finish required.
      c. Make each coat a different tint from that of the preceding coat, with final coat tinted to the exact shade selected by the Engineer. Lightly sand surfaces between each coat of gloss and semi-gloss finishes, and wipe clean.
   5. Comply with the recommendation of the product manufacturer for drying time between succeeding coats. Contractor shall follow the manufacturer’s specific curing requirements for rust inhibitive primer shop coats prior to allowing top coating.

6. Sand and dust between each coat to remove defects visible from a distance of five feet.
7. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and skipped or missed areas.
8. Do not apply finish coats to hollow metal doors and frames until after glazing has been installed.
9. Inspection:
    a. Do not apply additional coats until the completed coat has been inspected by the Engineer.
    b. Only inspected and reviewed coats will be considered in determining the number of coats applied.
10. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.
11. Make edges of coatings adjoining other materials or colors clean and sharp with no overlapping.
12. Apply primer on all work before glazing.
13. Refinish entire wall where portion of finish has been damaged or is not acceptable.
14. Runs on face are not permitted.

3.4 PROTECTION

A. Furnish and lay drop cloths in all rooms and areas where painting and finishing is being done to adequately protect flooring and other work from damage during the prosecution of the painting work.
B. Remove all canopies of lighting fixtures, all electric switch plates, and similar equipment, set them carefully away, and cover adequately, protect the fixtures, etc.; replace the canopies, plate, etc. in as good condition as when found.
C. Do not paint over any code-required labels, such as Underwriter's Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
D. Correct and refinish all interior and exterior surfaces in the existing facility affected by the new work. Materials and their application shall be as required to most closely match the existing finishes and as specified in this Section.

3.5 CLEANING

A. At the completion of the work of this Section, remove all paint spots and oil or grease stains, caused by this work from floors, walls, fixtures, hardware and equipment, leaving their finishes in a satisfactory condition. Remove all materials and debris and leave the site of the work in a clean condition so far as this work is concerned.

3.6 FINAL INSPECTION

A. Protect all painted and finished surfaces against damage until the date of final acceptance of the work. The Engineer will conduct a final inspection of all painters' work. As part of the final inspection the Contractor shall demonstrate compliance with the specified film thickness with appropriate paint gauges. The Contractor shall be required to repaint, refinish, or retouch any areas found which do not comply with the requirements of this Section.

3.7 LOAD RATING IDENTIFICATIONS

A. Provide markings indicating the load rating of all hoists, monorails and lifting hooks.
B. Markings shall be 3-inches high stenciled letters painted adjacent to the item in a color contrasting the background color.

3.8 PAINT SCHEDULE, GENERAL

A. The following product model and coatings system numbers are listed below to establish the standard of quality. Equivalent products from other manufactures will be accepted provided they meet or exceed the performance of the listed products.
B. Surface preparation shall be as specified within this specification section, as noted below and as required per manufacturer recommendations.
C. When applying coats over epoxy coatings that have been in place for more than 45 days, prepare surface in accordance with the "Surface Preparation" section of this specification.
D. When applying coats over previously painted items in an existing facility, verify the products specified below are compatible with the existing coatings. If specified coatings are not compatible, prepare surface in accordance with the "Surface Preparation" section of this specification and provide a bonding primer that is compatible with the existing and specified coatings.
E. All film thicknesses are listed as dry film thicknesses and are the minimum required.

3.9 PAINT SCHEDULE, SHOP FINISHED ITEMS

A. For shop coated items specified to receive field coats, contractor to verify if proposed field coatings are compatible with shop coatings and provide a letter of findings to Architect for review prior to field coats.
B. If field coatings are not compatible with the shop coatings, contractor to provide to a letter to Architect from the painting manufacturer listing an intermediate coat that is compatible with the shop coatings and the finish coat specified below.
C. For items delivered to the site with a shop primer, the primer coat specified below is not required if the finish coats specified below are compatible with the shop primer otherwise the intermediate coat approved by the manufacturer is required prior to the finish coat.
D. For items delivered to the site prefinished and requiring a finish coat in the field for color, if the finish coat specified below is not compatible with the prefinished coat, the intermediate coat approved by the manufacturer is required prior to the finish coat.
E. Shop primed hollow metal doors and frames shall receive the primer coat listed below, regardless of compatibility.

3.10 PAINT SCHEDULE, ARCHITECTURAL COATINGS

A. General: This section covers painting of architectural items including but not limited to, walls, floors, ceilings, hollow metal doors and frames, wood trim, PVC trim, etc.
B. Masonry Surfaces: 2 finish coats over a primer.
    1. Surface Preparation: Clean and Dry
    2. Primer:
        a. Tnemec: Series 130 Envirofill at 100 SF/Gallon
        b. Sherwin-Williams: Heavy Duty Block Filler at 8 to 10.5 mils
        c. PPG: Speedhide Block Filler

3. Two Finish Coats, eggshell or satin:
    a. Tnemec: Series 1028/1029 Enduratone at 2 to 3 mils
    b. Sherwin-Williams: Pro Industrial Acrylic Coating at 3 to 4 mils
    c. PPG: Pitt-Tech Plus EP DTM Acrylic at 3 to 4 mils

C. Concrete Floors: 2 finish coats over a primer.
1. Surface Preparation: Clean, Dry and Surface Grind
2. Primer:
    a. Tnemec: 201 Epoxoprime at 6 to 8 mils
    b. Sherwin-Williams: ArmorSeal 8100 Water Based Epoxy Floor Coating at 2 to 4 mils
    c. PPG: MegaSeal HSPC
3. Two Finish Coats:
    a. Tnemec: 281 Tnemec-Glaze at 8 to 12 mils
    b. Sherwin-Williams: ArmorSeal 8100 Water Based Epoxy Floor Coating at 2 to 4 mils
    c. PPG: MegaSeal SL at 10 to 12 mils

D. Metals: Metal items including but not limited to hollow metal doors and frames, steel bollards, etc., 2 finish coats over a primer.
1. Surface Preparation: Per Manufacturer's Specifications
2. Primer:
    a. Tnemec: Series 1 Omnithane Gray at 2.5 to 3 mils
    b. Sherwin-Williams: Pro Insdustrial Pro-Cryl Universal Acrylic Primer at 3 mils
    c. PPG: Pitt-Tech Plus EP Acrylic Primer at 2 to 4 mils
3. Two Finish Coats, semigloss:
    a. Tnemec: Series 1028/1029 Enduratone at 2 to 3 mils
    b. Sherwin-Williams: Pro Industrial Acrylic Coating at 3 to 4 mils
    c. PPG: Pitt-Tech Plus EP DTM Acrylic at 3 to 4 mils

E. Electrical Conduit: Painting of surface mounted electrical conduit exposed to view.
1. Conduit Painting Schedule:
    a. Electrical Room: Not painted.
    b. Above Finish Ceiling: Not painted.
    c. All Other Rooms and Areas: Painted.
2. Same color and finish as surface conduit is mounted to.

F. Galvanized metal fabrications built into concrete and masonry: Items including but not limited to steel beams, plates, etc., 1 primer coat on surfaces in contact with concrete or masonry.
1. Surface Preparation: ASTM D6386 Solvent Cleaning Followed by SSPC-SP16
2. Primer:
    a. Tnemec: Series 1 Omnithane Gray at 2.5 to 3 mils
    b. Sherwin-Williams: SW Recoatable Epoxy Primer at 4 to 6 mils
    c. PPG: Durathane MCZ

G. Exterior Wood Trim and Other Exterior Softwood: 2 finish coats over a primer.
1. Surface Preparation: Clean & Dry - Scuffed Up with Medium Grit Sandpaper
2. Primer:
    a. Tnemec: Tnemec 151-1051 Elasto Grip FC at 2 to 3 mils
    b. Sherwin-Williams: Exterior Latex Wall and Wood Primer at 1.4 mils

c. PPG: PPG Seal Grip Gripper Acrylic Primer 17-921 XI Series

3. Two Finish Coats, satin:
   a. Tnemec: Series 1028/1029 Enduratone at 2 to 3 mils
   b. Sherwin-Williams: Pro Industrial Acrylic Coating at 3 to 4 mils
   c. PPG: Pitt-Tech Plus EP DTM Acrylic at 3 to 4 mils

H. PVC Trim: 2 finish coats over a primer.
1. Surface Preparation: Clean & Dry
2. Primer:
   a. Tnemec: Tnemec 151-1051 Elasto Grip FC at 1.5 mils
   b. Sherwin-Williams: Multi-Purpose Interior-Exterior Latex Primer-Sealer
   c. PPG: PPG Seal Grip Gripper Acrylic primer 90-1710 XI Series
3. Two Finish Coats, satin:
   a. Tnemec: Series 1028/1029 Enduratone at 2 to 3 mils
   b. Sherwin-Williams: Pro Industrial Acrylic at 3 to 4 mils
   c. PPG: PPG: Pitt-Tech Plus EP DTM Acrylic at 3 to 4 mils

3.11 PAINTING SCHEDULE, INDUSTRIAL COATINGS

A. General: This section covers painting of the piping and equipment systems including but not limited to, valves, levers, valve handles, fittings, stands, supports, hangers, pumps, motors and appurtenances.

B. Finish: Unless otherwise noted, finish of all industrial coatings is gloss.

C. Metals in high H2S environments: Process piping and equipment systems located in wet well and wet well entrance.
1. Surface Preparation: SSPC-SP10 Near White Metal Blast Cleaning
2. Primer and Finish Coats:
   a. Tnemec: 3 coats Series 104 HS Epoxy 11 at 6 to 10 mils
   b. Sherwin-Williams: 2 coats SW Sher-Glass FF Epoxy at 8 to 10 mils
   c. PPG: 2 coats Sigmashield 880 at 12-16 mils

D. All portions of submerged metals subjected to UV Exposure: Provide 1 additional finish coat as indicated in this section in addition to the primer coat and 2 finish coats specified.
1. Finish Coat:
   a. Tnemec: Series 1095 Endura-shield at 3 to 4 mils
   b. Sherwin-Williams: Hi-Solids Polyurethane 250 at 3 to 4 mils
   c. PPG: Pitthane Ultra 95-812 Series

E. Weather Exposed Ferrous Metal Piping and Equipment: Two finish coats over a primer.
1. Surface Preparation: Per Manufacturer’s Specifications
2. Primer:
   a. Tnemec: Series V69 Tneme-Epoxoline 11 at 3 to 5 mils
   b. Sherwin-Williams: Macropoxy 646 Epoxy at 5.0 –6.0 mils
   c. PPG: Amerlock 2/400
3. Two Finish Coats:
   a. Tnemec: Series 1095 Endura-shield at 3 to 4 mils
   b. Sherwin-Williams: Hi-Solids Polyurethane 250 at 3 to 4 mils
   c. PPG: Pitthane Ultra 95-812 Series

F. Plastic Clad Insulated Pipe: One finish coat over a primer.
   1. Surface Preparation: Clean & Dry
   2. Primer:
      a. Tnemec: Series 151-1051 Elasto-Grip at 1.0 to 1.5 mil
      b. Sherwin-Williams: Multi-Purpose Interior-Exterior Latex Primer-Sealer
      c. PPG: Seal Grip Gripper 17-921 XI Series
   3. Finish Coat:
      a. Tnemec: Series 1028/1029 Enduratone at 2 to 3 mils
      b. Sherwin-Williams: Pro Industrial Acrylic Coating at 3 to 4 mils
      c. PPG: Pitt-Tech Plus EP DTM Acrylic at 3 to 4 mils

G. PVC Pipe and PVC Conduit: One finish coat over a primer.
   1. Surface Preparation: Clean & Dry - Scuffed Up with Medium Grit Sandpaper
   2. Primer:
      a. Tnemec: Series 151-1051 Elasto-Grip at 1.0 to 1.5 mils
      b. Sherwin-Williams: Multi-Purpose Interior-Exterior Latex Primer-Sealer
      c. PPG: Seal Grip Gripper 17-921 XI Series
   3. Finish Coat:
      a. Tnemec: Series 1028/1029 Enduratone at 2 to 3 mils
      b. Sherwin-Williams: Pro Industrial Acrylic Coating at 3 to 4 mils
      c. PPG: Pitt-Tech Plus EP DTM Acrylic at 3 to 4 mils

3.12 PIPING IDENTIFICATION SCHEDULE

A. Pipe Coating
   1. All pipes, whether concealed or exposed to view shall be painted a separate color.
   2. Colors to be as scheduled in the PIPE IDENTIFICATION SCHEDULE below or as otherwise directed by the Engineer.
   3. Pipe supports consisting of pipe rings, clamps, clevises, U bolts, pipe rollers, saddles, etc., shall be painted with the same color as that of the pipe.
   4. Wall supported pipe hangers consisting of brackets, standoffs, etc., shall be painted with the same color as that of the wall.
   5. Ceiling/roof supported pipe hangers consisting of thread rods, beam clamps, etc., shall be painted with the same color as that of the ceiling.
   6. Floor supported pipes consisting of stanchions shall be painted with same color as that of the pipe.

B. Pipe Markers
   1. All pipes shall be labeled with pipe markers.
   2. Markers shall be corrosion resistant laminated plastic bound to the pipes with nylon fasteners or shall be "coil-fit." Stickers are not acceptable. Markers and flow direction indicators shall be manufactured by Seton, Brimar Industries, or equivalent.
   3. Pipes with diameters less than 1-1/4 inch shall have marker hung from pipe with nylon fasteners.
   4. Lettering size shall be in accordance with the following:

SIZE OF LEGEND LETTERS

Outside Diameter of Pipe or Covering	Minimum Length of Marker	Size of Letters
In	In	In
Up to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

5. Adjacent to each marker there shall be an arrow indicating flow direction.
6. Marker location shall be in accordance with the American National Standard Institute Scheme for Identification of Piping Systems (ANSI A13.1). Markers shall be placed adjacent to all valves and/or flanges; adjacent to all changes in direction on all pipe branches; and where all pipes pass through walls or floors on each side of wall/floor. On straight runs of piping, markers shall be placed at no less than 10 foot intervals. Where pipes are located above or below the normal line of vision, the lettering shall be placed below or above (as appropriate) the horizontal centerline of the pipe.
7. Color of markers shall be as scheduled in the PIPE IDENTIFICATION SCHEDULE below or as otherwise directed by the Engineer.

C. Valve Status Indication Arrows
1. Valve status indicator alignment arrows shall be provided on the indicator and scale sides of all interior hand wheel, chain and lever operated valves. Arrow heads shall appear aligned when the valve is in the full-open position. Arrow heads shall be painted on with stencils, or a color contrasting with the color of the valve. Arrow heads shall be minimum of 3/4-inch in smallest dimension. Valve position indicators shall be aligned to be visible from normal working levels.

D. Refer to Specification Sections 11000, 15100, 15400 and 15600 for Equipment and Valve Identification requirements.

PIPE IDENTIFICATION SCHEDULE

SYSTEM NAME/ MARKING	TAG	PIPE COLOR (1)	PIPE MARKERS (2)
Water			
Cold Potable Water	CW	Lt. Blue	White on Green
Hot Potable Water	HW	Lt. Blue	White on Green
Process Liquid - Wastewater			
Forcemain	FM	Dark Gray	White on Green
Domestic Wastewater			
Sump Pump Discharge	SPD	Black	White on Green

NOTES:
(1) Stainless steel piping shall not be painted, but shall receive the pipe markings indicated.
(2) Pipe markers colors notations are defined as follows (ANSI/ASME A13.1):
White on Red = White lettering on Safety Red background (fire quenching fluids)
Black on Orange = Black lettering on Safety Orange background (toxic or corrosive fluids)

Black on Yellow = Black lettering on Safety Yellow background (flammable and oxidizing fluids)
White on Brown = White lettering on Safety Brown background (combustible fluids)
White on Green = White lettering on Safety Green background (potable, cooling, boiler and other waters)
White on Blue = White lettering on Safety Blue background (compressed air)
White on Purple = White lettering on Safety Purple background (user defined – irritant)
Black on White = Black lettering on Safety White background (user defined)
White on Grey = White lettering on Safety Grey background (user defined - residuals)
White on Black = White lettering on Safety Black background (user defined)

END OF SECTION

SECTION 09905

SHOP COATINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation and application of shop coatings on materials, equipment, and piping indicated in the various specification sections relating thereto, and as specified herein, including primers and topcoats for materials, equipment and piping that are finished at the point of manufacturer or fabrication.

B. Examine the various Sections of the Specifications and be thoroughly familiar with all provisions regarding shop coatings.

1.2 PREFINISHED ITEMS NOT REQUIRING PAINT OR FINISH

A. Copper, bronze, brass, chromium plate, nickel, stainless steel, aluminum or monel metals, except surfaces in contact with or embedded within concrete or masonry, unless otherwise specified elsewhere.

1.3 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.4 REFERENCES

A. ASTM D2247 - Practice for Testing Water Resistance of Coatings in 100 Percent Relative Humidity.

B. ASTM D 2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

C. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

D. Federal Test Method No. 141 - Method 6141, Stain Removal.

E. SSPC - Steel Structures Painting Council.

F. SSPC-PA1, “Standard for Shop, Field, and Maintenance Painting”.

G. SSPC-PA2, “Measurement of Dry Paint Thickness with Magnetic Gauges”.

H. SSPC-SP1, “Solvent Cleaning”.

I. SSPC-SP6, “Commercial Blast Cleaning”.

J. SSPC-SP10, “Near-White Blast Cleaning”.

K. SSPC-SP16, "Brush Blast Cleaning of Non Ferrous Metals"

L. SSPC-PA Guide 3, Standard “A Guide to Safety in Paint Application”, latest revision.

1.5 SUBMITTALS

A. Submit product data under provisions of Section 01340.

B. As a minimum, the following shall be included in the submittal package for all items, products, material or equipment, as specified.

1. Submit data on the proposed shop coatings, details on surface preparation methods, application procedures and dry mil thickness.
2. Submit a minimum of three (3) color charts for all factory top coats for color selection by Engineer.

3. Submit coating manufacturer's certification that the proposed shop coatings are applicable for the applications indicated.
4. Submit coating manufacturer's certification that proposed shop coatings are compatible with field coatings, as specified in Section 09900.
5. For potable water applications, submit coating manufacturer's certification that the proposed shop coatings comply with ANSI/NSF Standard 61.

1.6 QUALITY ASSURANCE

A. All Shop Coatings shall meet the requirements of the materials section and shall be guaranteed by the manufacturer to be compatible with the field coatings, as specified in Section 09900. The Contractor shall coordinate this requirement during the Shop Drawing Phase.
B. All Shop Coatings shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) compliance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Part 3 - EXECUTION for specific products and applications.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Definitions
   1. Submerged surfaces are defined as:
      a. Those surfaces which are below the maximum water surface level as indicated on the drawings, and/or extend 3'-0" above the maximum water surface for uncovered tanks.
      b. All surfaces contained within covered tanks.
      c. The full height of all partially submerged items such as sluice gates, slide gates, weir gates, piping, etc.
      d. All surfaces contained within underground structures, vaults and manholes such as valve pits, drywells, etc.
   2. Enclosed surfaces are those non-submerged surfaces enclosed and/or protected within a building in such a manner that it cannot be exposed to UV light or weather conditions.
   3. Weather exposed surfaces are all other conditions including buried items which do not fall into the definition of submerged or enclosed surfaces, as noted above.
B. Ferrous Metal
   1. All submerged ferrous metals shall be sandblast cleaned in accordance to SSPC-SP10, near white, immediately prior to priming.
   2. All other ferrous metals, Enclosed and Weather exposed surfaces, shall be sandblast cleaned in accordance to SSPC-SP6, commercial grade, immediately prior to priming.
   3. Remove dirt, oil and grease by washing surfaces with mineral spirits.
   4. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.

C. Galvanized Metal (nonferrous metals indicated to be painted):
   1. Solvent clean in accordance with ASTM D6386.
   2. Surfaces shall receive SSPC-SP-16 and shall be surfaced prepared in accordance with ASTM D6386.
   3. Surfaces shall be dry and free of dust, oil, grease and other foreign material before priming.
   4. Restore shop coats of paint with identical materials if removed for welding and fabrication.

3.2 APPLICATION

A. Equipment
   1. Motors, speed reducers and similar parts shall have a surface preparation in accordance with the manufacturer standard coating requirements and suitable for weather exposed use. The minimum coating system shall be 3 coats of polyamide epoxy at a minimum of 3 mils per coat. Other coatings must be approved by the Engineer.
   2. Items finished at the point of manufacture (shop primed and painted), such as submersible pumps and other similar surfaces, shall receive manufacturer's standard coating of baked, powder epoxy enamel, suitable for the intended service.
   3. All equipment casing openings requiring protection shall have a water repellent tape and vapor phase inhibitor treated paper.
   4. All other ferrous surfaces shall be factory primed except ferrous surfaces obviously not to be painted such as gears, exposed machined or bearing surfaces, enclosed machined or bearing surfaces, lubricated contact surfaces moving under load, thread connections to be field connected and other similar items. Surfaces not to be painted shall be given a heavy shop coat of grease or other suitable rust resistant coating per manufacturer's recommendations. The minimum priming system shall be a coat of a single component metal primer with good corrosion and rust protection, rated for exterior exposure and with ability to be topcoated with acrylics, epoxies and urethanes.
   5. These coatings shall be maintained as necessary to prevent corrosion during all periods of storage and erection, until final acceptance by the Owner.

B. Pipe, Fittings and Valves
   1. The exterior surfaces of all ductile iron pipe and fittings buried shall receive the standard factory applied asphaltic coating (in accordance with AWWA C151).
   2. The exterior surfaces of buried valves and miscellaneous piping appurtenances shall be prepared in accordance with the manufacturer's recommendations and at a minimum shall receive a shop coat of fusion bonded epoxy coating.
   3. The exterior surfaces of ductile iron pipe, fittings and valves submerged, enclosed or weather exposed shall receive a factory applied shop primer. The minimum priming system shall be a coat of a single component metal primer with good corrosion and rust protection, rated for exterior exposure and with ability to be topcoated with acrylics, epoxies and urethanes.
   4. Machined surfaces shall be cleaned and coated immediately after being machined, with a suitable rust resistant coating per manufacturer's recommendations.

5. All other ferrous surfaces shall be factory primed except ferrous surfaces obviously not to be painted. Ferrous surfaces not to be painted shall receive a heavy shop coat of grease or other suitable rust resistant coating per manufacturer's recommendations. The minimum priming system shall be a coat of a single component metal primer with good corrosion and rust protection, rated for exterior exposure and with ability to be topcoated with acrylics, epoxies and urethanes.
6. These coatings shall be maintained as necessary to prevent corrosion during all periods of storage and erection until final acceptance by the owner.

END OF SECTION

SECTION 10140

SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Safety Signage

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 SUBMITTALS

A. Submit product data under provisions of Section 01340.
B. Submit manufacturer's catalogs and data sheets including complete installation details showing proposed anchorage to surrounding materials.
C. Submit manufacturer's standard color chips of prefinished items from manufacturer’s full range of colors, for selection by the Engineer.
D. Submit a schedule listing each location a sign is required and graphic view of each sign for review.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver items in manufacturer's original unopened protective packaging.
B. Store material in original protective packaging to prevent soiling, physical damage or wetting.
C. Handle so as to prevent damage to finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Compliance Signs
B. Emedco
C. Seton
D. Or equal

2.2 SAFETY SIGNAGE

A. Signs shall be rigid plastic, .060 inch thick, rated for exterior use.
    1. The graphics and/or letters shall have the background standard with the manufacture.
B. Safety signs shall be 14” wide by 12” high with wording as indicated in the schedule. The first line shall be of a different color or highlighted in such a way to stand out with letters at least 1¾” high. The remaining message to have letters that are at least 1” high.
C. Provide signs at locations and worded as listed below.

Location	Words/Symbol
At all hatches	DANGER DO NOT LEAVE OPENING UNGUARDED

PART 3 - EXECUTION

3.1 INSTALLATION OF SIGNAGE

A. Install signage in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 11000

EQUIPMENT - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test all equipment specified herein and as shown on the Drawings.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
   1. Section 01010 – Summary of Work (construction sequencing requirements that affect number and duration of equipment startups and certifications)
   2. Section 01340 – Submittals
   3. Section 01600 – Delivery, Storage and Handling
   4. Section 01800 – Equipment Startup, Certification and Operator Training.
   5. Section 09905 – Surface Preparation and Shop Coatings

1.3 QUALITY ASSURANCE

A. Provide only equipment of proven reliability manufactured by reputable manufacturers.

B. Acceptable manufacturers are listed in each equipment item section in this Division and are intended to indicate the type and quality of materials expected. Refer to the General and Supplemental Conditions for the manner in which “or equals” and “substitutes” will be evaluated.

C. Certificates, patents, licenses or other required legalities, when applicable, are specified in each Section of this Division.

D. The Specifications and Drawings direct attention to certain required features and performance of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the equipment complete in all details and ready for operation for the intended purpose.

E. These Specifications are intended to provide standard equipment of a recognized manufacturer meeting all the requirements of the Specifications. Due to differences in such prefabricated equipment of various manufacturers, submit complete shop drawings, cut sheets, specifications, etc. to the Engineer to review for compliance with the Contract Documents prior to ordering any equipment. If the equipment differs materially from the dimensions given on the Drawings, submit complete drawings showing elevations, dimensions etc. for the installation. If Engineer's acceptance is obtained for alternate equipment, make any needed changes in the structures, piping or electrical systems necessary to accommodate the equipment at no additional cost to the Owner.

F. Workmanship shall be first class in all respects.

1.4 SUBMITTALS

A. Provide shop drawings and samples as specified in the General Conditions and Section 01340 of the Construction Contract. Equipment Systems Manufacturers shall integrate all required shop drawings into a common package.

B. Catalog Data: Submit manufacturer's literature and illustrations for all equipment to be installed, including dimensions, construction details, shop painting details, and materials by generic name.

C. Installation Instructions: Submit complete sets of manufacturer's instructions for each equipment item, including equipment storage requirements.

D. Complete Operation and Maintenance Manuals in compliance with Specification Section 01340.

E. Certificates: Submit manufacturer's certification that equipment, accessories and shop painting meet or exceed the Specification requirements. Submit equipment performance testing results as required by these specifications. Should the proposed equipment not comply with all the specification requirements, all deviations from the specification requirements shall be listed.

F. Submit all requirements for interface with controls and/or equipment furnished in Divisions 13 and 16. Submit wiring diagrams as required to accurately depict all such interface requirements to ensure proper operations of each system or item of equipment.

G. Provide certified bearing life calculations on all equipment bearings.

H. Specific submittal requirements may be defined in individual sections in this Division.

I. Guarantees/Warranties as specified below.

J. Attention is directed to the fact that the Drawings are based upon a particular piece of equipment.

1. If the equipment to be provided requires an arrangement differing from that indicated on the Contract Drawings, the Contractor shall prepare and submit for review, detailed mechanical drawings showing all necessary changes. Such changes shall be at no additional cost to the Owner.

K. Contractor shall provide a Submittal Certification from each individual Equipment Manufacturer certifying that the Equipment Manufacturer has:

1. Reviewed the Contract Documents, the intended installation by the Contractor, and the intended functional and operational conditions;
2. Determined all conditions to be acceptable; and
3. Found no conditions which would cause the warranty to be void; or the equipment to function improperly, or not meet the performance requirements.

The submittals will not be reviewed without the inclusion of these noted certifications. Process Equipment Manufacturer Submittal Certification Form is provided in Section 01340.

L. Proposed equipment/valve identification tag information.

1.5 GUARANTEE/WARRANTIES

A. The Contractor shall provide the Owner with a Guarantee/ Warranty for the entire project in accordance with Article 7.17 (Contractor's General Warranty and Guarantee) and Article 15.08 (Correction Period), and as referenced, of the General

Conditions (Section 00700) No shop drawings submittals are required for this item.

B. Any specified extended warranties (i.e. those which run longer than the Contract Correction/ Warranty Period) shall be prepared in the name of the Owner and shall become effective after the completion of the Correction/ Warranty Period. The Contractor will be required to handle warranty problems during the Correction/ Warranty Period. Extended warranties shall meet the requirements specified in the relevant Section. Proposed extended warranty language shall be submitted to the Engineer for review as a part of the Shop Drawing process.

C. Equipment that is supplied by a system supplier and is intended to function as a complete and integrated system shall be warranted accordingly.

D. Any part of a mechanical equipment system that shows undue or excessive wear, or that fails due to normal operational conditions during the Correction/ Warranty Period, shall be considered as evidence of defective material or defective workmanship, and it shall be replaced with equipment or parts to meet the specified requirements at no cost to the Owner.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 01600 for additional requirements.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN OF EQUIPMENT

A. All parts and components of mechanical equipment shall be designed for satisfactory service under continuous duty without undo wear under the specified operating conditions.

B. All parts of mechanical equipment shall be amply proportioned for all stresses which may occur during operations, and for any additional stresses which may occur during fabrication and erection. Iron castings shall be tough, close-grained gray iron casting, Class 30, in accordance with ASTM A48, latest revision. Structural steel shall conform to ASTM A36.

C. Mechanical equipment, including drives and electrical motors, unless otherwise noted, shall be supplied and installed in accordance with Occupational Safety and Health Act (OSHA) requirements. The Contractor's attention is drawn to the requirements for equipment guards. The noise level of equipment, drives and motors, unless otherwise noted, shall not exceed 90 dBA measured 3 feet from the unit under free field conditions.

D. All equipment and machinery furnished under this Contract shall be the latest improved design suitable for the service specified. All equipment and machinery shall be designed and constructed to operate efficiently, continuously and quietly under the specified requirements with a minimum of maintenance, renewals and repairs. The design and construction of all equipment and machinery shall be such as to permit operation with minimum wear, vibration and noise when properly installed.

E. Ample room for erecting, repairing, inspecting and adjusting of all equipment and machinery shall be provided. The design, construction and installation of all equipment and machinery shall conform to and comply with the latest safety codes and regulations.

F. All equipment of identical size, type and service shall be the product of the same

manufacturer.

G. All equipment selected shall suit the general arrangement of the space in which it is to be installed.

H. Unless otherwise specified, electrical SCR controller units shall be furnished with the driven equipment, mounted and factory aligned, where applicable. Wiring of motors and controls shall be in accordance with the requirements of Division 16 and other applicable portions of the Specifications. Electrical variable frequency drives shall be furnished and installed by the electrical contractor, unless otherwise noted as specified in Division 16.

I. Suitable provisions shall be made for easy access for service and replacement parts.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.

B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be galvanized unless otherwise indicated below or specified elsewhere.

1. Galvanized steel unless otherwise indicated below or specified elsewhere.
2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications, including but not limited to the wetwells. For additional description and definition of submerged surfaces refer to Specification Section 09900.

C. Expansion bolts shall have malleable iron and lead composition elements of the required number of units and size.

D. Unless otherwise specified, stud, tap, and machine bolts shall be of the best-quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).

E. Anchor bolts, epoxy anchors, and expansion bolts shall be set accurately. If anchor bolts are set before the concrete has been placed, they shall be carefully held in suitable templates of acceptable design. Where indicated on the Drawings, specified, or required, anchor bolts shall be provided with square plates at least 4 in. by 4 in. by 3/8 in. or shall have square heads and washers and be set in the concrete forms with suitable pipe sleeves, or both. If anchor or expansion bolts are set after the concrete has been placed, all necessary drilling and grouting or caulking shall be done by the Contractor and care shall be taken not to damage the structure or finish by cracking, chipping, spalling, or otherwise during the drilling and caulking.

F. All anchors shall be designed and supplied by the equipment manufacturer. Anchors include, but are not limited to, anchor rods, epoxy anchors and expansion anchors. All anchor designs shall include the following:

1. Anchors shall be designed for all applicable loads and load combinations in accordance with the Building Code applicable to the Project as by the equipment manufacturer. Equipment dynamic loads shall also be included with the other loads.

2. Anchor design shall include the quantity, material, finish, diameter, type, spacing and concrete embedment depth of anchors. Design of epoxy and expansion anchors shall be based on cracked concrete.
3. Expansion anchors are not permitted for exterior applications, wet service conditions, or dynamic loads. Cast-in anchor rods or epoxy anchors shall be used in these applications.
4. All anchors shall be installed with the required embedment depth. If anchors are fully developed in the concrete equipment pad and are not embedded in the slab, the anchorage capacity of the pad to the slab shall be verified by the Engineer prior to placement of the pad.
5. Anchors shall be no less than 3/8" diameter.
6. Concrete strengths are as follows:
   a. New concrete: f'c shall be as shown on the structural Drawings and as specified in Section 03300, unless otherwise specified (e.g., precast concrete structures).
   b. Existing concrete: f'c = 3,500 psi
7. Epoxy and Expansion Anchors shall conform to Specification Section 03300. Anchor rods shall conform to Specification Section 05500 .
8. Anchors shall be shown on the equipment shop drawings, with all the required information indicated.

2.3 FOUNDATIONS, INSTALLATION AND GROUTING

A. The Contractor shall furnish the necessary materials and construct suitable concrete foundations for all equipment installed by the Contractor, even though such foundations may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting as specified below.

B. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

C. In setting pumps, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 in. for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-shrink grout.

D. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

E. Where such procedure is impracticable, the method of placing grout shall be as permitted by the Engineer. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout surfaces shall be patched in an approved manner, if necessary. All foundation and grout exposed surfaces shall be given a burlap-rubbed finish and painted with at least two coats of the epoxy-based paint specified for concrete.

F. If threaded rod with lower support nuts are used to secure the equipment in place temporarily during concrete equipment pad placement, the support nuts shall be

removed prior to grouting so that the threaded rod anchor bolts are not supporting the equipment and the top nuts can be tightened to secure the equipment directly to the large bedding surface provided by the non-shrink grout and concrete equipment pad. Equipment foundations shall be designed to absorb equipment vibration and transmit forces to building structure or ground. Contractor shall demonstrate that this has been completed to the RPR prior to grouting.

2.4 ELECTRIC MOTORS

A. Unless otherwise specified or permitted by the Engineer, all electric motors furnished and installed by the Contractor shall conform to the requirements hereinafter set forth.

B. All equipment motors and appurtenances (e.g., switches, instruments, etc.) shall meet the area classification and NEMA requirements as listed on Drawing E-1.

C. All motors shall be specifically designed for the installation orientation required by the equipment submitted (i.e., horizontal motor design for horizontal installation, vertical motor design for vertical installation). Universal motors shall not be allowed.

D. Ratings of Motors

1. Every motor shall be of sufficient capacity to operate the driven equipment under all load and operating conditions without exceeding its rated nameplate current or power or its specified temperature limit.
2. When the horsepower rating is specified for a motor, the motor furnished shall meet the requirements of the output specified. When the horsepower rating is not specified, the motor shall have sufficient capacity to operate the driven equipment as given in the Detailed Specifications.
3. All electric motors shall be UL recognized.
4. Motor shall have a service factor of 1.15, unless otherwise specified.

E. Type of Motors

1. All motors shall be NEMA Design B, and shall have starting characteristics and ruggedness as may be necessary under the actual conditions of operation and, unless otherwise specified, shall be suitable for full-voltage starting.
2. Motors shall be manufactured by General Electric Co., Reliance, Toshiba, Siemens, or be an equivalent product, that meets all the requirements herein.
3. All motors shall have Class F insulation with temperature rise in accordance with NEMA Standards for Motors and Generators and based on a maximum ambient temperature of 40 deg. C.
4. Motors Installed in Class I/ Division 1 Hazardous Locations:
    a. Motors shall be explosion-proof (XP) rated for Class I/ Division 1/ Group C and D rated for hazardous locations and shall meet the requirements of the National Electric Code and other safety codes pertaining thereto.
    b. Motors shall include integral high temperature thermostats or similar device with a high temperature interlock to shut down the motor and auxiliary contact to activate an alarm condition.
    c. Thermostats shall be normally closed, hermetically sealed and rated a minimum of 0.5A at 120 VAC. The thermostats shall be set so that the temperature of the motor will not exceed the auto-ignition temperature for a Class I/ Division 1/ Group C and D location.
5. Motors Installed in Class I/ Division 2 Hazardous Locations:

a. Motors shall be either explosion-proof (XP) rated for Class I/ Division 1/ Group C and D or Class I/ Division 2 Group C and D locations. Motors may be TEFC rated; however, TEFC motors used in hazardous areas shall be non-sparking type (brushless) and shall have non-sparking cooling fans. All motors shall meet the requirements of the National Electric Code and other safety codes pertaining thereto.

b. Motors shall include integral high temperature thermostats or similar device with a high temperature interlock to shut down the motor and auxiliary contact to activate an alarm condition.

c. Thermostats shall be normally closed, hermetically sealed and rated a minimum of 0.5A at 120 VAC. The thermostats shall be set so that the temperature of the motor will not exceed the auto-ignition temperature for a Class I/ Division 2/ Group C and D location.

6. All motors shall be NEMA Premium Efficiency type. The nominal and/or minimum guaranteed efficiency shall be printed on the motor nameplate.

a. All fractional motor efficiency values shall conform to the Small Motor Rule, unless exempted, and shall be as indicated in NEMA MG-1-2018 Tables 12-19, 12-20, and 12-21, latest accepted edition.

b. All integral motor efficiency values shall conform to the Integral Horsepower Motor Final Energy Rule, unless exempted, and shall be as indicated in NEMA MG-1-2018 Table 12-12, latest accepted edition, unless exempted, as indicated below:

Nominal Full Load Motor Efficiencies						
	Open Motors			Enclosed Motors		
HP	3600 rpm	1800 rpm	1200 rpm	3600 rpm	1800 rpm	1200 rpm
1	77.0*	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7
20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5
100	93.6	95.4	95.0	94.1	95.4	95.0
125	94.1	95.4	95.0	95.0	95.4	95.0
150	94.1	95.8	95.4	95.0	95.8	95.8
200	95.0	95.8	95.4	95.4	96.2	95.8
250	95.0	95.8	95.4	95.8	96.2	95.8
300	95.4	95.8	95.4	95.8	96.2	95.8
350	95.4	95.8	95.4	95.8	96.2	95.8
400	95.8	95.8	95.8	95.8	96.2	95.8
450	95.8	96.2	96.2	95.8	96.2	95.8
500	95.8	96.2	96.2	95.8	96.2	95.8

F. General Design of Motors

1. Motors shall comply with the latest NEMA Standards for Motors and Generators, unless otherwise specified. Motors shall not run beyond nominal full speed rpm.
2. Motor windings shall be braced to withstand successfully the stresses resulting from the method of starting. The windings shall be treated thoroughly with acceptable insulating compound suitable for protection against moisture and slightly acid or alkaline conditions.
3. Bearings shall be of the self-lubricating type, designed to ensure proper alignment of rotor and shaft and to prevent leakage of lubricant.
4. Bearings for open motors shall be of the sleeve or ball type, as specified under the respective items of mechanical equipment. Bearings for totally enclosed and explosion-proof motors shall be of the ball type. The exception to this shall be belt-drive applications in which case the motor manufacturer shall determine if roller bearings are required in lieu of ball bearings due to higher radial loads.

5. Vertical motors shall be provided with thrust bearings adequate for all thrusts to which they can be subjected in operation.
6. Vertical motors of the open type shall be provided with drip hoods of acceptable shape and construction. When the drip hood is too heavy to be easily removed, provision shall be made for access for testing.
7. All motors installed above or within potable water storage tanks shall use food grade lubrication that is NSF approved.

G. Wound-Rotor Induction Motors
1. Wound-rotor motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detailed Specifications.
2. Motors shall be of the wound-rotor, induction type suitable for speed control by rotor resistance.
3. The collector rings shall be constructed of hard composition metal of sufficient conductivity and ample contact surface. The rings shall be mounted accurately and securely on the shaft by means of acceptable insulating construction. The leads to the collector rings shall be fastened to and insulated from the shaft in a suitable manner.
4. The collector rings and brushes for the wound-rotor induction motors shall be suitable for operation in an atmosphere containing moisture.
5. The brushes shall be of the electrographite type, or other suitable type, of sufficient hardness and conductivity and shall have ample contact surfaces. Brush holders shall be provided with adjustable, spring-tension devices. Brushes shall be connected to the holders with tinned, flexible, copper-wire pigtails so arranged that no appreciable current shall be carried through the sliding contacts or springs. Brushes shall operate without noise or chattering. Rings and brushes shall be located on top of the motor, and shall be easily accessible for inspection and maintenance.

H. Synchronous Motors
1. Synchronous motors shall comply in all respects with the latest NEMA Standards for Motors and Generators, and AN Standard C50 for Rotating Electrical Machinery.
2. Synchronous motors shall be designed for operation of the motor-driven equipment under the conditions specified in the Detail Specifications.
3. The temperature rise (based on a cooling temperature not exceeding 40 deg. C. and an altitude not exceeding 3,300 ft.) in the various parts of the motors, when operating continuously at rated voltage, frequency, and power factor, shall conform to the applicable requirements of the above- mentioned NEMA Standards.
4. Synchronous motors shall be manufactured by General Electric Co., or be an equivalent product.

I. Single-Phase Motors with Auxiliary Devices
1. Single-phase motors requiring switching devices and auxiliary starting resistors, capacitors, or reactors shall be furnished as combination units with such auxiliaries either incorporated within the motor housings or housed in suitable enclosures mounted upon the motor frames. Each combination unit

shall be mounted upon a single base and shall be provided with a single conduit box.

J. Motor Terminal Boxes and Leads
   1. Motors shall be furnished with oversize conduit terminal boxes to provide for making and housing the connections and with flexible leads of sufficient length to extend for a distance of not less than 4 inches beyond the face of the box. The size of cable terminals and conduit terminal box holes shall be as permitted by the Engineer. An acceptable type of solderless lug shall be furnished. Totally enclosed and explosion-proof motors shall have cast-iron terminal boxes.

K. Special Motors
   1. Hoists and other devices complying with special safety codes shall be furnished complete with their control equipment and with all accessories and safety devices for code-approved, safe, and efficient operation.

L. Premium Efficiency Motors – "For Use with Variable Frequency Drives"
   1. Motors other than inverter duty rated type which are used on variable frequency drive equipment shall have an insulation system that is inverter grade to meet NEMA MG1-2018, latest accepted edition, Class F insulation system with a Class B temperature rise at a 1.15 service factor. Motors shall be wound with inverter duty wire and shall be multi-dipped and baked in a polyester, Class H varnish.
   2. Nameplate on motor shall be stamped indicating motor is "Certified for Use with VFDs".
   3. Motors of the sizes indicated below and operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings to ground.
      a. Motors between 25 HP and up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end.
      b. Motors over 100 HP shall be provided with an insulated or hybrid bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or Contractor and shall be installed in accordance with the manufacturer's recommendations.
      c. Grounding rings may be external or internal to the motor for open drip proof motors (ODP), totally enclosed fan cooled (TEFC) and totally enclosed non-ventilated (TENV). Grounding rings shall be internal to the motor for all Class 1/ Division 1 and Class 1/ Division 2 motors. Grounding rings shall not interrupt or alter the motor design flame path.
      d. Grounding rings shall be AEGIS or equal.

M. Premium Efficiency Motors – "Inverter Duty Rated"
   1. Inverter Duty Rated motors which are used on variable frequency drive equipment shall meet the following requirements:

a. Motor shall be suitable for operation over entire speed range indicated without causing motor overheating at any condition.
b. Forced ventilation type inverter duty rated motors with a separate external continuously operating fan shall not be acceptable.
c. Motors installed in Division 1 hazardous (classified) location shall be identified as acceptable for variable speed when used in Division 1 locations.
d. Motor shall have Class F insulation with a Class B temperature rise at a 1.0 service factor (non-sinewave power) and 40°C ambient conditions per NEMA MG1-2018, latest accepted edition.
e. Motor shall be wound with inverter duty wire and phase paper and shall be multi-dipped and baked in polyester, Class H varnish.
f. Nameplate on motor shall be stamped indicating motor is "Inverter Duty Rated".

2. Motors of the sizes indicated below and operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge electrical shaft currents within the motor and/or its bearings to ground.
a. Motors between 25 HP and up to 100 HP shall be provided with a minimum of one shaft grounding ring installed either on the drive end or non-drive end.
b. Motors over 100 HP shall be provided with an insulated or hybrid bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or Contractor and shall be installed in accordance with the manufacturer's recommendations.
c. Grounding rings may be external or internal to the motor for open drip proof motors (ODP), totally enclosed fan cooled (TEFC) and totally enclosed non-ventilated (TENV). Grounding rings shall be internal to the motor for all Class 1/ Division 1 and Class 1/ Division 2 motors. Grounding rings shall not interrupt or alter the motor design flame path.
d. Grounding rings shall be AEGIS or equal.

N. Submersible Motors
1. Motors which are rated for submersible use shall be of the highest efficiency in the industry for this type of motor and horsepower rating.
2. When used in conjunction with variable frequency drive equipment, the submersible motor shall be rated for inverter duty with Class H insulation.

2.5 DRIVE COUPLINGS

A. Couplings shall be all metal, flexible, designed for both angular and parallel misalignment, provided with a guard, and provided with a means for lubrication.
B. Close-coupled connections shall have machined shouldered joints for motor and pump motor support.
C. High torque couplings shall be all metal gear couplings with external grease fittings. A service factor of 1.50 shall be used based on the motor nameplate rating.
D. Drive couplings for mixers which differ from the above referenced all metal type,

which are standard integral parts of a mixer manufacturer's assembly may be permitted, with review and approval of the Engineer.

2.6 BELT DRIVES

A. V-belt drives shall be provided with front removable guards (refer to Section 2.12), not requiring disturbing of the sheaves.
B. Capable of upsize and downsize sheaving.
C. Design shall be based upon minimum 1.5 service factor, unless specified elsewhere.

2.7 GEAR REDUCTION UNITS

A. Gears of gear reduction units shall be made of highest quality alloys treated for hardness and severe service. All gear reduction units on equipment shall be selected for Class II or more severe service as classified by the American Gear Manufacturers Association.
B. Unless otherwise specified, the complete reduction unit shall be fully enclosed in a heavy cast-iron or fabricated steel housing with gears running in oil. All bearings shall be of the anti-friction type.
C. The actual and rated horsepower, torque, overhang capacity, or bearing capacity of each reduction unit shall be not less than the horsepower rating of the drive motor, nor less than that which will be encountered under full load or under the most severe loading conditions of the equipment. The Engineer may reject any gear reduction unit that does not meet the above requirements. The manufacturer of gear reduction units shall be long established with a good reputation.
D. Unless otherwise specified, all gear reduction units shall be helical or spiral bevel helical combinations. The planetary gear units and worm gear type units may be used only where specified. Class of service shall be Class II or heavier, as determined by the manufacturer or as directed by the Engineer.
E. The equipment manufacturer shall furnish the Engineer with complete engineering information, catalog data, design features, loading capacities, and mechanical efficiency ratings for every gear reduction unit incorporated in the work.

2.8 LUBRICATION FITTINGS

A. All lubrication fittings shall be brought to locations that are readily accessible to operators from normal operating walkways or platforms. Equipment lubrication fittings shall be extended to outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, floor plating or other obstruction, and to eliminate creating falling hazards by unusual elevations. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible.
B. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type.
C. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.
D. Oil drains shall be piped to a location outside the equipment frame for ease of draining. Provide ball valve for positive shutoff. Pipe shall be type-L copper or galvanized steel.

2.9 SPARE PARTS AND SPECIAL TOOLS

A. For each type of equipment furnished, the Contractor shall provide spare parts, as specified on the respective sections of the Division, and a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, maintenance, and disassembly of such equipment.

B. Tools shall be high-grade, smooth, forged, alloy, tool steel. Grease guns shall be lever type.

C. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment.

D. All spare parts and special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts and special tools until completion of the work, at which time they shall be delivered to the Owner.

E. Spare parts shall be appropriately labeled and containerized, and shall be properly packaged for long-term storage.

F. If the Contractor utilizes a spare part to remedy an issue during the Contract work (through Final Completion) they shall replace the spare part at no additional cost to the Owner.

2.10 EQUIPMENT DRIVE GUARDS

A. All equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal or rigid fiberglass OSHA approved guards enclosing the drive mechanism. Guards shall be securely installed but shall be removable with quick open latches.

B. Guards shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members, unless otherwise specified.

C. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment.

D. The guards shall conform in all respects to all applicable safety codes and regulations.

2.11 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resultant electrolysis.

B. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

2.12 NAMEPLATES

A. Each piece of equipment shall be provided with a substantial nameplate of noncorrodible metal, securely fastened in place and clearly and permanently inscribed with the manufacturer's name, model or type designation, serial number, principal rated capacities, electrical or other power characteristics, and similar information as appropriate.

B. An enlarged paper copy of all the nameplate data on equipment and motors shall be provided in the Shop Drawings and Operation and Maintenance Manuals.

2.13 SURFACE PREPARATION AND SHOP COATINGS

A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

2.14 ELECTRICAL CONTROLS

A. Additional controls for various items of equipment are specified under Division 13 and/or Division 16, as indicated on the Drawings, and as specified. Due to potential differences in electrical requirements for equipment of various manufacturers, the Contractor shall coordinate the electrical requirements of the equipment supplied with the work specified in Division 13 and/or Division 16.

B. Provide auxiliary contacts as required for remote status and alarm conditions. Contractor shall coordinate each piece of equipment. Refer to the Electrical and Instrumentation Drawings.

C. Electrical controls for all equipment shall comply with the requirements of Division 16 and the National Electric Code, including provisions to allow each piece of equipment to be locked out/tagged out for maintenance or repairs.

D. Control panels shall be constructed in conformance with UL 508A and bear the UL 508A seal confirming the construction. UL inspection and seal application can be accomplished at the panel fabrication facility or by field inspection by UL inspectors. Obtaining the UL seal and any inspections shall be provided at no additional cost to the Owner.

2.15 GAUGES

A. General: Pressure gauges to be supplied by the pump manufacturer. Refer to Section 11311C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall carefully inspect receiving structures and anchor supports for defects in workmanship prior to equipment arrival.

B. Contractor shall carefully inspect all equipment for:
   1. Damage in shipping.
   2. Defects in workmanship and materials.
   3. Tightness of all nuts and bolts.

C. Inspection shall include, but not be limited to, the following as applicable:
   1. Soundness (without cracked or damaged parts).
   2. Correctness of setting, alignment, and relative arrangement of various parts.
   3. Adequacy and correctness of packing, sealing and lubricants.
   4. Completeness in all details, as specified.

D. Field Quality Control
   1. As part of the equipment cost, the Contractor shall provide the services of a duly authorized Manufacturer's representative to assist the Contractor with equipment adjustment, start-up, and necessary testing to prove that the equipment is in proper and satisfactory operating condition.
   2. On completion of the work, the Manufacturer's representative shall provide written certification that the equipment conforms to the requirements of the

Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void, as outlined in the equipment certification form provided in Section 01800.

3. As part of the startup services, the Manufacturer's representative shall provide the Owner's personnel with training in the proper operation and maintenance of all associated equipment. The equipment training certification form provided in Section 01800 shall be used for this purpose.
4. When the work is substantially complete the Contractor will be required to demonstrate, to the satisfaction of the Engineer, the ability of all equipment to operate as intended without defect including binding, vibration, jamming, overheating, etc.
5. All equipment found defective by the Engineer shall be replaced by the Contractor at no expense to the Owner.

3.2 PREPARATION

A. Provide all required adhesives, sealants, insulation, lubricants, waterproofing, fireproofing or other protection specified in each Section of this Division.

3.3 INSTALLATION

A. Contractor shall install equipment in accordance with Manufacturer's requirement. Manufacturer(s) shall work with the Contractor to ensure that the equipment has been properly installed.
B. Do not install equipment until all defects or inadequacies in receiving structure have been corrected to meet Specifications.
C. Erect and lubricate equipment in strict accordance with the manufacturer’s instruction. Installation shall include all oil and grease required for proper operation.
D. All equipment mechanisms shall withstand all stresses that may occur during fabrication, erection, and intermittent or continuous operation.
E. Contractor to furnish and install supports as indicated on the Drawings, and as required by the equipment manufacturer.
F. Thoroughly clean all equipment and appurtenant piping to remove all dirt, grease, mill scale, and other foreign matter and touch up factory finish to the satisfaction of the Engineer.

3.4 STARTUP AND TESTING

A. Test and adjust all equipment in accordance with the general requirements of Specification Section 01800, and the specific requirements of the various Division 11 Specification Sections.
B. Demonstrate the equipment's ability to operate without overloading jamming, excessive vibration, etc. during normal operation conditions.
C. Demonstrate the equipment's ability to meet all the performance requirements specified for the equipment system to make a complete operational system, suited for its intended use.

END OF SECTION

SECTION 11310

PUMPS - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Furnish, install, test and place into satisfactory operation pumping equipment and appurtenances as shown on the Drawings, as specified herein and as required for a complete installation.
2. Contractor will perform pump tests in the Engineer's presence to indicate that pump efficiency, capacity, and discharge head conform to specifications in Pump Schedule in this Division.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1. Sections 01800 and 11000.
2. Surface preparation and shop coatings are specified in Division 9.
3. Instrumentation is specified in Division 13.
4. Piping and valves are specified in Division 15.
5. Electrical is specified in Division 16.

1.3 QUALITY ASSURANCE

A. In accordance with the requirements of Section 11000.

B. All pumping equipment shall be designed, constructed, installed and tested in accordance with the best practice, methods and the standards of the Hydraulic Institute.

C. All rotodynamic pumps shall be tested in accordance with ANSI/HI 14.6. If an acceptance grade is not specified for a specific rotodynamic pump, the pump must meet the default acceptance grade based on the intended service outlined in ANSI/HI 14.6 Table 14.6.4.

D. Additional performance requirements are outlined in pump specifications.

1. Pumps shall meet all performance requirements listed in this specification, and associated specifications.
2. In the event that the pump(s) equipment fails to meet the performance requirements specified, the Engineer shall have the right to require the Manufacturer to modify or replace the pumping equipment to enable said system to meet the performance requirements specified.
3. A second test, and any subsequent tests as may be necessary to ensure compliance with the Specifications shall be performed at no additional cost to the Owner.
4. All costs arising from project delays caused by failure to meet the performance requirements specified herein shall be borne by the Manufacturer and shall be

responsible to the Contractor for any liquidated damages incurred due to any delay in passing all factory testing.

E. Only pumping units having wire-to-water efficiencies within a reputable manufacturer's equipment range of efficiencies will be accepted.

1.4 SUBMITTALS TO THE ENGINEER

A. In accordance with the requirements specified in Section 01340 and 11000. Submit such shop drawings, manufacturer's literature, short-term and long-term storage requirements, and operations and maintenance manuals.

B. Submit the following information for all pumps specified:

1. Manufacturer's rating curves showing the following pump characteristics for each unit of flow:
   a. Total dynamic head.
   b. Brake horsepower.
   c. Efficiency.
   d. Required net positive suction head.
   e. Allowable suction lift.
2. Variable speed units:
   a. Variable speed curves with at least five speeds plotted from maximum RPM to minimum RPM required to obtain the minimum pump flows at the heads indicated in the pump schedule.
3. Literature, layout drawings and typical specification describing pumping equipment, showing all important details of construction and dimensions.
4. Maintenance instructions shall be furnished to indicate operation, assembly, disassembly and troubleshooting.
5. Mechanical seal drawing shall be furnished indicating service conditions, materials of construction, and basic interface dimensions.
6. Literature, Schedule and Layout Drawing for pump Gauge assemblies.

C. After fabrication and prior to shipment, shop test completed pump and motor assemblies indicated in the Pump Schedule for performance in accordance with the ANSI/HI 14.6 and submit certified copies of the pump and motor performance data furnished.

1.5 DELIVERY, STORAGE, AND HANDLING

A. In accordance with the requirements of Section 11000. Manufacturer shall deliver equipment to the project site where and when directed by the Contractor.

1.6 WARRANTY

A. In accordance with the requirements of Section 11000 and 11311C.

PART 2 - PRODUCTS

2.1 PUMPING SYSTEM

A. General:

1. Pump:
   a. Pump type and use are specified in Pump Schedule in this Section.

b. See the Specification Section noted in the Pump Schedule for additional information for each specific pump type.
c. Pump shall be suitable for intended purpose as specified and as shown on Drawings.
d. Pumps designated for a certain function shall be supplied by same manufacturer.
e. All parts shall be designed and proportioned to have liberal strength, stability and stiffness to perform required function.
f. Provide ample room and fittings for inspection repairs and adjustments.
g. Pump base accurately aligned, sized and rigidly anchored into position in accordance with Drawings.
h. Anchor bolts, plates, nuts and washers shall be SAE bolt steel of ample size and strength for purpose intended, furnished and installed by Contractor in accordance with manufacturer's instructions.
i. Provide adaptor flanges, as necessary, to match piping system.
j. Brass or stainless steel name plates providing manufacturer's name, rated capacity, total dynamic head, operating speeds and other pertinent data shall be attached to pump equipment.

2. Motors:
   a. Refer to requirements in Section 11000.
   b. Type specified in the Pump Schedule in this Division.
   c. All motors shall be of nationally known manufacturer and conform to NEMA standards and specifications.
   d. Maintain sufficient capacity to operate pump throughout designated operating range without exceeding name plate rating for current and power.
3. Mechanical Seals (unless otherwise indicated).
   a. General: Refer to Section 11311C.
4. Gauges:
   a. Provide one suction gauge and one discharge gauge per pump. Gauges shall be provided by pump manufacturer and in accordance with Section 11311C.
5. Gate Valves:
   a. General: Refer to Section 15101.
6. Check Valves:
   a. General: Refer to Section 15110.
7. Surface Preparation and Shop Coatings
   a. Provide surface preparation and shop coatings in accordance with Specification Section 09905.
8. Field Coatings
   a. Provide field coatings in accordance with Specification Section 09900.
9. Spare Parts:
   a. Spare parts shall be delivered at the same time as the equipment to which they pertain.

b. The Contractor shall properly store and safeguard such spare parts until Substantial Completion of the work, at which time they shall be delivered to the Owner.
c. Parts shall be packaged in individual suitable containers labeled with the part number, name and quantity.

2.2 PUMP SCHEDULE

A. Stated pump capacity (flow, head, NPSHr, efficiency, and power) listed below are also considered the guarantee values per ANSI/HI 14.6 for all rotodynamic style pumps.

B. Harward Street Pump Station Duty Pumps: Section 11311C.
1. Location: Pump Room
2. Function: Pump raw, screened, domestic sanitary sewage.
3. Number of Units: Two (PSP-1, PSP-2)
4. Type: Horizontal, self-priming centrifugal
5. Capacity: 1500-3330 GPM each.
   a. Design Point: 3330 GPM at 83-feet TDH at full speed.
      1) Efficiency 74%
   b. Minimum Point: 1500 GPM at 68-feet TDH at minimum speed.
6. Pump Test Acceptance Grade: 2B
7. RPM: 1450 maximum.
8. Seal: Cartridge-type single or split mechanical type.
9. Drive: V-Belt Drive; variable frequency drives (provided under Division 16) capable of variable speed operation as specified.
10. Motor: 125 HP, 1800 RPM, 460V, 3 phase, 60 hertz, TEFC NEMA Premium Efficiency Motors for use with variable frequency drives.
11. Controls: Control shall be as specified in Division 13.
12. Remarks: 10-inch suction and 10-inch discharge. Gorman-Rupp 10-Inch Super T Series Pumps.

C. Harward Street Pump Station Jockey Pump: Section 11311C
1. Location: Pump Room
2. Function: Pump raw, screened, domestic sanitary sewage.
3. Number of Units: One (PSP-3)
4. Type: Horizontal, self-priming centrifugal
5. Capacity: 550-1850 GPM.
   a. Design Point: 1850 GPM at 75-feet TDH at full speed.
      1) Efficiency 59%
   b. Minimum Point: 550 GPM at 64-feet TDH at minimum speed.
6. Pump Test Acceptance Grade: 2B
7. RPM: 1350 RPM maximum
8. Seal: Cartridge-type single or split mechanical seal.
9. Drive: V-Belt Drive; variable frequency drives (provided under Division 16) capable of variable speed operation as specified.
10. Motor: 75 HP, 1800 RPM, 460V, 3 phase, 60 Hz, TEFC NEMA Premium Efficiency Motors for use with variable frequency drives.
11. Control: Control shall be as specified in Division 13.

12. Remarks: 8-inch suction and 8-inch discharge. Gorman-Rupp 8-Inch Super T Series Pumps.

PART 3 - EXECUTION

3.1 EXAMINATION, PREPARATION AND INSTALLATION

A. In accordance with the requirements of Section 11000 and the manufacturer's written instructions.

3.2 START UP AND TESTING

A. In accordance with the requirements of Section 01800 and 11000.

B. Perform all adjustments necessary to place equipment in satisfactory working order and to meet performance testing requirements. If equipment fails to meet performance requirements, the Contractor shall modify or replace the equipment at no additional cost to the Owner.

3.3 CLEANING AND FIELD COATINGS

A. In accordance with the requirements of Section 09900 and 11000.

3.4 TRAINING AND WARRANTY PERIOD SUPPORT

A. In accordance with the requirements of Section 01800.

END OF SECTION

SECTION 11311C

SELF PRIMING NON-CLOG CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test self-priming non-clog centrifugal pumps, and all appurtenances necessary to make a complete and operable system as indicated in the Specifications and as shown on the Drawings.

B. Each pump shall be capable of continuously pumping raw unscreened wastewater at all flow and head conditions indicated in the pump schedule, and along the entire pump curve.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to;

1. Additional requirements are specified in Sections 01800, 11000, 11310.
2. General requirements are specified in Division 1.
3. Concrete and grout are specified in Division 3.
4. Surface Preparation, Shop and Field Coatings are specified in Division 9.
5. Section 11000 – Equipment – General
6. Section 11310 – Pumps General, including pump schedule
7. Instrumentation and Controls are specified in Division 13.
8. Pipe, fittings, and valves are specified in Division 15.
9. Electrical is specified in Division 16.

1.3 QUALITY ASSURANCE

A. In accordance with the requirements of Section 11000.

B. All system components specified herein shall be furnished by a single Manufacturer who regularly engages in the production of this type of equipment. The Manufacturer shall be responsible for the performance and warranty of the entire system provided under this section.

C. Qualifications of Manufacturers: The Manufacturer shall have a minimum of 5 years of experience in the design and manufacture of the specified equipment. The Manufacturer shall have a minimum of 10 similar installations operating for a minimum of 5 years.

D. Acceptable Manufacturers:

1. Gorman-Rupp, Mansfield, OH;
2. Or equivalent.

1.4 SUBMITTALS

A. In accordance with the requirements specified in Section 01340 and 11000. Submit such shop drawings, manufacturer’s literature, short-term and long-term storage requirements, and operations and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. In accordance with the requirements of Section 11000. Manufacturer shall deliver equipment to the project site where and when directed by the Contractor.

1.6 WARRANTY

A. In accordance with the requirements of Section 11000.

B. The Contractor shall obtain a 5-year warranty from the pump manufacturer covering all pumps, in the name of the Owner, against defects in workmanship and materials, covering parts, shipping, and labor. The terms of the warranty shall be from the date of substantial completion as determined by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. All pumps designated for a certain function shall be supplied by the same manufacturer.
2. All parts shall be designed and proportioned to have liberal strength, stability, and stiffness to perform required functions.
3. Exposed hardware shall be stainless steel.
4. Provide ample room and fittings for inspection, repairs and adjustments.
5. All openings and internal passages shall be large enough to permit the passage of 3 inch diameter sphere solids and any trash or stringy material which may pass through the average house collection system. Screens or any internal devices that create a maintenance nuisance or interfere with priming and performance of the pump will not be permitted.

B. Pumps:

1. Pump casing: All areas of the pump casing and volute which are exposed to sewage shall be constructed of gray cast iron minimum Class 30 (ASTM A48) of ample thickness, capable of prolonged resistance to the abrasive action of the solids and grit suspended in the liquid passing through the pump.
2. Impeller:
   a. 8-inch Connection Pumps:
      i. The impeller shall be two-vaned, semi-opened, non-clog, cast in No. 65-45-12 ductile iron with integral pump out vanes on the back shroud. Impeller shall be threaded onto the pump shaft and be secured with a lockscrew. Impeller shall be dynamically balanced.
   b. 10-inch Connection Pumps:
      i. The impeller shall be continuous vane extending from one edge of the impeller through the central portion of the impeller to the other edge. The impeller height shall increase continuously from the outer radius of to the central region of the impeller.
3. Shaft: Impeller shaft shall be of the following material:
   a. 8-Inch Connection Pump: Alloy Steel 4150
   b. 10-Inch Connection Pump: Solid Stainless Steel No. 17-4.
4. Shaft seal:

a. The pump shaft seal shall be sealed against leakage by an oil lubricated, double floating, self-aligning mechanical seal. Both the stationary sealing member and mated rotating member shall be of tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating so that faces will not lose alignment during periods of shock loads that will cause deflections, vibrations and axial movement of the pump shaft.
b. The seal shall be lubricated with oil from a separate, oil filled reservoir. The same oil shall not be used to lubricate both the shaft seal and the shaft bearings.
c. The seal shall be warranted for a minimum of four (4) years from the date of substantial completion on a pro-rated basis. Should the seal fail during the first year the seal shall be replaced at no cost to the Owner. The cost of the replacement seals would be for second year - 25%, third year - 50% and the fourth year - 75 % of the full cost of the seal.
d. The elastomers shall be Viton and the cage and spring shall be stainless steel.

5. Shaft bearings: The pump shaft bearings shall be of the following type:
   a. 8-Inch Connection Pump:
      i. Radial Bearing: Open Single Roll Ball
      ii. Thrust Bearing: Open Double Roll Ball
   b. 10-Inch Connection Pump:
      i. Radial: Open Double Roll Ball
      ii. Thrust: Open Double Roll Ball
   c. All bearings shall be of ample size and proper design to withstand all radial and thrust loads which can reasonably be expected during normal operation. Bearings shall be lubricated from a separate reservoir from the shaft seal.
6. Pump suction and discharge spools: Each pump shall be equipped with a one piece, cast iron suction and discharge spools, flanged on each end. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting of gauges and other instrumentation.
7. Pump high temperature thermostat shall be provided on the pump casing.

C. Pump suction lift and reprime performance:
1. Each pump shall be so designed as to retain adequate liquid in the pump casing to insure unattended automatic repriming while operating at its rated speed in a completely open system without suction check valves and with a dry suction leg.

D. Serviceability features:
1. Special tools: No special tools shall be required for the replacement of any components with in the pump.
2. Removable section for impeller access:
   a. 8-inch Connection Pump
      i. Cover plate: The pump shall be equipped with a removable cover plate, allowing access to the pump interior to permit the clearance

of stoppages and to provide simple access for service and repairs without removing suction or discharge piping.

b. 10-inch Connection Pump

i. Suction Head: The pump shall be equipped with a removable suction head. The suction head shall be secured to the pump casing using hex head cap screws and lock washers. Removal of any blockages in the impeller shall be accomplished by removing the suction head.

3. Wear plate and rotating assembly:

a. 8-inch Connection Pump:

i. The pump shall be fitted with a replaceable wear plate. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable cover plate. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.

b. 10-inch Connection Pump:

i. The pump shall be fitted with a replaceable wear plate. The wear plate shall have one or more notches and/or recesses provided along a common diameter of the wear plate to disturb and dislodge any solids which might otherwise remain on the impeller in dynamic operation. Replacement of the wear plate, impeller, seal, and suction check valve shall be accomplished through the removable suction head. The entire rotating assembly, which includes bearings, shaft, seal, and impeller, shall be removable as a unit without removing the pump volute or piping.

4. Impeller clearance adjustment: Clearance between the impeller and wear plate shall be done from the exterior of the pump casing. The entire rotating assembly shall move as one unit to enable the clearances to be adjusted. Clearance adjustment by means of moving the shaft, thereby affecting the seal, shall not be acceptable.

E. Drive transmission:

1. Power shall be transmitted from motors to pumps by means of V-belt drive assemblies. The drive assemblies must be selected to establish proper pump speed to meet the specified operating conditions.
2. Each drive assembly shall have a minimum of two v-belts. Single v-belt drives are not acceptable. Each V-belt assembly shall be sized to adequately transmit the power from the motor to the pump.
3. Drive systems shall have a safety factor of 1.5 or greater.

F. Belt guards:

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or a combination of materials consisting of expanded, perforated or solid sheet metal, except that openings shall not exceed 1/2 inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component, and shall be securely fastened to the base.

3. All metal shall be free of burrs and sharp edges. Structural joints shall be welded continuously. Tack welds shall not exceed 4 inch spacing. Panels may be riveted its frame.
4. The guard shall be primed with a minimum of 1.5 mils of a zinc-based synthetic primer. A finish acrylic enamel coating (minimum of 1.5 mils.) shall be applied in accordance with section 3, Color definitions of ANSI 253.1: 1976, Safety Color Code for Marking Physical Hazards.

G. Motors and High Temperature Thermostat:
1. Premium efficiency motors meet the requirements of Section 11000 and 11310.
2. The motor shall be provided with an integral high temperature thermostat with a high temperature interlock to shut down the motor and auxiliary contact to activate an alarm condition.
3. Thermostats shall be normally closed, hermetically sealed and rated a minimum of 0.5A a 120 VAC.

H. Air Release Valves:
1. Each pump shall be equipped with one automatic air release valve, designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming or repriming cycle, the air release valve shall close to prevent recirculation. Valves shall provide visible indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. Materials of construction:
   a. Valve Body: Gray Iron No. 30.
   b. Hardware - Internal Wetted: Stainless Steel 18-8.
   c. Hardware - External: Steel
   d. Diaphragms/O-Rings: Buna-N
3. A cleanout port, 3-inches or larger in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Manufacturer to supply upstream union between air release valve and pump discharge flange. Contractor to supply downstream union on air release valve drain piping for each air release valve. Coordinate installation with Engineer.
5. Valves shall be field adjustable for varying discharge heads.

I. Suction Check-Flap Valve:
1. Each pump shall incorporate a suction check valve that can be removed or installed.
   a. 8-inch Connection Pump: The suction check valve shall be removed and installed through the removable cover plate opening, without disturbing the suction piping.
   b. 10-inch Connection Pump: The suction check valve shall be removed and installed through the suction head without disturbing the suction piping. A blowout center shall protect pump casing from hydraulic shock or excessive pressure.
2. Sole function of check valve shall be to eliminate re-priming with each cycle. Pumps requiring suction check valves to prime or reprime will not be acceptable.
3. Suction/Flap valve materials shall be steel reinforced neoprene.

J. High Temperature Shutdown Kit:
   1. Mounts to the pump foot and rated for 145 degrees F to shut down the pump on high temperature. Coordinate with Division 13.

K. Pump Drain Kit - Provide for each pump:
   1. Provide an adequate length of flexible plastic hose, equipped with a quick-connect female camlock fitting on one end. The hose shall be long enough to extend from each pump body to the Pump Room sump drain. Coordinate the required hose length with the Engineer.
   2. For each pump drain supply a pipe nipple, bushing, bronze gate valve and quick connect male camlock fitting.

L. Gauge Kit:
   1. Each pump shall be equipped with a glycerin-filled compound gauge to monitor suction pressures, and a glycerin filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter and shall be graduated in feet of water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated -34 to +34 feet water column minimum. Pressure gauges range shall be selected at the nearest standard range which provides a top limit above the pump shut off head.
   2. Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and fittings, and shall include a shut off valve installed in each gauge line at the point of connection to a suction and discharge pipe. Fittings shall be stainless steel.
   3. Coordinate the location of the gauge panel in the field with Owner and Engineer.

2.2 SURFACE PREPARATION AND SHOP COATINGS

A. In accordance with the requirements of Section 09905 and 11000.

2.3 SPARE PARTS

A. In accordance with the requirements of Section 11000.

B. Provide the following spare parts:
   1. One complete spare mechanical seal with all gaskets, seals, sleeves, O-rings, and packing required to replace the seal.
   2. One set of impeller clearance adjustment shims.
   3. One quart of seal lubricant.
   4. One cover plate O-ring.
   5. One rotating assembly O-ring.
   6. One wear plate.
   7. One impeller.
   8. Any special tools required for maintenance of the equipment

PART 3 - EXECUTION

3.1 EXAMINATION, PREPARATION AND INSTALLATION

A. In accordance with the requirements of Section 11000 and the manufacturer’s written instructions.

3.2 START-UP AND TESTING

A. In accordance with the requirements of Section 01800 and 11000.

3.3 CLEANING AND FIELD COATINGS

A. In accordance with the requirements of Section 09900 and 11000.

3.4 TRAINING AND WARRANTY PERIOD SUPPORT

A. In accordance with the requirements of Section 01800.

END OF SECTION

SECTION 13410

INSTRUMENTATION AND PROCESS CONTROL GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. General Requirements and Definitions:

1. A single System Integrator (SI) shall furnish all services and equipment as specified herein and in the following Specification sections:

Section	Title
13440	Instruments
13441	Control Narratives
13442	Programmable Logic Controllers
13444	Control Panels

Additional requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

Section	Title
01010	Summary of Work (construction sequencing requirements that affect number and duration of equipment startups and certifications)
01340	Submittals
01600	Delivery, Storage and Handling
01800	Equipment Startup, Certification and Operator Training

2. The System Integrator (SI) provide all labor, materials, equipment, operations, methods and procedures as indicated in the Contract Documents to achieve a fully integrated and operational system.
3. All systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly integrated systems.
4. All systems shall be adjusted, tested, inspected and optimized to the satisfaction of the Engineer and Owner prior to being turned over to the Owner.
5. The words "provide", "supply", "supply and install", "install", "furnish" or "furnish and install" shall mean a complete and properly functioning hardware installation performed by the System Integrator unless otherwise noted. The System Integrator shall design and coordinate the Instrumentation & Process Control system for proper operation with related equipment, materials, and labor furnished by others under other sections of these Specifications and with related existing equipment.
6. Refer to Civil, Mechanical, Instrumentation, and Electrical Drawings to coordinate material and equipment locations. Refer to the Process Drawings for locations and connection to primary instrumentation, control valves and process equipment. Refer to the Electrical Drawings for the location of transmitters, control stations, motor drives and centers, variable speed drives, control panels, wiring diagrams, network, and computer equipment.

B. Work Included:
   1. Refer to Paragraph 1.1.A.1 for list of specifications.
   2. Equipment Control:
      a. Provide PLC programming, SCADA programming, and network configuration for equipment control or connection to control, status indication and alarm annunciation of equipment as shown in the Instrumentation Drawings, and described in Section 13441 – Control Loop Descriptions.
   3. Application Development: Refer to Section 13441
   4. Meetings:
      a. The SI shall attend a Pre-Instrumentation meeting with the Contractor, Engineer, and others prior to the submission of any specifications.
      b. The SI shall attend construction meetings as necessary to coordinate construction sequencing.
   5. Miscellaneous:
      a. Furnish and install all transducers, media converters, protocol converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, intrinsic safety barriers, power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system for new and existing equipment.
      b. Furnish and install all vendor or manufacturer cables and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals. All methods, materials and supplies will meet the requirements of Division 16.
      c. Furnish mounting hardware for each instrument. The System Integrator will provide information on the proper installation in accordance with the Manufacturer's requirements for each instrument and shall supervise the installation. Tubing, process taps and an isolation valve will be provided under Mechanical in Division 11 and 15. Coordinate the size and type of connection required. Refer to the Instrument Installation Detail Drawing in the Contract.
   6. O&M Documentation:
      a. Provide complete O&M documentation as listed under paragraph 1.4 and other related Division 13 specifications.
   7. Demolition:
      a. Remove and/or relocate existing equipment as indicated on the Drawings.
      b. Deliver PLC, OIT, and communications equipment not reused to Owner.
   8. Coordination:
      a. Process Instrumentation and Process Control Systems will be provided under Division 11, where specified. The System Integrator shall coordinate with the instrumentation and control systems provided under these sections.
      b. Conduit and wiring (excluding integral or vendor furnished cables and fiber optics) shall be provided and tested under Division 16 and as shown on the Electrical Drawings.

c. Provide manufacturer recommended installation and mounting requirements for each instrument to be connected to process equipment, piping or fittings requiring a process connection such as NPT taps, sample piping and process line insertion. The System Integrator will supervise and provide guidance on proper installation of instrumentation equipment. This shall include manufacturer's recommended mounting installation heights and locations for gas detection sensors, clearances for level sensors per manufacturer's blanking distance, etc.

d. The System Integrator shall coordinate with Division 11 control panel manufacturers in establishing network communications as required on the Drawings, and the signals required in Section 13441.

C. Related Work by Others under this Contract:

1. Local control stations (including E-stops, local hand switches, speed pots, and local indicating lights) and equipment control panels (i.e. MCCs, VFDs), indicated on Electrical Drawings.

D. Demonstration of Complete Instrumentation and Process Control System:

1. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated by the Contractor and accepted by the Engineer in writing. Final demonstrations shall be made only after the Engineer is satisfied that the work has been completed in accordance with the intent of the Contract Documents.
2. After the Instrumentation and Process Control System is completed, and when directed by the Engineer, demonstrate the total system operation and make final adjustments to the system. If any system or piece of equipment within a system fails to function properly, rectify such defects or inadequacies and make a final demonstration as directed by the Engineer.
3. Provide the services of authorized manufacturers' representatives to instruct the Owner's representatives in the proper operation of each partial or complete system installed under this Contract where noted.
4. Pay all charges or fees, including the cost of any special test equipment, factory engineers, etc., necessary for the proper performance of the specified tests, demonstrations and instructions.
5. All demonstrations and instructions referred to shall be scheduled at the convenience of the Engineer and the Owner and in no case shall be scheduled without at least 72 hours written notice to the Engineer. Scheduling of testing and certification of equipment by the Engineer until all instrumentation and electrical equipment have been installed, calibrated including testing/transmitting of alarms, status, etc have been performed in the field in accordance with the Specifications. Once the systems have been tested in the field, the Contractor shall notify the Engineer a minimum of 72 hours before a formal startup and testing of each location. All testing of the equipment or system(s) shall be performed in a single contiguous block of testing dates or as agreed upon by the Engineer.
6. Service calls:
    a. Provide system integrator services of one 8-hour working day (not including travel time) upon request of the Owner within the first year of operation. Unused time shall be issued to the Owner as a credit.

E. Removals, Relocations and Rearrangements:
   1. Examine the existing site for the work of all trades, which will influence the cost of the work under Division 13. This work shall include removals, relocations and rearrangements relating to the work of all trades which may interfere with, disturb or complicate the performance of the work under Division 13; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
   2. Provide in the bid a sufficient amount effort to include all removals, relocations, rearrangements and reconnections herein specified, necessary or required to provide approved operation and coordination of the combined new and existing systems and equipment.

1.2 QUALITY ASSURANCE

A. All materials provided under this Contract shall be equal in quality, appearance and performance to that specified herein and shall be subject to the approval of the Engineer. Verify the availability of all materials proposed to be used in the execution of the work prior to submitting same for the Engineer's approval. Supply chain issues or the discontinuance of production of any material or product after approval has been granted shall not relieve the Contractor from furnishing an Engineer approved alternate of comparable quality, function, and design without additional cost.

B. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.

C. Materials and equipment with any chipset furnished under this Contract shall be purchased and supported by the manufacturer or by an authorized manufacturers representative.
   1. A certificate of authenticity or manufacturers manifest shall be provided at Engineers request.

D. Material and equipment furnished under this Contract shall acceptable for use by all applicable government agencies (E.g. EPA, DHS, etc) for use with critical infrastructure (E.g. the National Defense Authorization Act of 2018 banned the use of Hikvision and it shall not be used on any projects).

E. The Contractor shall have supplied comparable systems to those specified herein and shall maintain engineering and service departments capable of supporting and maintaining these systems. Provide throughout the warranty period as defined in 00800, all necessary supervision, labor, materials, and equipment, in order to correct any defects in any system due to faulty materials, equipment, installation methods, or workmanship and consequent damage resulting from such defects. This work shall be scheduled during normal working hours and at the convenience of the Owner.

F. System Integrator:
   1. The Contractor's attention is directed to the fact that the instrumentation is an integrated system and as such, shall be furnished by one supplier, who shall provide all of the equipment and appurtenances regardless of manufacturer, and be responsible to the Contractor for satisfactory operation of the entire system provided. Substitutions on functions specified will not be acceptable.

2. The exception shall be where instrumentation and control packages are furnished by respective equipment manufacturers as required in Division 11, 14, 15, and 16. All necessary provisions will be made to ensure a proper signal and communication interface as indicated on the P&IDs and associated equipment specifications between the main process instrumentation and control packages specified within this section and those provided. The Contractor shall provide startup reports which demonstrate proper operation of Division 11, 14, 15, and 16 equipment and associated Division 11 control systems.

G. Acceptable System Integrators:
   1. AEC Engineering, Freeport, ME
   2. Electrical Installations Inc., Moultonborough, NH
   3. I&C Systems Engineering, Scarborough, ME
   4. LCS Controls Inc., Rochester, VT
   5. Or equal, having a minimum of 5 years' experience in supplying comparable systems.

1.3 SUBMITTALS

A. Shop Drawings and Samples:
   1. Submit Shop Drawings and O&Ms in accordance with General Conditions Section 01340 and as indicated herein.
   2. Shop Drawings shall consist of:
      a. Project name and location
      b. Contractor's name
      c. Index Sheet - Listing the equipment being submitted utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/type and catalog number. The .pdf shall also have integral bookmarks.
      d. Manufacturer's scale or dimensioned drawings along with standard catalog number.
      e. Equipment ratings, service clearances and configuration.
      f. Listing of accessories to be furnished
      g. Panel wiring diagrams showing the location of each mounted component, front panel elevation(s), internal wiring diagram of each component including terminal numbers.
      h. Bill-of-Material Table showing a complete listing of the components in each control panel. Table shall include separate columns for the following: Item Number, Quantity, Manufacturer, Part number, Description, Designator Tag, Supplier name and phone number.
      i. Initial and record loop diagrams showing point to point wiring for all instrumentation equipment including terminal numbers. Prior to final completion, update the above drawings with wire labels and terminals provided by the Electrical Subcontractor. Refer to Section 13444 for additional information.
      j. SAT Report:
         i. The SI shall furnish an I/O checkout sheet identifying and acknowledging that field wiring is properly terminated to the SI furnished hardware.

ii. The SI shall furnish a checklist of all the instruments that have been configured and ready for additional testing.
iii. The SI shall furnish a checklist of all of the PLC, SCADA, network, and security functions that have been tested.

k. SCADA screens, OIT screens, and database tags.
l. Refer to the other Division 13 Sections for additional shop requirements.

3. All material shall be contained in one submission; partial submissions will not be accepted.
4. Submissions shall be in the form and quantity indicated in the General Conditions. Each equipment type shall be separated by index tabs with typewritten titles.
5. Provide samples of programs, graphics, etc., within 10 days upon receipt of request from the Engineer.

B. Maintain properly documented and witnessed test and checkout reports and submit these to the Engineer. No form of energy shall be applied to any part of the instrumentation system prior to receipt by the Engineer, from the Contractor, of the supplier's certified statement of approval of the installation and containing his authorization to energize the system, except that the supplier's serviceman may do so for the purpose of check-out as described herein.

1.4 DELIVERY, STORAGE AND HANDLING

A. Coordinate material and equipment delivery with the project schedule. Notify the Engineer immediately, in writing, if material or equipment delivery will adversely affect the project schedule, include documentation from equipment suppliers indicating the revised delivery dates and the reason for the delay.
B. Coordinate delivery of equipment directly to other vendors where instrumentation supplied under this section has to be installed in panels supplied under other specification sections.
C. Exercise care during loading, transporting, unloading and handling of materials to prevent damage.
D. Check for defective or damaged materials, and for incomplete equipment shipments within seven days after equipment delivery to the project site.
E. Store materials and equipment on the construction site in enclosures or under protective covering in order to assure that materials and equipment are kept undamaged, clean and dry. The Contractor shall maintain an inventory of instruments and control panels received on site and store in a safe, secure, dry and temperature controlled location. This inventory shall be made available to the Engineer upon request.
F. Replace or repair, to the satisfaction of the Engineer, all materials and equipment that are defective or that have been damaged during installation, at no additional cost to the Owner.

1.5 O&M REQUIREMENTS:

A. Provide the Owner with a list of local service departments of duly authorized distributors of materials and equipment of the type installed, which will stock the manufacturer's standard parts, etc. The list may be included on the bill-of-materials.

B. At the completion of the installation, provide Record Drawings on sheets no less than 11" x 17", indicating the final configuration of all systems as they were installed. Symbols, equipment designations, instrument ISA designations, etc., shall be consistent with the Contract Documents. Provide exact locations of all work which has been concealed in concrete, masonry or underground. The following diagrams shall be included:
   1. Control Panel diagrams on 11" by 17" sheet showing the front face and panel mounted equipment with full listing of components including names, descriptions and model numbers for each component. One copy of the panel diagrams will be laminated for insertion into the pocket inside each control panel.
   2. Panel wiring diagrams showing the location of each mounted component; front panel elevation(s) and name plates; internal wiring diagram of each component including field instruments and terminal numbers; and network communications including all provided equipment, on 11" by 17" sheets.
   3. Provide a hardcopy set of applicable drawings in each control panel and one binder with a hardcopy of all record drawings.
   4. Provide a copy of all record drawings to the Owner and Engineer in AutoCAD DWG format or Adobe PDF format on a USB drive. .pdfs shall have integral bookmarks denoting all sections and subsections. USB drive shall be clearly labeled.

C. Refer to the other Division 13 Sections for additional O&M requirements.

D. O&M Manual Organization:
   1. O&M's shall be organized to be easily navigable. Devices shall be arranged by group and type. Example, all flow meters will be grouped together and arranged so that mag meters are together, than thermal mass meters, etc. .pdf's shall be bookmarked.
   2. The hardcopy operations and maintenance manuals shall be organized in three ring binders with a maximum size of 4". The following is a proposed outline for the O&M Manual(s), provide applicable Sections and information:

TITLE

Table of Contents

Section 1 - Reserved for description of system by Owner

Section 2 - Field Instruments (arranged by device group and type, ex. Flow meters, submersible level, floats, etc.)

2.1 Instrument schedule / Bill of Materials.

2.2 ISA data sheets and instrumentation listing with part numbers

2.3 O&M literature for each type of instrument with labeled dividers

2.4 Instrument configuration data

Section 3 - Panel Equipment (arranged device type)

3.1 Bill-of-Material Table

3.2 O&M and Manufacturer's literature

Section 4 - Miscellaneous devices (arranged alphabetically by manufacturer)

4.1 Bill-of-Material Table

4.2 O&M and Manufacturer's literature

Section 5 - Drawings
5.1 Network drawings
5.2 Panel fabrication and assembly drawings
5.3 Panel wiring diagrams
5.4 Interconnection wiring diagrams
Section 6 - PLC
6.1 CPU, memory capacity, communication ports
6.2 Rack Layout and module configuration
6.3 I/O List
6.4 PLC communication parameters/ port configuration
Section 7 - Miscellaneous Data
7.1 Data Networking Equipment List
7.2 Data Networking Equipment Configuration, IP Addresses, Layout, and Security Access.
Section 8 - Software programs and PDF Literature
8.1 PLC Programming Software
8.2 OIT Programming Software
Section 9 - Program
9.1 PLC Program in native format with data tag registers, cross reference list, and comments.
9.2 OIT programs in native format with screen color Printouts, communication configuration, and data tag printout.
9.3 SCADA programs with screen color printouts, communication configuration, and data tag printout.
9.4 Custom Report Printouts
9.5 Alarm Configuration and alarm tag printouts.

E. The cover and edge of each volume shall contain the following information:

Project Name
Owner's Name

Instrumentation and Control System
Operations and Maintenance Manual
Specification Section 13###
Volume X of Y
(where X is the volume number and Y is the number of volumes)
Subcontractor Name, Date

F. Electronic O&M Information:
1. Supply all electronic files on USB drive
   a. .PDFs shall be bookmarked by order of O&M.
   b. Scanned .PDFs shall not be accepted.
2. Refer to other Division 13 specifications for additional information.

G. Warranty Documentation: The Contractor and System Integrator shall investigate, diagnose, repair, update and distribute all pertaining documentation of deficiencies which become evident during the warranty period. All such documentation shall be submitted to the Engineer within 30 days of solving the problem.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. All of the equipment and software shall be the manufacturer's latest proven design. If a piece of equipment or software was sole sourced, but is no longer the current version, the SI shall propose and carry the latest version of the product migration path. Specifications and Drawings call attention to certain features, but do not purport to cover all details entering into the design of the instrumentation and process control system. The completed system and the equipment furnished by the Contractor shall be compatible with the functions required.
2. Components shall be finished to the manufacturer's standard for the service intended unless otherwise indicated in the Specifications or on the Drawings.
3. All electrical components of the system shall operate on 120-volt, single-phase, 60-Hertz current, except as otherwise noted in the specifications and drawings. Power shall be supplied from either local electrical distribution panels, or an associated control panel UPS with breakers for each circuit as indicated on the Instrumentation and Electrical drawings.
4. All controls for electrically operated or motor-driven equipment (including electrically actuated valves, small pumps and chemical feed equipment, etc.) shall be complete, including all necessary auxiliary relays, so as to require only wiring and connections to the equipment control circuit. All contacts for control of motor-operated or electrically operated equipment shall be rated not less than 10 amperes on 120 volts unless otherwise specified herein.
5. Panel components including switches, relays, instrumentation, etc. supplied by the various process equipment manufacturers, but indicated to be installed within panels furnished by the System Integrator, shall be furnished to the System Integrator for incorporation into his panels. Equipment shall be installed to the manufacturers requirements and recommendations. System Integrator shall install these items within his panel and shall produce a complete, functional, pre-wired system for installation requiring only external power and instrumentation connections. The Contractor shall coordinate this requirement and shall ensure that equipment manufacturers provide all necessary installation instructions and requirements to the System Integrator.
6. Identification:
    a. All panels, and control devices shall have identifying nameplates. Equal quality nameplates shall be attached to all field-installed units.
    b. Each field transmitter shall have an attached manufacturer's tag with the Manufacturer's name, model number, serial number, power requirements, and scaled range of the instrument.

c. Provide suitable lamicoid labels for each process measurement element and transmitter. Label will identify each medium being measured, range and units of measurement and indicating transmitter/element ID No., for example:

Harward Pump Station Flow
0.0 to 5,000.0 (GPM)
HAR-FIT-PSP

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. The Specifications and Drawings do not attempt to fully indicate the degree of assembly, subassembly, shipped condition, extent of field work, or degree of accuracy required to install the equipment or materials. The Contractor shall be required to rely on his prior experience or to otherwise inform himself of the amount of field work required to assemble, erect, and install the equipment or material, as received, to produce a finished installation ready for use or operation.
2. All equipment installed as part of the work shall be positioned, assembled, aligned, doweled, and otherwise set to the tolerances required by the equipment manufacturer. Where tolerances and methods are not specifically indicated, they shall be in accordance with best millwright practice.
3. All materials incorporated in the work shall be installed in accordance with the Drawings and Specifications. Where detailed drawings or technical specifications are not provided, the materials shall be installed in accordance with the manufacturer's preferred recommendations and conforming to the best practice of the trade involved. Installation shall include all accessories required to produce a completed installation ready for use.
4. The Owner will assume no liability or responsibility for any portions of the installation under this Contract until they are demonstrated and accepted in writing. Final demonstrations shall be made only after the Owner and Engineer are satisfied that the work has been completed in accordance with the intent of the Contract Documents.
5. Sensors or instrumentation to be installed shall be provided with sufficient cable length and mounting configuration for easy removal, service, and replacement. The service of the instrument shall not require its wiring removed or disconnected. Any instrument found deficient in this area shall be reconfigured by the Contractor as approved by the Engineer at no additional cost to the Owner or Engineer. Refer to instrumentation details or submit an RFI prior to procurement, submittal, and/or installation.

B. Electrical Work:

1. All electrical work shall conform to the requirements indicated in Division 16.

C. Procedures Prior to Startup:
   1. The Contractor and System Integrator shall:
      a. Coordinate and schedule the work of the service personnel necessary. The System Integrator shall be onsite during VFD and MCC startup and configuration to verify proper connection and scaling to the control panel using PLC program.
      b. All wiring will be installed, terminated, and tested by the Contractor in each control panel. Wire labeling shall be coordinated between the SI and the Electrical Contractor during construction to assign terminal numbers in loop drawings of all field terminations, including intermediate junction boxes. Refer to Section 16000.
      c. Calibrate and configure all Division 13 supplied instrumentation as specified in Section 13440.
         i. Verify that each instrument is properly installed, configured, and is properly measuring values for the application.
         ii. Coordinate that the control system is scaling matches the instrument scaling.
         iii. Provide digital averaging/filtering or any other advanced configuration where required for proper equipment control. This “filtered” engineering process signal used for process control shall accurately track and represent the original engineering process signal without “turbulence”, “signal delay” or “signal droop”.
         iv. Configure all instruments to fail in the safest condition for the specific application. Example, a wastewater pump station with backup floats should have the analog level measurement fail low and a water plant finish water chlorine instrument should fail to a value to shut the facility down.
      d. Verify the facility installation.
      e. Be onsite during Equipment Startup to verify equipment wiring and basic functionality of Division 13 furnished equipment.
      f. Coordinate and verify interface with electrical equipment, including field wiring terminations.
      g. Prior to the witnessed site acceptance testing, the System Integrator shall perform a preliminary test to verify operation prior to witnessed testing. The Contractor shall assist as necessary.
      h. Perform and IO checkout from field device to PLC prior to any automated and PLC testing.
         i. The System Integrator shall monitor and manipulate the PLC inputs and outputs through the PLC program.
         ii. The Contractor, Electrical Contractor, and SI will assist with testing IO from devices. The individual(s) assisting with checkout shall be qualified to do the required testing.
      i. Coordinate VFD interface and scaling.
      j. Document hardware configuration and wiring information.
      k. Configure all furnished network equipment unless otherwise specified.
      l. Demonstrate network functionality.

D. Site Acceptance Testing
   1. A Site Acceptance Test shall be performed on each Division 13 control system after the installation at each site to verify that each instrument and equipment drive is connected properly to the control panel and that all functions of the control panel are operating as specified.
      a. The Contractor shall schedule Startup and SAT activities with the Engineer at least 5 business day in advance.
      b. The Contractor shall not schedule more than 3 days of site acceptance testing, or training during any week without agreement from the Engineer and Owner. No site acceptance testing shall occur on Fridays without agreement from the Engineer and Owner.
      c. Additional SAT activities restrictions may be determined by the Owner.
   2. The Contractor and SI shall:
      a. Verify the facility installation.
      b. Demonstrate proper instrument configuration.
      c. Provide final instrument field calibration sheet/documentation after SAT has been completed.
      d. Verify accuracy of documentation, operator's manuals, software documentation, and site operating instructions, etc. after SAT has been completed. Documentation shall include all field modifications.
      e. Troubleshoot and correct any hardware deficiencies.
      f. Be available during the Site Acceptance Test to correct any hardware deficiencies and/or adjust instrument configurations as necessary.
      g. The SI will be responsible for all PLC, OIT, and SCADA programming. The Contractor will be responsible for all hardware and equipment unless otherwise specifically stated.
      h. Demonstrate each functional requirement identified by the Specification.
      i. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices and operation of equipment shall be closely coordinated with Engineer and Owner's staff.
      j. Demonstrate all networking functionality.
      k. Verify system performance parameters and system responses under field operational conditions.
      l. Demonstrate all equipment control functions, including the operation of automatic control strategies. Actuation of field devices and operation of equipment shall be closely coordinated with Engineer and Owner's staff.
      m. Provide digital averaging/filtering or any other advanced configuration in instruments or PLC program where required for proper equipment control.
      n. Verify system performance parameters and system responses under field operational conditions.
      o. Verify accuracy of documentation, especially operator's manuals, software documentation, and site operating instructions. Documentation shall include all field modifications.

p. Provide completed site acceptance testing (SAT) test documentation. Including:
   i. Startup reports
   ii. Initial startup values

3. The SAT will be observed by the Engineer and/or Owner's representative.

E. Refer to Section 01800 for additional startup, testing, training requirements for the instrumentation equipment.

END OF SECTION

SECTION 13440

INSTRUMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:

1. Field Instruments:
   a. Furnish and install the instrumentation as shown on the Drawings and listed in the Instrumentation Schedule at the end of this Section. The locations of the instruments are shown on the Process and Electrical Drawings.
   b. Instruments shall be installed in accordance with the Drawings and as indicated in the Manufacturer's installation manuals. Any deviation in instrumentation or electrical installation requirements for the supplied equipment shall be provided at no additional cost to the Owner.
   c. Provide support as necessary during Site Acceptance Testing to adjust the configuration of field instruments (E.g. signal dampening, ranges, echo suppression, etc.).
   d. Provide ISA sheets and instrument configuration documentation after acceptance testing.
2. Miscellaneous:
   a. Furnish and install all transducers, media converters, protocol converters, terminals, transformers, interposing or pilot relays (for both new and existing equipment), signal transmitters, signal splitters/boosters, intrinsic safety barriers, power supplies, power supply connections and other miscellaneous instrumentation required to make a complete system.
   b. Furnish and install all vendor or manufacturer cables and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals with sufficient service loop. Manufacturer cables between elements and transmitters shall not be spliced without prior engineer approval. All methods, materials and supplies will meet the requirements of Division 16.
   c. Furnish mounting hardware for each instrument. The System Integrator will provide information on the proper installation in accordance with the Manufacturer's requirements for each instrument and shall supervise the installation. Tubing, process taps and an isolation valve will be provided under Mechanical in Division 11 and 15 unless otherwise specified. Coordinate the size and type of connection required. Refer to the Instrument Installation Detail Drawing in the Contract.
3. Acceptance Testing:
   a. Additional Requirements are specified elsewhere including but not necessarily limited to Section 01800, 13410, and 13444.
4. O&M Documentation:
   i. Provide complete O&M documentation as listed in Specification 13410, including:

(1) Final ISA S20 instrument data sheets (or equivalent) with updated calibration data. The ISA instrument datasheet shall be representative of the latest version. If the calibration and configuration data is on the instrument configuration sheets, the calibration and configuration data does not need to be replicated.

(2) Instrument configuration sheets (often seen in the appendixes of the instrument manuals). Configuration sheets shall be completed with all non-default setup values.

5. Coordination:

b. Provide manufacturer recommended installation and mounting requirements for each instrument to be connected to process equipment, piping or fittings requiring a process connection such as NPT taps, sample piping and process line insertion. The System Integrator will supervise and provide guidance on proper installation of instrumentation equipment. This shall include manufacturer's recommended mounting installation requirements (clearances for level sensors per manufacturer's blanking distance, etc.) Refer to the execution requirements below for additional installation requirements.

B. Requirements specified elsewhere:

1. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

a. Section 13410 Instrumentation and Process Control General (and as referenced).

1.2 QUALITY ASSURANCE

A. Materials and equipment furnished under this Contract shall be standard products of manufacturers regularly engaged in manufacture of such products and shall be manufacturer's latest standard design that complies with Specification requirements. Products shall essentially duplicate material and equipment that have been in satisfactory local use at least three years.

B. Refer to installation section for qualification of the individuals configuring and calibrating provided instruments.

1.3 SUBMITTALS

A. Shop Drawings and Samples:

1. Submit Shop Drawings and O&Ms in accordance with General Conditions Section 01340, 13410, and as indicated herein.

a. Schedule with all tags, part numbers, quantities, and authorized area representative.

b. Manufacturer's scale or dimensioned drawings and cutsheet along with standard catalog number. Catalog number shall be written on any cutsheet that has an extensive part number or highlighted.

c. Equipment ratings, service clearances and configuration.

d. Listing of accessories to be furnished

e. ISA Instrument Sheets (or equivalent)

2. All material shall be contained in one submission; partial submissions will not be accepted.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. Furnish and install all vendor or manufacturer cables and appurtenances between primary instruments and the transmitters, receiving instruments or destination terminals. All methods, materials and supplies will meet the requirements of Division 16.
2. Furnish mounting hardware for each instrument. The System Integrator will provide information on the proper installation in accordance with the Manufacturer's requirements for each instrument and shall supervise the installation. Tubing, process taps and an isolation valve will be provided under Mechanical in Division 11 and 15. Coordinate the size and type of connection required. Refer to the Instrument Installation Detail Drawing in the Contract.
3. Provide manufacturer recommended installation and mounting requirements for each instrument to be connected to process equipment, piping or fittings requiring a process connection such as NPT taps, sample piping and process line insertion. The System Integrator will supervise and provide guidance on proper installation of instrumentation equipment. This shall include manufacturer's recommended mounting installation heights and locations for gas detection sensors, clearances for level sensors per manufacturer's blanking distance, etc.
4. Refer to Section 13410.

B. Instrumentation Equipment (Refer to Instrumentation Schedule at the end of this Section)

1. **Magnetic Flow Meters and Indicating Transmitters: FE/FIT**
   a. Provide electromagnetic type flow meters, as indicated in the Instrumentation Schedule, with the following requirements.
   b. Transmitter:
      i. Type: Remote Wall Mount
      ii. Display: Backlit LCD
      iii. Power: 120 VAC
      iv. Accuracy: Minimum 0.50% of rate above 1 ft/s fluid velocity
      v. Analog Output: 4 to 20 mA DC
      vi. Discrete Output: Sinking 24 VDC Pulse
      vii. Operating Temperature: -4 to 120 ºF
      viii. Electrical Connections: ½" NPT
      ix. Enclosure Rating: NEMA 4X
      x. Communications Protocol: None
      xi. Memory: Non-volatile
      xii. Measuring Range: Per Instrumentation Schedule

c. Measuring Element:
   i. Type: Flange Style flow tube for continuous flow measurement
   ii. Applications:
      (1) Pretreated Wastewater
   iii. Materials:
      (1) Housing & Flanges: Carbon Steel with painted corrosion resistant coating
      (2) Measuring tube: 304 Stainless Steel
      (3) Liner: Hard Rubber
      (4) Measuring Electrodes: Hastelloy C
   iv. Ground Reference: Stainless Steel Ground Rings
   v. Operating Temperature: -30 to 150 °F
   vi. Operating Pressure: Max 230 psi
   vii. Electrical Connection: ½" NPT
   viii. Process Connection: ANSI B16.5 Class 150 connections compatible with the type and classification of pipe installed.
   ix. Size: Per Instrumentation Schedule
   x. Enclosure Rating: Per Instrumentation Schedule
d. Accessories and Spare Parts:
   i. Grounding electrodes.
e. For Flow Tubes mounted in Class I, Div. 1/2 area the entire flow meter system shall be rated for that classification and carry the required Factory Mutual approval. Refer to Instrumentation Schedule for required flow tube enclosure rating.
f. The PLC shall use a counting function, in conjunction with the transmitter pulse output, to totalize flow through the flow meter. The pulse output shall close the circuit each time a configurable volume passes through the flow tube. The pulse output shall be configurable through the flow meter transmitter.
g. Equivalent to:
   i. Siemens Sitrans Mag 5000 with 5100 flow tube
   ii. Khrohne IFC 100 with Optiflux 2000 series flow tube
   iii. Rosemount 8712E with 8750W series flow tube
   iv. Endress & Hauser Proline 400 with Progmag W series flow tube
   v. Or Equal

2. **Radar Measurement for Level: LE/LT**
   a. Provide a radar transducer with remote transmitter, as indicated in the Instrumentation Schedule, with the following requirements.
   b. Transmitter:
      i. Type: Remote indication and integral transducer for continuous level measurement
      ii. Display: Backlit LCD
      iii. Power: 24 VDC Loop Power
      iv. Accuracy: 0.25% full span
      v. Analog Output: 4 to 20 mA DC
      vi. Enclosure: NEMA 4X

vii. Options: Ability to function with radar and/or ultrasonic measurement elements.

c. Transmitter / Measuring Element:
   i. Type: Non-contacting pulse radar with integrated horn antenna
   ii. Display: None
   iii. Power: 24 VDC Loop Power
   iv. Accuracy: 0.25% full span
   v. Analog Output: 4 to 20 mA DC
   vi. Operating Temperature: -40 to +150 °F
   vii. Communication: Bluetooth
   viii. Applications:
      (1) Level Measurement:
      (2) Foaming Liquids or Slurries
   ix. Beam Angle: 8°
   x. Frequency: 80GHz
   xi. Dielectric Constant: 1.4 minimum
   xii. Materials: PFA Fluoropolymer or Polypropylene
      (1) Chemically resistant to the following:
         (a) Acids
         (b) Bases
         (c) Sodium Hypochlorite
         (d) Sodium/Magnesium Hydroxide
         (e) Ferric/Ferrous Chloride
         (f) Sodium Bisulfite
         (g) Neat and Dilute Polymer
   xiii. Operating Temperature: -40 to +150 °F
   xiv. Enclosure Rating: NEMA 4X / IP 67
   xv. Measuring Range: Per Instrumentation Schedule

d. Accessories and Spare Parts:
   i. For transmitters that require a handheld device for programming and configuration provide one handheld programmer.

e. Mounting:
   i. Wet Wells:
      (1) Provide two stainless steel floor mount channel bracket

f. Transducers that are mounted in Class I, Div 1/2 designated areas shall either be explosion proof or intrinsically safe and shall carry the required Factory Mutual approval. Intrinsically safe instruments shall be protected by a suitable intrinsically safe barrier. Refer to Instrumentation Schedule for hazardous area requirements.

g. Equivalent to
   i. Siemens LR100 series and LT500
   ii. Or equal

3. **Float Type Level Switches (for Non-Intrinsically Safe circuits): LSLL, LSL, LSH, LSHH**

   a. Provide a float switch, as indicated in the Instrumentation Schedule, with the following requirements.

b. Float Switch
   i. Type: Narrow angle float switch
   ii. Applications:
      (1) Raw Wastewater
   iii. Materials: Polypropylene float
   iv. Operating Temperature: 32 to 160 °F
   v. Float Rating: Submersible
   vi. Cable:
      (1) Water resistant
      (2) Oil Resistant
   vii. Switch Contacts:
      (1) SPDT
      (2) 5 amps at 120 VAC or 24 VDC
      (3) Non-mercury mechanically activated

c. Accessories and Spare Parts:
   i. Open Tanks or Channels:
      (1) Provide a stainless steel mounting rack with an adjustable cable stop for each float switch.
      (2) External weight set for setting float switch activation angle
   ii. Building Sumps:
      (1) Wall mountable clamp for setting float switch activation level and angle

d. Equivalent to:
   i. Signal Master by SJE Rhombus
   ii. Series M by Warrick Controls
   iii. LS Float Switch by Siemens
   iv. or equal

4. **Float Type Level Switches (for Intrinsically Safe circuits): LSLL, LSL, LSH, LSHH**

a. Provide a float switch, as indicated in the Instrumentation Schedule, with the following requirements. A non-mercury float switch shall be provided with non-oxidizing contacts to allow low DC voltage signals for use with intrinsic safety devices.

b. Float Switch
   i. Type: Narrow angle float switch
   ii. Applications:
      (1) Raw Waste Water
   iii. Materials: Polypropylene float
   iv. Operating Temperature: 32 to 140 °F
   v. Float Rating: Submersible
   vi. Cable:
      (1) Water resistant
      (2) Oil Resistant
   vii. Switch Contacts:
      (1) Non-oxidizing
      (3) 0.1 amps at 125 VAC or 30 VDC
      (4) Non-mercury mechanically activated

c. Accessories and Spare Parts:
   i. Open Tanks or Channels:
      (1) Provide a stainless steel mounting rack with an adjustable cable stop for each float switch.
      (2) External weight set for setting float switch activation angle
d. Class I, Div. 1/2 Installations:
   i. Float switches that are mounted in a Class I, Div. 1/2 designated areas shall be intrinsically safe and be protected by a suitable intrinsically safe barrier.
   ii. Float switch cables will terminate in a junction box rated for Class I, Div. 1/2 areas as required by the installation. The gas tight seal, required when transitioning between hazardous and non-hazardous areas, will be installed after the junction box. The manufactured cable will be spliced in the junction box and extend to the respective control panel.
e. Refer to Instrumentation Schedule for hazardous area requirements. Equivalent to:
   i. Milliampmaster Control Switch by SJE Rhombus
   ii. 9G-EF Float Switch by Siemens
   iii. SNF-52 Series by MDI
   iv. Eco-Float Gold by Anchor Scientific
   v. or equal

5. **Gas Detection Analyzer: AE/AIT (O2, LEL, H2S)**
   a. Sensor:
      i. Type and Range:

Type	Sampling Method	Detection Principle	Range
Combustibles	Diffusion	Infrared	0-100% LEL (CH4)

      ii. Application: Hazardous gas detection in rated areas
      iii. Accuracy / Repeatability (of measured value):
         (1) LEL: ±1%
      iv. Zero Drift (of full span):
         (1) LEL: <1% / year
      v. Material: Stainless Steel / Polymide
      vi. Enclosure Rating: Class 1 Division 1 Group C&D, NEMA 4X
      vii. Operating Temperature: -4 to 150 ºF
      viii. Warrantee:
         (1) LEL: 5 years
      ix. Mounting: ¾" NPT
   b. Transmitter:
      i. Type: Wall Mount
      ii. Display:
         (1) Backlit LED with pushbutton interface
         (2) Gas levels shall be displayed on the interface
         (3) Normal, Alarm, and Fault lights shall be provided on the transmitter

iii. Power: 24VDC
iv. Inputs: One sensor
v. Analog Output: One 4-20mA DC
vi. Discrete Output: 3 SPDT Relays rated 5A @ 120VAC
(1) 2 configurable relays, configurable to be latching or unlatching and normally energized or de-energized
(2) 1 fault relay, failsafe
vii. Operating Temperature: -20 to 140 ºF
viii. Enclosure Rating: Class 1 Division 1 Group C&D, NEMA 4X
ix. Electrical Connection: ¾" NPT
(1) Hot swap sensors
x. Material: 316 stainless steel
xi. Communications: HART
xii. Warrantee: 2 years
xiii. Mounting: Wall mount

c. Accessories:
i. Provide all necessary junction boxes required to mount sensors in the locations specified and as shown on the drawings. Junction boxes shall carry the same enclosure and material ratings as the transmitter.
ii. Span gas shall be provided for each sensor.
iii. Provide and install plugs for all unused electrical connections.

d. The gas detector shall be configured to alarm at the following OSHA alarm points (any required accessories for configuration shall be provided):
i. CH4: 10% LEL

e. Thee gas detectors shall be mounted at the following heights:
i. LEL: 2 Feet Below Ceiling
ii. Transmitter: 5 feet Above Finished Floor

f. Configuration:
i. The first relay shall be wired to the NO contacts, configured to be normally de-energized and unlatching,
ii. The second shall be wired to the NC contacts, configured to be normally energized and latching with manual reset.
iii. The third relay shall be NO and normally energized (failsafe).
iv. The transmitter shall hold value during maintenance.

g. Transducers that are mounted in Class I, Div. 1/2 designated areas shall either be explosion proof and shall carry the required Factory Mutual or UL/CSA approval. Refer to Instrumentation Schedule for hazardous area requirements.

h. Equivalent to:
i. UltimaX5000 Gas Monitors by MSA
ii. Draeger. Polytron 5000/8000 series
iii. Or equal

6. **Strobe Light:**

a. Strobe lights shall be provided as shown on the drawings and in the instrumentation schedule. Strobe lights shall flash.

b. Power: 120 VAC
c. NEMA Rating: Refer to Instrumentation Schedule
d. Each light shall be provided with a mounting bracket suitable for wall mounting to the existing building.
e. Size: 90 or 120 mm
f. LED strobe light.
g. Each light shall be provided with a red Fresnel lens.
h. Equal to:
    i. Allen-Bradley 855B Round Industrial Beacon
    ii. Federal Signal
    iii. Or Equal

7. **Alarm Horn:**
    a. General: Provide strobe lights as shown on the drawings and in the instrumentation schedule.
    b. Power: Refer to instrument schedule
    c. NEMA Rating: Refer to Instrumentation Schedule
    d. Volume: Adjustable volume of 78 to 103 dBa
    e. Equal to:
        i. Adaptahorn by Edwards or equal.
        ii. Federal Signal 31X
        iii. Or equal

8. **Temperature Element, Indicator with Switch: TSL, TSH**
    a. Provide temperature switch, as indicated in the Instrumentation Schedule, with the following requirements.
    b. Temperature Switch:
        i. Type: Dual point temperature switch with thermistor type sensor. Sensor and relay shall be provided by the same manufacturer and shall be matched to make a function instrument system.
        ii. Applications:
            (1) Air
        iii. Display: LCD
        iv. Power: 24VDC
        v. Analog Output: None
        vi. Enclosure Materials: Thermoplastic
        vii. Switch Contacts:
            (1) SPDT
            (2) 10 amps at 120 VAC
        viii. Setpoint Adjustment: Programmable through onboard keypad
        ix. Operating Temperature: 32 to 122 ºF
        x. Enclosure Rating: NEMA 4X
        xi. Electrical Connections: ½" NPT
        xii. Memory: Non-volatile
        xiii. Mounting: Wall Mountable
    c. Accessories and Spare Parts:
        i. None

d. Equivalent to:
   i. Ranco
   ii. Dwyer TSW
   iii. Johnson Controls
   iv. Or equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. The Specifications and Drawings do not attempt to fully indicate the degree of assembly, subassembly, shipped condition, extent of field work, or degree of accuracy required to install the equipment or materials. The Contractor shall be required to rely on their prior experience or to otherwise inform himself of the amount of field work required to assemble, erect, and install the equipment or material, as received, to produce a finished installation ready for use or operation.
   2. All equipment installed as part of the work shall be positioned, assembled, aligned, doweled, and otherwise set to the tolerances required by the equipment manufacturer. Where tolerances and methods are not specifically indicated, they shall be in accordance with best millwright practice.
   3. All materials incorporated in the work shall be installed in accordance with the Drawings and Specifications. Where detailed drawings or technical specifications are not provided, the materials shall be installed in accordance with the manufacturer's preferred recommendations and conforming to the best practice of the trade involved. Installation shall include all accessories required to produce a completed installation ready for use.
   4. Sensors or instrumentation to be installed shall be provided with sufficient cable length and mounting configuration for easy removal, service, and replacement. Access to the instrument shall not require its wiring removed or disconnected. Any instrument found deficient in this area shall be reconfigured by the Contractor as approved by the Engineer at no additional cost to the Owner or Engineer. Refer to installation details. Coordinate with Engineer, Electrical Contractor, and General Contractor as required.

B. Electrical Work:
   1. All electrical work shall conform to the requirements indicated in Division 16.

C. Field Calibration and Configuration:
   1. All instruments shall be configured by a qualified individual with experience configuring the instruments provided.
   2. All instrumentation shall be calibrated in the presence of the Owner and Engineer using manufacturer's recommended calibration procedure and standards.
   3. All flow and level transmitters shall be factory calibrated and set up to the extent possible at the factory. Span, range, and operating parameter adjustment shall be made at the factory or in the field by a factory trained personnel. Each system shall meet the manufacturer's standard accuracy.

4. Analyzing instruments shall be field calibrated by a factory-trained engineer or technician using procedures recommended by the manufacturer. Provide all materials required for proper calibration. Calibration shall be done in the presence of the Engineer.
5. Secondary functions such as alarm actuations and pacing shall be adjusted during initial calibration and demonstrated after the system is placed in service. Range adjustments shall be sealed by colored lacquer in the presence of the Engineer immediately following calibration.
6. Process calibration, such as volumetric drawdown tests on flows and level measurements, shall be conducted on all measuring systems as requested by the Engineer.
7. Provide instrument calibration sheet if factory calibrated (per the scaled range in the instrumentation schedule) by the instrument manufacturer.
8. Each instrument will be provided with an adhesive sticker declaring the date of certified calibration and initialed by the factory authorized field personnel.
9. Update any instrument configuration documentation after acceptance testing.
10. Refer to Specification 01800 and 13410 for startup, testing, training requirements for the instrumentation equipment.

INSTRUMENTATION SCHEDULE

Note: Add prefix "HAR-" to each instrument tag.

TAG	TYPE/SIZE	DESCRIPTION	LOCATION	RANGE	UNITS	SERVICE	POWER	P&ID	SPEC. SECTION
AE-GAS AIT-GAS	LEL	Wet Well Hazardous Gas Analyzer and Indicating Transmitter	Wet Well	0-100	%	NEMA 7	24 VDC	I-00-03	13440 2.1.B.5
AL-GASA	STROBE	Inside Wet Well Upper Level Strobe	Wet Well	-	-	NEMA 7	120VAC	I-00-03	13440 2.1.B.6
AL-GASB	STROBE	Outside Wet Well Strobe	Outside Wet Well	-	-	NEMA 4X	120VAC	I-00-03	13440 2.1.B.6
AL-GASC	STROBE	Inside Wet Well Lower Level Strobe	Wet Well	-	-	NEMA 7	120VAC	I-00-03	13440 2.1.B.6
AH-GAS	HORN	Inside Wet Well Alarm Horn	Wet Well	78 to 103	dB	NEMA 7	120 VAC	I-00-03	13440 2.1.B.7
LE/LT-WW1 LIT-WW1	RAD	Wet Well Radar Level Transducer and Indicating Transmitter	Element: Wet Well Transmitter: Pump Room	0.0 to 10.0	ft	Element: NEMA 6P C1D1 Transmitter: NEMA 4X	24 VDC Loop Power	I-00-03	13440 2.1.B.2
LSHH-WW	FLT	Wet Well High-High Level Float	Wet Well	-	-	NEMA 6P C1D1	-	I-00-03	13440 2.1.B.4
LSLL-WW	FLT	Wet Well Low-Low Level Float	Wet Well	-	-	NEMA 6P C1D1	-	I-00-03	13440 2.1.B.4
FE-PSP FIT-PSP	14" MAG	Pump Station Flow Meter and Indicating Transmitter	Pump Room	0.0 to 5000.0	gpm	NEMA 4X	120 VAC	I-00-03	13440 2.1.B.1
LSH-SMH	FLT	Sewer Manhole High Level Float	Sewer Manhole	-	-	NEMA 6P C1D2	-	I-00-03	13440 2.1.B.4
LSH-PUMPRM	FLT	Pump Room High Level Float	Pump Room	-	-	NEMA 6P	-	I-00-03	13440 2.1.B.3
TSL/TSH-ELERM	TEMP	Electrical Room Low and High Temperature Switches	Electrical Room	-	-	NEMA 12	24 VDC	I-00-03	13440 2.1.B.8

MAG - Electromagnetic

FLT - Float

RAD- Radar

END OF SECTION

SECTION 13441

CONTROL LOOP DESCRIPTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes control descriptions for loop diagrams shown on the Instrumentation Drawings.

B. Control Loops Descriptions shall be used by the System Integrator (SI) for developing PLC code and SCADA development under this contract. The AESS or SI executing this specification shall be referred to as the "Programmer" herein.

C. The Programmer shall be responsible for all of the scope within this specification unless specifically stated otherwise.

D. At a minimum, all status, alarm, and control signals shown on the drawings shall be provided as such and in accordance with the CONTROL DESCRIPTIONS - GENERAL unless specifically stated otherwise.

E. The specific requirements of the custom software will be defined during the Shop Drawing submittal process, with the input of the Owner and Engineer. A meeting(s) will be held at the project site, with a representative of the System Integrator, PLC Programmer/Supplier, Client, Contractor, and Engineer, to finalize the custom programming specifications.

F. The Programmer shall update and create the SCADA Screens and alarms for the new functionality as described herein.

1. The existing SCADA software is Factory Talk, installed in 2025.

G. The Programmer shall provide 4 hours to update the reports.

H. The Programmer shall assign IP addresses and establish communication to all network Division 11 panels, VFD's and other networked equipment outside of Division 11 manufacturers

I. The specific requirements of the custom software shall be defined during the Shop Drawing submittal process, with the input of the Owner and Engineer. A meeting shall be held at the project site, with a representative of the Programmer, Client, Contractor, and Engineer, to finalize the custom programming specifications.

J. Requirements specified elsewhere:

1. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
    a. Section 13410 Instrumentation and Process Control General (and as referenced).

1.2 SYSTEM DESCRIPTION

A. Provide instrumentation hardware, software and programming as necessary to perform control functions specified herein and as shown on drawings. Ensure coordination with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

B. The specifications direct attention to certain required features of the system, but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the CONTROL LOOPS complete in all details and ready for operation.

1.3 SUBMITTALS

A. Shops
   1. Provide annotated versions of the PLC, operator interface terminal and SCADA programming files in .pdf format for review by the Engineer. Provide the PLC and OIT files 15 days prior to FAT.
      a. The programs will be submitted in .pdf format. Native format shall be provided at the engineer's request.
      b. PLC Programming and diagnostic software shall be Windows based via Relay Ladder Logic (RLL) custom programming tools for the PLCs
      c. RLL will be fully documented including a listing of each task/function. Annotations shall clarify the intent of each task/function with a description of the process so that the engineer or a future programmer will be able to clearly understand.
   2. PLC programming logic (ladder logic, function blocks, structured text, etc.). Include the following:
      a. PLC I/O configurations
      b. PLC communication configurations
      c. PLC cross reference list
      d. PLC tag data base and memory usage
   3. OIT Program. Submit the following:
      a. OIT communication configurations
      b. OIT Screen List
      c. OIT Screen printouts

B. Operation and Maintenance Manuals:
   1. Provide annotated final versions of the modified PLC, operator interface terminal and SCADA programming files on DVD or USB drive. The PLC and OIT programing files shall be stored on individual USB drives located in each of the respective control panels as well as a USB drive with the SCADA programming files.
   2. Refer to Section 13410 for additional O&M sections.

C. All PLC, OIT, and SCADA programs are property of the Owner. All programs shall be unlocked, the program nor functions or add-on instructions within the program shall have a password.

PART 2 - PRODUCTS – NOT APPLICABLE

PART 3 - EXECUTION

3.1 CONTROL DESCRIPTIONS – GENERAL

A. The OIT and SCADA setup and programming shall include:
   1. Graphic screens to monitor equipment status (on/off, enable, speed, etc.) and process instrumentation (i.e. wet well levels, etc.); elements to allow easy review and adjustment of process parameters; trending screens for measure

process values such as flow and level; alarm adjustment screen with ability to adjust (if required), set delay time and activate/deactivate each alarm condition and alarm summary screen with acknowledge.

2. Provide all screens needed for process and equipment monitoring, equipment control, operating parameter adjustment, and alarms as specified. A minimum list of OIT/SCADA screens is as follows:
    a. Process System Overview: Screens shall be provided for each major process system for process and equipment monitoring, equipment control, operating parameters adjustment, and Alarms as described in Section 13440 and herein. Operators shall be able to access specific function screens from each Process System Overview Screen as applicable, showing process control variables and alarm set-ups, tank levels, etc. upon clicking the piece of equipment or tag setting displayed on process system overview screen.
        i. Process and Equipment Setting Screens: Setpoint and tuning settings that are will be available though popups located on equipment or process system screens as appropriate.
        ii. System adjustment parameters shall be done with multi-tiered popups. Primary system setpoint changes (E.g. elevations, etc.) will be available at the first level. Secondary parameters (E.g. system minimum/maximum speeds, etc.) that require little or intermittent changes will be available at subsequent levels.
        iii. An indicator will be shown next to or on each piece of equipment to indicate if it is available for automatic operation. This is noted as Equipment Availability.
        iv. Operators shall be able to access more detailed equipment screens upon clicking on equipment displayed on the process system screen.
        v. A checklist of System Availability will be shown on the Process System screens. System Availability is defined herein.
    b. Equipment Screens: Equipment screens are to show the status of each piece of equipment. Operators will be able to modify the HOA status of the equipment, change the speeds, see the run totalizer, amperage, speed feedback, etc.
        i. The Equipment screen will show a list of all items that prevent it from running in automatic from the PLC. Equipment Availability is defined herein.
    c. Menu Screen and Navigation:
        i. Provide a Menu screen to easily navigate through all the process systems. Additionally provide a dropdown menu for navigation as well.
        ii. Provide a back button on each screen to navigate to the previous screen.
    d. Alarm Summary and Alarm Set-up Screens
        i. Provides all alarms with alarms, descriptions, setpoints, enable/disable, alarm status, etc. Alarms shall be grouped by equipment.

ii. The alarm screens will show all current and past alarm conditions along with the date/time of activation and date/time of acknowledgment. Each alarm condition will be maintained in a database which shall include the ability to track alarm frequency. The operator will be capable of printing out an alarm report for a selected period of time and removing old data from the system.

e. Equipment Run Time Screen

f. Flow Totalizer Screen (today, yesterday, total, resettable)

g. Trending Screens (SCADA Only):

i. Provide trends for all signals identified herein and trend grouping as herein.

ii. Trends to be grouped by system (E.g. disinfection, filter, etc.). Trends are to be used on multiple system screens as required.

iii. Trends on pages will be able to be easily removed or added to pre-built pages by clicking on the tag

iv. The following trending screens shall be provided at a minimum:

(1) Wet Well Level, Station Flow, Pump Run Status, Pump Speed Feedback

3. All screens shall show an alarm acknowledge and alarm reset pushbutton.

4. All screens shall show the status of the automated alarm dialer in the banner or header.

5. The Division 13 System Integrator shall employ and make use of the software manufacturers ability to utilize global objects (dynamos, genies, etc.) for pumps, valves, pushbuttons, pilot lights, etc. whereby changing the properties of the global object, is reflected in that object throughout the entire project.

B. The SCADA system shall automatically track and accumulate the operating hours of all major equipment provided under this contract. The totalized time and a reset for each time meter shall be displayed on the equipment run time screen.

C. All Control Loop programming shall be done in the PLC where the inputs/outputs terminate unless otherwise stated. All PLC tags shall be descriptive in nature.

D. Equipment Fail Alarms:

1. Equipment Fail alarms are defined as a condition where a command is given and the status confirmation of that command is not received within an acceptable time-frame. Fail Alarms shall not be triggered in the event of Loss of Power, or any other alarms related to the equipment (i.e. High Temp, O/L. Fault, Low Pressure, etc.). Examples are as follows:

a. Fail to start-stop: A piece of equipment is given the command to start and the running status is not confirmed within an appropriate time delay. Conversely a piece of equipment is commanded to stop and the run status does not drop out within an appropriate time delay.

b. Fail to make speed: A VFD driven piece of equipment is commanded to go to a specific speed and it does not reach that speed (within a deadband) within an appropriate time delay.

2. Provide the applicable Equipment Fail alarms for all equipment based on type and I/O available.

E. In the event of an instrument or process analyzer failing or loss of signal, the PLC shall the default safest condition to not upset the product or process condition/control. Failing conditions may be different by instrument type and shall be finalized during construction.
   1. For example, level instrument failure in a wet well should go to a low level to not run the pumps dry.
   2. An alarm shall be generated as "loss of signal" for that particular instrument/analyzer.

F. Control Loops
   1. Local LOR/HOA – all local hardware selector switches shall:
      a. In Local or Hand position run the associated equipment to be used in conjunction with a potentiometer for VFD speed.
      b. In Off position, Stop the associated equipment
      c. In Remote or Auto position, the control of the associated equipment shall be transferred to the PLC. At the OIT/SCADA the operator shall control the equipment with a software HOA. The OIT/SCADA system will display the "In Remote" and "Not in Remote" status based on an auxiliary contact in the Remote position. This status shall be displayed near the software selector switch. The same shall apply for "Auto" and "E-stop".
   2. Software LOR/HOA/MOA – all OIT/SCADA software selector switches shall:
      a. In Hand position, Run the associated equipment in manual mode whereby an operator can adjust the setpoint speed.
      b. In Off position, Stop the associated equipment from running remotely.
      c. In Remote or Auto, the control of the associated equipment shall be transferred to PLC control as described in the control loop.
      d. Related alarms such as Motor High Temperature, E-Stop, etc. shall be displayed as statuses at the LOR/HOA controls or with the equipment status.
   3. Flow Totalizing –
      a. All flow meters shall be configured in PLC for flow totalizing with display at OIT/SCADA.
      b. Flow totals shall be configured as both running totals (today, yesterday, lifetime, and resettable).
      c. Systems with more than one flow meter will also have a combined flow totalizer in the same style.
      d. Flow meters from other divisions shall be displayed and totalized similarly.
   4. Runtime Hours Totalizing –
      a. All equipment with a Run Status signal shall be configured in the PLC for run hour totalizing with display at OIT/SCADA.
      b. Runtime Hour totals shall be configured as both running totals with a password protected (or higher user privilege) reset and with a separate pushbutton resettable total.
   5. Alarms: All alarms shall be displayed and identified:
      a. The specification may assign initial alarm prioritization. Owner and engineer reserve the right to change alarm priority at no cost.

b. All alarms will be able to be enabled or disabled by SCADA users. Refer to the Security Section below.
c. All alarms shall be latched upon activation and reset with the Alarm Acknowledge pushbutton unless otherwise specified.
d. All alarms, unlatching and latching shall be logged in the alarm history.
e. All alarms shall be able to be enabled or disabled with a button.
f. Delays – Alarms shall activate if TRUE setpoint exceed for this adjustable time period (0-600 seconds, initially 5s) unless otherwise specified.

6. Analog Alarms: shall be configured at the OIT/SCADA with the following (operator adjustable):
   a. Low and High Setpoints as specified in specific loops below
   b. Low-Low and High-High Setpoints as specified in specific loops below.
7. Digital Alarms: all alarms noted as such or as other (fault, overload, fail, E-Stop, etc.) on drawings as shall be configured at the OIT/SCADA with the following (operator adjustable):
8. Timer modes: Any control that requires a duration setpoint shall include a countdown displayed value to indicate to the operator the length of time until the mode expires or starts.
9. Totalizer modes: Any control that requires a totalized setpoint shall include a current total displayed value to indicate to the operator the current progress towards the setpoint.
10. PLC Failure Mode: Upon PLC failure, all discrete outputs shall de-energize to an off condition.
11. Mode or equipment selections shall be selected by a description. Selecting a number associated with a selection shall not be acceptable.

G. Emergency Standby Power:
   1. The System Integrator shall provide programming of time delays to stagger restarting of equipment and loads as sequenced in Section 16620 – Diesel Generators.
   2. The adjustment, sequencing, and staging of the loads will be adjustable by Supervisor account levels or higher.

H. Reading/Writing across the Network– Provisions shall be made such that multiple points of access have the ability to change setpoints and modes. This functionality shall be furnished such the setpoint or command will automatically reset and the operator does not have to intervene. The setpoint or command shall change to a value that does not have control in the system once the required change is made.

3.2 CONTROL PANEL DESCRITIONS – MASTER TELEMTRY UNIT

A. General: The MTU PLC at the treatment plant shall be modified to communicate with the new PLC at the Harward Pump Station.

B. PLC:
   1. If the PLC does not have communication with Harward Pump Station, it will wait 30 seconds, then try again. After 4 consecutive failed communication attempts (2 minutes), the MTU will activate a Harward Pump Station Loss of Communications Alarm, then move onto the next pump station. The MTU will then try again on the next polling cycle.
   2. The PLC will calculate, display, and trend the polling reliability to Harward Pump Station.

3. The Harward Pump Station PLC shall send an unsolicited message to the MTU PLC in the event of a:
    a. High Level Alarm
    b. High-High Level Alarm
    c. E-Stop Alarm
4. Alarms at SCADA:
    a. Harward Pump Station Loss of Communication Alarm
    b. Alarms in the following control narrative
5. Monitoring and Control at SCADA:
    a. Harward Pump Station Polling Reliability Display and Trend
    b. Monitoring and Control in the following control narrative

3.3 CONTROL PANEL DESCRIPTIONS – HARWARD PUMP STATION CONTROL PANEL

A. Loop CP – Control Panel Status

1. General: Three status lights will be on the face of the Control Panel to provide an indication of panel status. The PLC generates one latching Common Alarm that illuminates a light on the face of the panel. A Reset pushbutton on the panel shall unlatch the alarms.
2. Panel Control definitions are defined on the Instrument Drawing I-00-01.
    a. Normal Power Indicator Light (YL-CP)
    b. Common Alarm Indicator Light (AL-CPA)
    c. Reset Pushbutton (HS-CPA)
    d. Backup Active Indicator Light (AL-CPB)
3. Local Control:
    a. The Normal Power indicating light (YL-CP) shall be illuminated and power fail relay shall be energized when the control panel is powered from an external 120 VAC power circuit.
    b. When power from the external 120 VAC circuit is lost and the control panel is powered by the UPS, the power fail relay will de-energize and the Normal Power indicating light shall not be illuminated.
4. PLC:
    a. The PLC shall monitor the power failure contact and shall activate the Control panel Power Fail alarm if an adjustable on-delay timer expires (0 to 600 seconds, initially 60 seconds).
    b. The PLC shall output a common alarm if any of the alarms configured in the PLC program are active. This common alarm output shall activate the Common Alarm indicating light on the panel (AL-CP).
    c. The contact stat of the reset pushbutton (HS-CP) shall be monitored by the PLC. When pushed, the hardwired control shall reset the PLC fail Alarm and the PLC shall unlatch the Common Alarm if the alarm condition has returned to normal.
    d. The PLC shall monitor the UPS fail contact (EY-CP) and shall activate an alarm if an adjustable on-delay timer expires (0 to 600 seconds, initially 10 seconds).
    e. The PLC shall monitor the Surge Alarm contact (ESH-CP) and shall activate an alarm if an adjustable on-delay timer expires (0 to 600 seconds, initially 10 seconds).

f. The PLC shall monitor and display the Backup Control active status if the contact is activated. When Backup Control is active, the Backup Control Indicator Light shall be illuminated.
g. The PLC shall activate a Loss of Communication Alarm if the RTU PLC unsuccessfully attempts to communicate with the MTU after a user adjustable Communication Alarm Attempts (0-10, initially 3).

5. Alarms at OIT/SCADA:
   a. Harward Control Panel Power Fail Alarm
   b. Harward Control Panel UPS Fail Alarm
   c. Harward Control Panel Surge Alarm
   d. Harward Control Panel Loss of Communications Alarm

*Alarm delays and setpoints only available at the OIT.

6. Monitoring and Control at OIT/SCADA:
   a. Harward Control Panel Reset Pushbutton
   b. Harward Control Panel Backup Control Active Status
   c. Harward Control Panel Communication Alarm Attempts

B. Loop GAS – Wet Well Gas Detection

1. General: The wet well is monitored for combustible gas. Three strobe lights and one alarm horn will be hardwired to activate when a High LEL level is detected. The “Silence” pushbutton on the front of the control panel will silence the horn, and the strobe lights will deactivate once the High LEL condition has cleared. The “Test” pushbutton on the front of the control panel will be used to test the alarm horn and strobe lights.
2. Field Instruments:
   a. AE/AIT-GAS: LEL Gas Analyzer and Indicating Transmitter
   b. AL-GASA: Inside Wet Well Upper Level Strobe Light
   c. AL-GASB: Outside Wet Well Strobe Light
   d. AL-GASC: Inside Wet Well Lower Level Strobe Light
   e. AH-GAS: Wet Well Alarm Horn
3. PLC:
   a. The PLC shall activate a Wet Well High LEL Alarm when the contact activates (delay 0 to 600 seconds, initially 5 seconds).
   b. The PLC shall activate a Wet Well LEL Instrument Fault Alarm when the contact activates (delay 0 to 600 seconds, initially 5 seconds).
4. Alarms at OIT/SCADA:
   a. Harward Wet Well High LEL Alarm
   b. Harward Wet Well LEL Instrument Fault Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
   a. None.

C. Loop ATC – ATC Panel Monitoring

1. General: The ATC Panel is monitored for a loss of flow alarm
2. Field Instrument:
   a. None.

3. PLC:
    a. The PLC shall activate an ATC Panel Loss of Flow Alarm when the contact activates (delay 0 to 600 seconds, initially 5 seconds).
4. Alarms at OIT/SCADA:
    a. Harward ATC Panel Loss of Flow Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
    a. None.

D. Loop WW1 – Wet Well Level Monitoring

1. General: The wet well stores sewage from the collection system before it is pumped to the wastewater treatment facility by the pump station pumps. The wet well level is continuously monitored by a radar level instrument. High-high and low-low level floats are used for alarming and backup pump control.
2. Field Instruments:
    a. LE/LIT-WW1: Radar Level Transducer and Indicating Transmitter
    b. LSHH-WW1: High-High Level Float
    c. LSLL-WW1: Low-Low Level Float
3. PLC:
    a. The level in the wet well shall be monitored, displayed, and trended at the OIT and SCADA.
    b. The PLC shall activate a Wet Well Radar Instrument Fail Alarm when the measured level is outside the range (delay 0 to 600 seconds, initially 60 seconds).
    c. The PLC shall activate a Wet Well High Level Alarm when the level in the wet well is above the High Level Setpoint (0.0-10.0ft) for a period of time (delay 0 to 600 seconds, initially 5 seconds).
    d. The PLC shall activate a Wet Well Low Level Alarm when the level in the wet well is below the Low Level Setpoint (0.0-10.0ft) for a period of time (delay 0 to 600 seconds, initially 5 seconds).
    e. The PLC shall activate a Wet Well High-High Level Alarm when the high-high level float switch contact activates (delay 0 to 600 seconds, initially 5 seconds).
    f. The PLC shall activate a Wet Well Low-Low Level Alarm when the low-low level float switch contact activates (delay 0 to 600 seconds, initially 5 seconds).
    g. The Operator shall be able to enter a user adjustable scale of the wet well level instrument at the OIT.
4. Alarms at OIT/SCADA:
    a. Harward Wet Well Radar Instrument Fail Alarm
    b. Harward Wet Well High-High Level Alarm
    c. Harward Wet Well High Level Alarm
    d. Harward Wet Well Low Level Alarm
    e. Harward Wet Well Low-Low Level Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
    a. Harward Wet Well Level and Trend
    b. Harward Wet Well Level Instrument Scale (OIT Only)

E. Loop PSP1, PSP2, PSP3 – Pump Station Pumps No.1,2,3

1. General: Three submersible pumps convey sewage from the wet well to the wastewater treatment plant. Pumps No.1,2 (PSP1, PSP2) are duty pumps and Pump No.3 (PSP3) is a jockey pump.
    a. Each pump shall have a virtual Manual/Off/Auto selector switch at the OIT. In Auto, the PLC shall run the pumps in proportional control based on the level in the wet well. In Proportional control, the PLC shall ramp the pumps from a minimum to maximum set speed between on and off levels.
    b. When the level in the wet well rises to the "Jockey Pump On" level, the jockey pump will run until the "Jocky Pump Off" level has been reached. If the jockey pump is running and the wet well reaches the "Duty Pump On" level, the jockey pump will turn off and the duty pump will turn on. The duty pump will run until the "Duty Pump Off" level has been reached. If the wet well continues to rise to the "Jockey Pump On (Wet Weather)" level, the jockey pump will turn on and run in combination with the duty pump. The duty pump will turn off when the wet well reaches the "Duty Pump Off" level and the jockey pump will turn off when the "Jockey Pump Off (Wet Weather)" level has been reached.
    c. The VFDs shall operate within adjustable VFD minimum and maximum speed setpoints.
    d. The duty pumps shall automatically alternate each time the duty pump turns off.
2. Field Instruments:
    a. None.
3. PLC:
    a. Pump Monitoring:
        i. The status of the pump will be displayed at OIT/SCADA as RUN/STOP based on the run status contact. The PLC will totalize the run time hours.
        ii. The PLC will activate a Motor High Temp Alarm when the contact activates (delay 0 to 600 seconds, initially 5 seconds).
        iii. The PLC will activate a Pump High Temp Alarm when the contact activates (delay 0 to 600 seconds, initially 5 seconds).
        iv. The PLC will activate a VFD Fault Alarm when the Fault contact activates (delay 0 to 600 seconds, initially 5 seconds).
        v. The PLC will monitor, display, and trend the speed feedback of the VFD (0.0 to 100.0%).
        vi. The Operator shall be able to set a VFD Minimum and Maximum Speed for the jockey pump and the duty pumps.
            (1) Pump Station Pump No.1,2: 0.0 to 100.0%, initially 80.0% and 100.0%
            (2) Pump Station Pump No.3: 0.0 to 100.0%, initially 80.0% and 100.0%
        vii. The PLC will monitor, display, and trend the load feedback for the VFD (0.0 to 100.0%).

viii. The PLC will activate a High Load Alarm when the load exceeds an operator adjustable setpoint (0.0 to 100.0%, initially 80.0%) (delay 0 to 600 seconds, initially 5 seconds).

ix. The PLC will activate a Low Load Alarm when the pump is running and the load is below an operator adjustable setpoint (0.0 to 100.0%, initially 10.0%) (delay 0 to 600 seconds, initially 30 seconds).

x. The PLC will activate an E-Stop Alarm when the contact activates (fixed 1 second delay).

xi. The PLC shall monitor and display the status of the LCS HOA selector switch as LCS In Auto/LCS Not In Auto.

xii. The PLC shall monitor and display the status of the CP HOA selector switch as CP In Auto/CP Not In Auto.

b. Pump Activation:

i. The Equipment Availability Status of each piece of equipment shall be displayed at the OIT. The OIT shall show the status of each of the conditions below to identify the reason the equipment is not Available. The PLC shall not automatically control the equipment if it not available The PLC shall software interlock the equipment to prevent it from running in any capacity for items that are not asterisked (*). The equipment is Available if all the following status conditions are true:

(1) Motor High Temp Alarm: Inactive
(2) Pump High Temp Alarm: Inactive
(3) VFD Fault Alarm: Inactive
(4) LCS HOA: In Auto
(5) CP HOA: In Auto
(6) E-Stop Alarm: Inactive
(7) Fail Alarm: Inactive
(8) Virtual MOA: In Auto*

ii. The PLC shall control the Available equipment based on System Availability. The System Availability will be displayed at the OIT. The system is available if all the following status conditions are true:

(1) Wet Well Low Level Alarm: Inactive
(2) Wet Well Low-Low Level Alarm: Inactive

iii. A Fail Alarm shall be activated if the equipment is Available and the PLC attempts to start the equipment, but the return run contact does not indicate that the motor is running (delay 0 to 600 seconds, initially 30 seconds). The Fail Alarm will not activate if another software interlock alarm is active.

iv. The Operator shall be able to set the duty pumps at Lead or Standby. If the Lead duty pump becomes unavailable, the pump shall turn off and the Standby duty pump shall become the Lead duty pump.

v. If a pump is unavailable, the PLC shall not command the pump to run or trigger new alarms associated with the pump.

vi. The equipment shall have a virtual Manual/Off/Auto switch at the OIT. In Off, the equipment shall not run. In Manual, the equipment shall run at an operator adjustable VFD speed setpoint (0.0 to

100.0%).

vii. In virtual Auto, the PLC shall activate and control the speed of the pumps based on the level in the wet well.
   (1) The Jockey Pump shall turn on at the Jockey Pump On elevation and turn off at the Jockey Pump Off level.
   (2) If the level in the wet well rises to the "Duty Pump On" setpoint, the jockey pump shall turn off and duty pump shall turn on. The duty pump shall turn off at the "Duty Pump Off" setpoint.
   (3) If the level in the wet well rises to the "Jockey Pump On (Wet Weather)" setpoint, the jockey pump shall turn on. Both the jockey and duty pump will run until the duty pump turns off when the "Duty Pump Off" setpoint is reached and the jockey pump shall turn off when the "Jockey Pump Off (Wet Weather)" setpoint is reached.
   (4) Refer to Process Drawings for control elevations.
   (5) The speed of the jockey pump shall be linearly proportional between the Jockey Pump Max Speed and the Jockey Pump Min Speed level setpoints. The speed of the duty pumps shall be linearly proportional between the Duty Pump Max Speed and the Duty Pump Min Speed level setpoints.
   (6) The PLC shall use a fixed 1 second time delay at the pump on and off levels.

c. Alternation:
   i. Pump Cycle Auto Alternation shall alternate the Lead/Standby duty pump every time the duty pump turns off. The operator shall be able to disable Duty Pump Cycle Auto Alternation.

4. Alarms at OIT/SCADA:
   a. Harward Pump Station Pump No.1,2,3 Motor High Temp Alarm
   b. Harward Pump Station Pump No.1,2,3 Pump High Temp Alarm
   c. Harward Pump Station Pump No.1,2,3 VFD Fault Alarm
   d. Harward Pump Station Pump No.1,2,3 High Load Alarm
   e. Harward Pump Station Pump No.1,2,3 Low Load Alarm
   f. Harward Pump Station Pump No.1,2,3 Fail Alarm
   g. Harward Pump Station Pump No.1,2,3 E-Stop Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
   a. Harward Pump Station Pump No.1,2,3 Run Status and Runtime Totalizer
   b. Harward Pump Station Pump No.1,2,3 Speed Feedback
   c. Harward Pump Station Pump No.1,2,3 Speed Minimum and Maximum Setpoints
   d. Harward Pump Station Pump No.1,2,3 Load Feedback
   e. Harward Pump Station Pump No.1,2,3 LCS HOA Status
   f. Harward Pump Station Pump No.1,2,3 CP HOA Status
   g. Harward Pump Station Pump No.1,2,3 Virtual MOA (OIT Only)
   h. Harward Pump Station Pump No.1,2,3 Start Command (OIT Only)
   i. Harward Pump Station Pump No.1,2,3 Speed Command (OIT Only)

j. Harward Pump Station Pump No.1,2 Duty Pump Cycle Auto Alternation Enable/Disable (OIT Only)

F. Loop PSP – Pump Station Flow Monitoring
1. General: Flow from the pump station pumps shall be monitored by an electromagnetic flow meter.
2. Field Instruments:
   a. FE/FIT-PSP: Flow Meter and Indicating Transmitter
3. PLC:
   a. The PLC shall monitor, display, totalize (total, today, and yesterday), and trend the flow from the pump station pumps.
   b. The PLC shall activate a Jockey Pump Low Flow Alarm if the jockey pump is running and the flow though the flow meter is below a Jockey Pump Low Flow Setpoint (0-5500gpm, initially 300gpm) (delay 0 to 600 seconds, initially 30 seconds).
   c. The PLC shall activate a Duty Pump Low Flow Alarm if a duty pump is running and the flow through the flow meter is below a Duty Pump low Flow Setpoint (0-5500gpm, initially 300gpm) (delay 0 to 600 seconds, initially 30 seconds).
4. Alarms at OIT/SCADA:
   a. Harward Jockey Pump Low Flow Alarm
   b. Harward Duty Pump Low Flow Alarm

   *Alarm delays and setpoints only available at the OIT.
5. Monitoring and Control at OIT/SCADA:
   a. Harward Flow, Totalizers, and Trend

G. Loop SMH – Sewer Manhole
1. General: A high level float monitors the sewer manhole for flood conditions.
2. Field Instruments:
   a. LSH-SMH: High Level Float
3. PLC:
   a. The PLC shall activate a Sewer Manhole Flood Alarm when the float switch contact activates (delay 0 to 600s, initially 30 seconds).
4. Alarms at OIT/SCADA:
   a. Harward Sewer Manhole Flood Alarm

   *Alarm delays and setpoints only available at the OIT.
5. Monitoring and Control at OIT/SCADA:
   a. None.

H. Loop PUMPRM – Pump Room Flood
1. General: A high level float monitors the pump room for flood conditions.
2. Field Instruments:
   a. LSH-PUMPRM: High Level Float
3. PLC:
   a. The PLC shall activate a Pump Room Flood Alarm when the float switch contact activates (delay 0 to 600s, initially 30 seconds).

4. Alarms at OIT/SCADA:
    a. Harward Pump Room Flood Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
    a. None.

I. Loop SP1 –Sump Pump

1. General: The sump pump is monitored for run status.
2. Field Instruments:
    a. LSH-SP1: High Level Float
3. PLC:
    a. The PLC shall activate a Pump Room Sump Pump Run Alarm when the contact activates (delay 0 to 600s, initially 10 seconds).
4. Alarms at OIT/SCADA:
    a. Harward Pump Room Sump Pump Run Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
    a. None.

J. Loop ELERM – Electrical Room Temperature Monitoring

1. General: A dual temperature switch monitors the electrical room for low and high temperature conditions.
2. Field Instruments:
    a. TSL/TSH-ELERM: Low Temperature Switch
3. PLC:
    a. The PLC shall activate an Electrical Room Low Temperature Alarm when the contact actives (delay 0 to 1200 seconds, initially 600 seconds).
    b. The PLC shall activate an Electrical Room High Temperature Alarm when the contact activates (delay 0 to 1200 seconds, initially 600 seconds).
4. Alarms at OIT/SCADA:
    a. Harward Electrical Room Low Temperature Alarm
    b. Harward Electrical Room High Temperature Alarm

*Alarm delays and setpoints only available at the OIT.

5. Monitoring and Control at OIT/SCADA:
    a. None.

K. Loop GEN – Generator and ATS

1. General: The PLC shall monitor the state of the ATS and generator and provide load stepping during emergency power startup.
2. Field Instruments
    a. None.
3. PLC:
    a. Automatic Transfer Switch: The PLC shall monitor the state of the ATS for normal or emergency power conditions.
        i. The PLC shall display the status of the ATS position as In Emergency or In Utility.

ii. The PLC shall activate an Emergency Power Alarm when the ATS position contract is in the emergency position (delay 0-600s, initially 1s).
iii. The PLC shall activate an ATS Warning if the ATS is not in the Emergency or Utility position (delay 0-600s, initially 60s).
iv. The PLC shall display the status of the Utility Available and Emergency Available contacts.

b. Generator: The PLC shall monitor the generator conditions.
i. The PLC shall display the run status of the generator.
ii. The PLC shall activate a Generator Fault Alarm when the contact activates (delay 0-600s, initially 1s).
iii. The PLC shall activate a Generator Low Fuel Alarm when the contact activates (delay 0-600s, initially 30s).
iv. The PLC shall activate a Generator Low Battery Alarm when the contact activates (delay 0-660s, initially 30s).

c. Load Steps:

Step 1:	Delay 30s
Jockey Pump	
Step 2:	Delay 60s
Lead Duty Pump	

d. The PLC shall remove the start command to all equipment when the ATS moves from the Utility to Emergency position or if the Loss of Utility Power contact is active.

4. Alarms at OIT/SCADA:
a. Harward ATS Emergency Power Alarm
b. Harward Generator Fault Alarm
c. Harward Generator Low Fuel Alarm
d. Harward Generator Low Battery Alarm

*Alarm delays, load step delays, and setpoints only available at the OIT.

e. Monitoring and Control at OIT/SCADA:
f. Harward ATS Status
g. Harward ATS Warning
h. Harward ATS Utility Available Status
i. Harward ATS Emergency Available Status
j. Harward Generator Run Status
k. Harward Generator Load Steps

END OF SECTION

SECTION 13442

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. Furnish, install, program and test the programmable logic controllers (PLCs) and all graphical interfaces as shown in the Instrumentation Drawings and described in Specification Sections 13440 and 13442 herein.
   2. Furnish, install, configure, wire, and test the uninterruptable power supply (UPS) and maintenance bypass switch (MBS) as shown in the Instrumentation Drawings and described in Specification Sections 13440 and 13442 herein.
   3. Requirements specified elsewhere:
      a. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
         i. Section 13410 Instrumentation and Process Control General (and as referenced).

B. Requirements specified elsewhere:
   1. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
      a. Section 13410 Instrumentation and Process Control General (and as referenced).

1.2 QUALITY ASSURANCE

A. The PLCs and OITs form an integral part of the overall control system for the facility and as such all PLCs shall be the product of one manufacturer. The Contractor shall provide all coordination as necessary to ensure that all PLCs, whether provided by the System Integrator, individual equipment manufacturers or others, are by the same manufacturer.
   1. All PLC’s provided within each line-up (E.g. micro, modular, automation modular) shall be part of the same series unless otherwise specified.

B. The OITs form an integral part of the overall control system for the facility and as such all OITs shall be the product of one manufacturer. The Contractor shall provide all coordination as necessary to ensure that all OITs, whether provided by the System Integrator, individual equipment manufacturers or others, are by the same manufacturer.

C. The manufacturer or its authorized representative shall provide complete technical support for all their products.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions of the Construction Contract, Section 01340 (Submittals) and Section 13410.

1.4 DELIVERY, STORAGE AND HANDLING

A. In accordance with Section 13410.

PART 2 - PRODUCTS

2.1 GENERAL

A. The PLC shall consist of rugged components designed specifically for industrial environments. The PLC shall consist of a power supply and one or more racks containing a central processing unit (CPU) module, I/O modules, PLC memory, and PLC network interface module(s). All components shall be housed in structurally secure enclosures.

B. The central processing unit CPU shall be modular and fully enclosed within a durable plastic shroud. When mounted on the system base, the modular CPU shall not occupy more than one available slot.

C. The I/O system shall be modular. Each module shall be fully enclosed within a durable plastic shroud. When mounted on the system base, each I/O module shall not occupy more than one available slot.

D. All components within the controller family shall be manufactured with a high degree of durability. All switches and other operator controlled devices shall be of the size and durability for their intended use as is normally offered for industrial applications. All signal and/or rack expansion cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.

E. All components within the controller family shall be part of the same series unless otherwise specified, or noted on the drawings, or approval by the engineer.

F. In order to minimize spare parts stocking requirements, the controller family shall have a high degree of interchange ability. The system shall incorporate a modular design using plug in assemblies with pin and socket connectors. Wherever possible, all assemblies and sub-assemblies performing similar functions shall be interchangeable. The system design shall accommodate the replacement of assemblies/modules without having to disconnect field wiring. Wherever possible, removable connectors shall be used to connect field wiring to the individual circuit board assemblies. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings each of which indicates the manufacturer's catalog number and a product manufacturing date code.

G. Refer to the control panel descriptions in Specification Section 13444.

2.3 MODULAR PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

A. General: Provide Programmable Logic Controllers (PLC) in the control panels as identified on the Instrumentation Drawings, capable of performing the functions and handling the network communications as described in Section 13441.

B. The following Control Panels provided by Division 13 shall have a PLC:

1. Harward Street Control Panel

C. PLC Min. Memory: 0.6 MB of programmable memory with battery backed-up static RAM.

D. Max. Scan Time: 1 ms/K

E. Max. Bit Execution Time: 0.4 microseconds

F. Power: 24VDC. Each PLC and Remote I/O Module shall be powered by an uninterruptible power supply (UPS)
G. Required agency approvals:
   1. UL Listed (UL 508)
   2. CSA Certified (CSA 142)
H. PLC External Communications: The PLC shall contain 2 Ethernet ports.
   1. PLC shall be able to communicate on two different subnets.
I. Provide memory module and battery backup.
J. PLC and Remote I/O Requirements:
   1. Provide all PLCs and I/O modules shall be from a single manufacturer.
   2. Discrete Inputs: 24 VDC and 120VAC as required, maximum of 16 points per module.
   3. Discrete Outputs: 120 VAC Relay outputs or 24VDC source. Maximum of 16 points per module.
   4. Analog Inputs: 4-20 mA DC, minimum 15-bit resolution. Maximum 4 channels per module. Provide differential Inputs.
   5. Analog Outputs: 4-20 mA DC, minimum 12-bit resolution. Maximum 8 channels per module. Provide differential Outputs.
K. Future Connections: Provide a minimum of the following for future connections:
   1. 20% additional discrete inputs per PLC (rounded up) wired to terminal blocks
   2. 20% additional discrete outputs per PLC (rounded up) wired to interposing relays and terminal blocks
   3. 10% with a minimum of four (4) additional analog inputs per PLC wired to terminal blocks
   4. 10% with a minimum of two (2) additional analog outputs per PLC wired to terminal blocks
   5. two (2) module spaces for future input, output, or special modules
L. Communications Modules:
   1. Provide adapters to extend PLC communication from the CPU to separate PLC module racks as necessary for internal or external IO modules. Refer to network drawings.
   2. Provide protocol converters for communication between the PLC native protocol to other networked devices as required.
   3. Adapters shall be fully supported or compatible with the PLC manufacturer or a Manufacturer Technology Partner.
M. Acceptable Programmable Logic Controller (PLC):
   1. Allen Bradley CompactLogix 5069-L306ER
   2. No equal

2.4 OPERATOR INTERFACE TERMINALS

A. General: Provide an Operator Interface Terminal (OIT) at each control panel to continuously indicate status of equipment, change operational parameters and indicate alarm status as described in Sections 13440 and 13441. The OIT shall be fully compatible with the PLC provided. The following Control Panels provided by Division 13 shall have an OIT:
   1. Harward Street Control Panel

B. Screen Size: 10.4 inch color active matrix screen with a minimum resolution of 640 by 480 pixels with field replaceable backlight.
C. Interface: Touchscreen rated at 1 million cycles (minimum).
D. Memory: 64 MB minimum application and graphic memory. The OIT shall also include a compact flash port. Provide a compatible SD card.
E. Clock: Provide integral real time clock with battery backup.
F. Communication: RS-232, Ethernet and USB ports.
    1. Ethernet interface shall be capable of communicating to two PLCs.
G. Power: 120 VAC or 24 VDC
H. Operating Temperature: 32-130°F
I. Enclosure: NEMA 12 with NEMA 4X front-face and touchpad
J. Provide hardware interface and cable used to configure the OIT.
K. Provide programming time required to configure OIT interface as described in Sections 13440, 13441 and finalized in the instrumentation meetings.
L. Provide all cables required to connect the OIT to the network or PLC.
M. The integrated OIT software shall have the following features:
    1. Trending
    2. Data Logging
    3. Alarms
    4. Graphic Symbols
    5. Animation
N. Acceptable Operator Interface Terminal (OIT):
    1. Maple System Graphic HMI
    2. No Equal

2.5 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. Provide an uninterruptible 120-volt backup power supply for each PLC, OIT, Ethernet switch or other device as shown on the Drawings to maintain continuous operation of PLCs, operator interface terminals, Ethernet switches, monitoring instrumentation and control and process circuits during a power outage.
B. UPS type shall be provided as a continuous-duty, on-line, solid state, double conversion, single-phase 120 VAC input, single-phase 120VAC true sinewave output uninterruptible power system with auto-bypass. The UPS shall be provided with surge arresting capabilities to prevent sudden surges to the attached electrical control systems.
C. The UPS will be inside the control panel, located in the bottom section of floor stand type control panels or provided an independent wall mounted enclosure. The UPS shall be installed per UL 508 requirements and be powered by a simplex outlet.
D. UPS shall be installed in a manner to not impede access to terminals or field wiring.
E. Provide appropriate maintenance bypass switch as specified herein to easily remove and bypass the UPS.
F. The UPS shall have “hot-swappable” batteries and be capable of being replaced with the UPS in operation. The run time operation of the UPS shall be accomplished using batteries mounted within the UPS enclosure and supplemented as necessary with batteries in an enclosure to provide the battery runtime specified herein. The battery enclosure shall match the main UPS enclosure as closely as possible.

G. The UPS shall be type rated for industrial use and capable of supplying standby power to all connected control panel equipment and circuits at peak load for a minimum of fifteen (15) minutes at full load, thirty (30) minutes half load. UPS minimum rating shall be 750 VA.

H. Acceptable manufacturers:
   1. Schneider Electric APC Smart-UPS
   2. Liebert GXT3 Series
   3. Tripp-Lite SU Series
   4. Eaton Powerware
   5. or equal.

2.6 MAINTENANCE BYPASS (MBP)

A. Each UPS shall be provided with a two-position external maintenance bypass switch and outlet system to permits the UPS to be removed for repair or maintenance without causing power disruption to the connected power loads. The external bypass switch shall be a snap-action type with switching speed 10ms or less independent of operator action. External bypass switch positions shall be labeled UPS and UTILITY. The bypass switch shall be capable of switching the required amps for the UPS system.

B. For UPS units up to and including 3 KVA, furnish Liebert MicroPOD, Tripp-Lite PDUB15, or equal
   1. Substitution of standalone switches along with custom plugs, receptacles, and appropriate wiring to achieve the specified functionality is acceptable, refer to schematics or substitution.
   2. For UPS units above 3 KVA, substitute standard manufacturers Maintenance Bypass switch offering or standalone switches as indicated above.

PART 3 - EXECUTION - In accordance with Sections 13410 and 13444

END OF SECTION

SECTION 13444

CONTROL PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Includes:
   1. Furnish, install, test, and commission the following panels listed in the control panel schedule.
   2. Coordinate with the manufacturers of supplied equipment for specific instrumentation and control requirements. Any deviation in instrumentation or electrical requirements for the supplied equipment shall be provided at no additional cost to the Owner.

B. Requirements specified elsewhere:
   1. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
      a. Section 13410 Instrumentation and Process Control General (and as referenced).

1.2 QUALITY ASSURANCE

A. The specifications direct attention to certain required features of the equipment but do not purport to cover all details entering into its design and construction. Nevertheless, the Contractor shall furnish the control panels complete in all details and ready for operation.

B. The control panels are an essential component of an integrated system with all plant controls and as such shall be supplied by the System Integrator in accordance with Sections 13410 and 13441.

1.3 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions of the Construction Contract, Section 01340, Submittals, and Section 13410.
   1. Control Panel Layouts, Wiring Diagrams:
      a. Control panel wiring diagrams shall also include loop diagrams showing point to point wiring for all instrumentation equipment including terminal numbers. Examples of drawings with type of information required are attached to the end of this section. Control panel drawings shall be provided on 11” x 17” format. Loop drawings shall include at a minimum:
         i. Area delineation
         ii. Instrument tagging
         iii. Signal converters, isolators, etc.
         iv. Cable / wire numbers
         v. Terminal numbers
         vi. Junction boxes, terminal boxes, etc.
         vii. Control panel, remote IO panels etc.
         viii. PLC / IO terminations

2. Conduit Entry into Panels:
   a. Conduit entry locations shall be indicated on the panel drawings, and physically marked within the control panel prior to leaving the factory. Entry locations shall include:
      i. Areas where conduit should not enter
      ii. Control conduit locations
      iii. Signal conduit locations
      iv. Intrinsically safe conduit locations
      v. Network cable conduit locations
3. Bills of Materials (with separate columns for the following: Item Number, Quantity, Manufacturer, Part number, Description, Designator Tag)
4. FAT Report Results
5. SAT Report Results

1.4 DELIVERY, STORAGE AND HANDLING

A. In accordance with Section 13410

1.5 CONTROL SYSTEM TESTING:

A. Tests Procedures Prior to Start-up:
   1. Refer to Section 13410.
   2. Factory Acceptance Test (FAT): A witnessed Factory Acceptance Test and verification for all deliverable equipment, software, and associated documentation shall be performed prior to shipment of control systems. The factory tests shall be performed to verify that the control systems are manufactured and assembled correctly, are operating as designed, and are in compliance with the contractual requirements for the deliverables. Communication and integration with Division 11 equipment shall be demonstrated by indication of network addresses and required data tags with forced status/value changes to be witnessed on SCADA.
      a. The Contractor shall schedule FAT activities with the Engineer at least 5 business day in advance.
      b. The contractor shall plan for testing of no less than 6 hours or all of the panels during any scheduled FAT day.
      c. The FAT shall include verification and integrated testing of all components. These tests shall include the following.
      d. Visual Inspections: The following inspection checks shall be performed on all deliverable hardware items, as a minimum:
         i. I/O Subsystem physical layout
         ii. Power supply mounting
         iii. Power cable routing
         iv. Data cable routing and mounting
         v. Wiring runs properly separated and installed
         vi. Fans, blowers, and heaters are unobstructed
         vii. Power supply and power conditioning equipment correctly installed
         viii. Wire numbering and color coding
         ix. Device labeling
         x. Enclosure integrity

xi. Paint work
xii. Control panel lighting
xiii. Panel and enclosure ground connections
xiv. Provide photos:
(1) Panel Exterior
(2) Panel Interior – Door
(3) Panel Interior – Enclosure
(4) Incoming power distribution
(5) PLC
(6) Communications devices
(7) Rear view of enclosure OIT/HMI

e. Relay Logic Checkout:
i. The System Integrator shall perform a complete checkout for all ladder logic circuits to ensure designed functionality.

f. I/O Point Checkout:
i. The System Integrator shall perform a complete checkout for every I/O point from the field wiring terminal strip to the operator interface terminal functions. The System Integrator shall test every input and output point including spares for proper operation. Test signals shall be generated to verify the operation of each Analog Input (AI) and Discrete Input (DI) including connected interposing relays, intrinsically safe circuits and relay circuits. Each Analog Output (AO) and Discrete Output (DO) shall be also tested for proper operation including control circuits, isolation relays, signal conditioner/isolators and other required control circuits.
ii. The System Integrator shall demonstrate that signals are alarmed when reporting under 4 mA and over 20 mA and do not report negative or out of range values.
iii. The System Integrator shall develop a point checkout form for each I/O point. The point checkout form shall include the point ID, description, all checks performed for the point, configured PLC hardware alarms, date and time of the check, and a signoff block for the System Integrator. For each item checked, the form shall include both the expected value/result and the actual value/result witnessed.
iv. The following items shall be checked for each I/O point:
(1) For each analog input point, the following values shall be checked:
(a) Value at -2% of full scale (ramped in both directions)
(b) Value at 0% of full scale (ramped in both directions)
(c) Value at 25% of full scale (ramped in both directions)
(d) Value at 50% of full scale (ramped in both directions)
(e) Value at 75% of full scale (ramped in both directions)

(f) Value at 100% of full scale (ramped in both directions)
(g) Value at 102% of full scale (ramped in both directions)
(h) Each High and Low Alarm condition
(i) Alarm Delay
(j) Alarm Enable/Disable

(2) For each analog output point, the following values shall be checked:
(a) Milliamp reading at 0% of full scale (ramped in both directions)
(b) Milliamp reading at 25% of full scale (ramped in both directions)
(c) Milliamp reading at 50% of full scale (ramped in both directions)
(d) Milliamp reading at 75% of full scale (ramped in both directions)
(e) Milliamp reading at 100% of full scale (ramped in both directions)

(3) For each discrete input point, the following items shall be checked:
(a) For status points, proper indication
(b) For alarm points, proper alarm notification

(4) For each discrete output point, the following items shall be checked:
(a) Proper operation

g. PLC Programming and OIT/SCADA Operation Checkout:
i. Submit the proposed PLC program and OIT/SCADA Configuration (screen printouts) as a shop drawing 15 days prior to the performance of the Factory Acceptance Testing. PLC code shall be a formal submittal.
ii. Verify to the extent possible that the PLC program and OIT/SCADA Operation, as submitted, performs all control and monitoring requirements as described in section 13441 - Control Loop Descriptions. A list of all modifications to the submitted PLC program shall be maintained and submitted after the FAT.

h. 48-Hour Continuous Burn-in Test:
i. After the successful completion of the functional testing specified above, a 48-hour continuous run of each control panel provided shall be performed. The test shall be passed if no function is lost, no hardware or software failure occurs, and no module automatic failover occurs. Hardware failure is defined for this test as the loss of a major piece of hardware, such as a PLC processor, I/O board, power supply, UPS, other panel equipment, or improper operation by the controller.

ii. During this test, the PLC shall be occasionally (a minimum of 3 times per 24-hour period) exercised with simulated inputs, events, and conditions in a manner that approximates an operational environment in order to verify proper operation.

iii. No programming changes will be allowed to bypass failed modules during this test. Any major software and/or hardware correction made to the control panel shall result in the mandatory rerun of the entire 48-hour test for that control panel.

iv. FAT Report

(1) After FAT, provide and submit a checkout sheet of the FAT. The FAT Report shall include a list of all IO checkout, relay logic checkout, visual, and other QAQC observations.

i. If any control panels are shipped to the site without having undergone the specified Factory Acceptance Test; and without the prior authorization by the Engineer, shall be removed from the site and shipped back to the control panel manufacturer's factory for testing at no cost to the Engineer or Owner.

B. Procedures Prior to Start-up:

1. Refer to Section 13410.

C. Onsite Control System Startup:

1. Refer to Section 13410.

PART 2 - PRODUCTS

2.1 CONTROL PANEL MODIFICATIONS

A. Harward Street Control Panel:

1. Remove the existing radio modem from the existing telemetry panel and install the existing radio modem in the new Harward Street Control Panel. Provide new antenna, surge arrestors, and a surge arrestor enclosure as shown on Instrumentation Drawing I-00-02.

2.2 MATERIALS

A. General: Refer to the General Conditions of Section 13440.

B. Intrinsically Safe Equipment

1. Intrinsically Safe Relay/Barrier Panels (ISR):

a. All instrumentation that is located in classified spaces must be either explosion proof or intrinsically safe. All instrumentation that is intrinsically safe shall be provided with intrinsically safe relays and barriers. Refer to the Instrumentation Drawings for all signals that shall be protected with intrinsically safe relays and barriers.

b. Intrinsically safe relays and barriers shall be housed in a dedicated Intrinsically Safe Relay/Barrier enclosure or as noted on the drawings..

c. Intrinsically Safe Relays and Barriers may be located in the same enclosure, but will not be permitted to be included in the PLC control panels.

d. Each enclosure shall be sized appropriately to accommodate a minimum of 20% future I/O capacity.

e. Provide all necessary power supplies, terminals, and circuit breakers in the panel for proper operation.
f. Intrinsically Safe Relay/Barrier panels shall be UL 698 listed and labeled.

2. Intrinsically Safe Relay/Barrier Enclosure Requirements:
   a. The enclosure shall be a wall mount, single door continuous hinged enclosure rated for the area. Enclosures shall meet this sections NEMA 4X / 12 requirements.
   b. A yellow lamicoid label with the words "Intrinsically Safe Enclosure" shall be affixed to the front door of the enclosure.
   c. The enclosure shall close with stainless steel screw clamps and have a hasp and staple for padlocking.
3. Intrinsically Safe Relays:
   a. Relays shall be provided for all intrinsically safe sensing or actuation circuits which terminate in hazardous areas.
   b. Relays shall be located in non-hazardous areas and installed in accordance with UL requirements.
   c. Refer to the instrumentation drawings for signals that require Intrinsically Safe Relays. Relays shall be 120VAC powered.
   d. Approvals: FM
   e. Equal to:
      i. Phoenix Contact
      ii. Gems Safe Pak
      iii. MTL 7700 Series
      iv. or equal
4. Intrinsic Safety Barriers
   a. Barriers shall be provided for all intrinsically safe sensing or actuation circuits which terminate in hazardous areas.
   b. Barriers shall reduce the level of energy as required by intrinsically safe protection between safe and hazardous locations.
   c. Barriers shall be suitable for use with 4 to 20 mA DC signals.
   d. Barriers shall be located in non-hazardous areas and installed in accordance with UL requirements.
   e. Refer to the instrumentation drawings for signals that require Intrinsically Safe Barriers. Barriers shall be 120VAC or loop powered.
   f. Approvals: FM
   g. Equal to:
      i. Phoenix Contact
      ii. Gems Safe Pak
      iii. MTL 7700 Series
      iv. or equal

C. Process Equipment Local Control Panels:
1. Local Control Panels (LCP):
   a. Local control panels, furnished by Division 13, will be used to protect the equipment from operating with hardwired interlocks. These panels will be located adjacent to the equipment as shown on the Electrical Drawings.

b. The local control panels will consist of latching relay logic that will protect the equipment based on instrumentation that is provided by the equipment vendor. (e.g. a High Discharge Pressure switch)
c. Each panel will include alarm light indicators and a reset push button to unlatch the alarm. For wiring diagrams of each panel, see the schematic on drawing.
d. All required circuit breakers and relays shall be DIN rail mounted to a subpanel in the enclosure.
e. Refer to schematics for additional information and requirements.
f. Refer to the drawings and/or schedule for the LCPs to be provided.

2. Local Control Panel Enclosure Requirements
   a. Each local control panel enclosure shall be a wall mount, single door continuous hinged enclosure that meets the NEMA rating of the area that it is installed in. See the Electrical Drawings for area NEMA ratings.
      i. NEMA 4X shall be 304 stainless steel.
      ii. NEMA 7 shall be cast aluminum explosion proof
      iii. NEMA 12 shall be painted steel.
   b. The enclosure shall open with a padlocking three-point latch and handle. Handle shall be operational with the use of only one hand. Additional miniature quarter turn latches may be used around the door if they are required to maintain the NEMA rating. These quarter turn latches shall a wing knob type and be able to be turned by hand, without any additional tools. Edge screw clips will not be accepted.
   c. Refer to this section for general enclosure requirements.

D. Control Panels
1. PLC Control Panels (CP):
   a. PLC control panels, furnished by Division 13, shall house all of the required PLC and communications equipment.
   b. For PLC and OIT hardware in the panel, see Programmable Logic Controllers - Section 13442.
   c. For other components in the panels, see Control Panel Components section herein.
   d. A lamicoid label on the door of the enclosure shall identify the PLC Control Panel. Label shall include the panel tag number and the panel name as indicated on the Instrumentation Drawings and in the list below.
   e. The enclosure ratings shall be NEMA 12 or NEMA 4X, refer to Electrical drawing E-01 for NEMA ratings required by area.
   f. Refer to Electrical power plans and control panel schedule for maximum panel sizes (use scaled drawings).
2. PLC & RIO Control Panel Requirements
   a. Each control panel enclosure shall be a NEMA 12 or NEMA 4X enclosure. The panel shall be sized by the System Integrator house all equipment and room for 20% I/O expansion and meet UL 508A requirements.
   b. All control components shall be mounted using a 35 mm DIN rail.

c. The center of the Operator Interface Terminal (OIT), Human Machine Interface (HMI), or panel mounted transmitter shall be mounted no higher than 67" and no lower than 63" above the finished floor elevation where an operator will stand.
d. Provide a PLC control panel shall be provided with a marshaling shelf for top conduit entry cable management as indicated in the panel schedule.
e. Floor mount Panels will be located on a 4" high housekeeping pad. Provide a window-kit for outdoor installation.
f. Provide heat dissipation and heating calculations of all heat loads for all heated or cooled panels to be included as part of the shop drawing review for this equipment. Design ambient air temperature shall be 0°F for heating and 95°F for cooling. Add necessary cooling as required by the design, and size the heater as necessary for the design if required.
g. The enclosure shall open with a padlocking three-point latch and handle. Handle shall be operational with the use of only one hand. Additional miniature quarter turn latches may be used around the door if they are required to maintain the NEMA rating. These quarter turn latches shall a wing knob type and be able to be turned by hand, without any additional tools. Edge screw clips will not be accepted.
h. All equipment shall be DIN rail mounted to a subpanel in the enclosure.
i. Provide an LED enclosure light fixture for each panel door at the top of the enclosure with an accessible On/Off switch. The panel light shall be provided with a separate overcurrent protective device and connected in such a manner so as to not disconnect control, instrumentation, or PLC power in the event that the GFI outlet should trip.
j. Each PLC control panel shall have a UPS. See section 13442 for specific UPS requirements. The UPS shall be mounted inside of the enclosure on a specific UPS shelf which keeps it off of the floor of the enclosure. Provide a UPS maintenance bypass switch (MBS) that allows the panel to be powered through the UPS or from line power, refer to schematics for additional details.
    i. Unless stated otherwise each field instrument whether powered by 120 VAC or 24 VDC shall be powered from the associated Control Panel's UPS. Field instruments that measure processes that are not disrupted during a power outage, require a significant amount of time to reset after power is restored from a power outage, or will cause disruptions to process control if the process value is not immediately available once power is restored shall be backed up by the UPS from the associated Control Panel.
    ii. The following shall NOT be powered from the UPS:
        (1) Control panel lighting.
        (2) Control panel heating.
        (3) Control panel cooling.
        (4) Instrumentation powered from control panel, but not indicated by UPS power as indicated on the Instrumentation and/or Electrical Drawings.

E. Components and Requirements:
   1. Enclosures
      a. Shall be either UL508A or UL698 Listed as an assembly, as required by location of intrinsically safe relays or barriers.
      b. Enclosures shall be sized as required to contain the necessary apparatus for the particular installation. Final panel/enclosure dimensions shall provide for easy access to all internal components with ease of maintenance and future modifications considered. Enclosure size shall accommodate UL requirements. Conflicts with panel sizing and available spacing shall immediately be brought to the attention of the Engineer prior to proceeding to procurement. Panels purchased without submittal/Engineer approval that present installation/egress/clearance issues shall be replaced by the Contractor at no additional cost to the Owner/Engineer.
      c. Panels larger than 36-inches in width or 48-inches in height shall not be wall mounted. Provide two doors if panel is larger than 36-inches wide.
      d. Enclosures larger than 16" in any dimension shall utilize a three-point latching system.
      e. Provide door and body stiffeners where necessary for a rigid enclosure. Floor mounted enclosures shall be provided with lifting eyes and, where floor-mounted, with 12-inch floor stands. No floor stands are to be provided for free-standing models.
      f. Doors shall have side mounted, stainless steel, continuous length, piano-type hinges and pins.
      g. Panels/enclosures shall be equipped with print pockets located on the inside of the door.
      h. A complete “As-Built” panel wiring diagram including exterior devices and motors to be connected shall be encased in clear re-sealable plastic pouch(es) and placed in the print pocket.
      i. NEMA 12 enclosures shall be sheet steel, 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 60" by 36", and 12 gauge for box sizes greater than 60" by 36". Free-standing enclosures shall be 12-gauge minimum. Enclosures shall have continuously welded seams, ground smooth, supplied with no holes or knockouts and a rolled lip around door and enclosure opening. Enclosures to be installed in areas with the potential for dripping liquids shall be provided with drip shields. Provide Oil resistant door gaskets. NEMA 12 enclosures shall be coated inside and out with ANSI 61 gray over phosphatized surfaces. Interior sub-panels for mounting of components shall be painted white.
      j. NEMA 4X stainless steel enclosures shall be Type 304 stainless steel enclosures shall be 16 gauge for box sizes up to and including 24" by 24", 14 gauge for box sizes larger than 24" by 24" up to 36" width, and 12 gauge for box widths greater than 36 inches. Free-standing enclosures shall be 12-gauge minimum. Enclosures shall have continuously welded seams, ground smooth, supplied with no holes or knockouts and a rolled

lip around door and enclosure opening. Enclosures to be installed outdoors shall be provided with drip shields. Provide oil-resistant door gaskets all around door openings. All enclosure hinges, clamps, etc. shall be stainless steel. Enclosures/panels shall be provided unpainted, with metal enclosures having a smooth brushed finish.

k. Provide enclosures equivalent to:
    i. Saginaw Control and Engineering
    ii. Hoffman
    iii. Or equal

2. Control Panel Wiring Requirements:
    a. All control panel wiring shall conform to the latest requirements of NEC and all state and local code requirements.
    b. Bundles of wires not in raceways must be secured to the panel structure every 8 inches minimum. All interior wiring will be point to point with no splices.
    c. Wires to the front of panel devices shall be looped, extra flexible, bundled and located in a manner to prevent damage due to opening and closing the door.
    d. All control wires internal to panels shall be minimum No. 14 AWG. Wires carrying line voltage shall be minimum No. 12 AWG. All conductors shall be copper. Wiring in close proximity to heating devices shall be Type AVA UL approved. All wiring shall be run in PVC wiring channels and bundled with nylon cable ties. Line voltage wiring must be run separately from control, signal and intrinsically safe wiring. PVC wiring channels shall be properly sized for the capacity of wires being installed based on the overall project needs and shall not be over filled.
    e. Discrete and analog wiring shall be separated to the greatest extent possible. It shall be assumed that discrete and analog conduits shall be installed into the panel on opposing sides. PLC I/O modules slots and field terminal blocks shall be grouped by type. I/O entry shall be indicated on the drawings as required by UL508.
    f. Wiring to equipment shall be distributed to the greatest extent possible amongst the PLC IO modules to minimize the amount of common failure points across common equipment. Example: If there are four DI modules and four raw water pumps, each DI module shall have IO for one of the raw water pumps.
    g. All network devices shall be powered with redundant power supplies.
    h. Analog wire shields shall be continued until the PLC I/O modules.
    i. All main, feeder, and branch circuits shall be provided overcurrent protection. PLCs, OITs, HMIs, instruments, power supplies (if not supplied with a field resettable fuse), spare circuits, and networking equipment shall have a dedicated fuse. Overcurrent protection shall be sized appropriately and account for inrush currents.
        i. Main panel circuit protection shall be a fused disconnect.
        ii. Feeder 120 VAC circuits shall use breakers for circuit protection. 24VDC branch circuits may use breakers or fuses.

iii. All outgoing power (120 V and 24 V) to field devices shall be fused.
iv. All loop powered devices shall be fused.
v. Each PLC module shall have a dedicated fuse.
vi. Fuse and circuit breaker sizing is the responsibility of the System integrator.

j. All wires shall be marked at both ends with numbers by self-sticking wire markers or with slip-on style plastic markers. Wire markers shall match the terminal block labels, unless otherwise specified.

k. Wire color coding shall include the following:
i. Red wires - Interior control circuits
ii. Yellow wires - Power from external sources
iii. Blue wires - DC voltages
iv. Blue/White wires – DC return (i.e.-24VDC)
v. Green wires - Ground

l. Terminals shall be arranged in alphabetic and numeric order in columns on removable sub-plates. A maximum of two connections shall be made to each side of a terminal, including jumpers. Provide an additional 20 percent spare terminals for each control panel with the following minimum requirements:
i. Power terminals
(1) 1 spare 120VAC
(2) 1 spare 24VDC
ii. Control terminals
(1) 5 spare
iii. Signal terminals
(1) 1 spare non-loop powered
(2) 1 spare loop powered

m. Provide ground terminal for each panel.

n. All control panels shall be provided with spare mountings for additional relays. Number of spare mountings will correspond to 5% of the total number of relays within each panel, with a minimum of one (1) spare mounting.

o. All wiring entering and leaving control panels shall be terminated on field terminal blocks and labeled.

p. Provide protection on all signal and data circuits that leave a building or are routed external to a building. Data circuit protection shall be provided at both ends of the signal or data highway lines within the control panel at one end and as close to the instruments or termination device as possible. Refer to drawings for additional requirements.

q. Provide equipment labels for all devices on the subpanel to easily identify panel components (relays, network switches, power supplies, etc.) Labels on equipment is not acceptable.

r. Provide a label indicating the power source on the front of each panel. As-built Panel drawings shall also indicate power source.

s. Wiring shall be in compliant with the National Electric Code and with the applicable UL requirements. All wiring shall be done with best practices and follow equipment manufacturer guidelines.
t. Provide complete "As Built" wiring diagrams to be provided with the O&M manuals and in the enclosures for all control panels.

3. Programmable Logic Controllers (PLC):
   a. Refer to Specification 13442 - Programmable Logic Controllers for PLC requirements.
4. Operator Interface Terminal (OIT):
   a. Refer to Specification 13442 - Programmable Logic Controllers for OIT requirements.
5. Uninterruptible Power Supply (UPS):
   a. Refer to Specification 13442 - Programmable Logic Controllers for UPS requirements in Control Panels.
6. Unmanaged Ethernet Switches (UES):
   a. General
      i. Provide unmanaged Ethernet switch(s) for connection to the control network as shown in the Drawings and specified herein.
   b. Physical Features
      i. Copper ports: 6
      ii. PoE Copper ports: 0
      iii. Fiber ports: 0
      iv. Operating temperature: 32 to 130 degrees f
      v. Power: 24 VDC
      vi. Enclosure: Metal case, DIN-rail mountable
      vii. Rating:ANSI/ISA Class 1, Division 2 Groups A, B, C, and D
   c. Network Features
      i. Auto sensing duplex and speed
      ii. LED link/activity status indication
   d. Acceptable Manufacturers
      i. N-Tron
      ii. Moxa
      iii. Antaira
      iv. Hirschman
      v. Or equal
   e. Basis of design: The drawings are based on generic network equipment. Equivalent alternate equipment (ex. SFP ports, PoE switch in lieu of PoE injectors) will be considered provided that all revisions required to the design be accomplished at no cost to the owner.
7. Data/Power Port:
   a. Provide a Data/Power port with Ethernet RJ45 jack and 120 VAC GFI outlet to meet Arc flash 70E requirements. Data power port will have a lockable hinged cover with panel mounted hardware and shall be installed on the front of the control panel.
   b. Control panels with a keyboard shall have a Data/Power port with a USB connection.

c. Environmental Rating: To match panel NEMA rating.
d. The Data and Power port shall be:
    i. Grace Engineered Products
    ii. Hubble "Panel-Safe" Power and Data Access Ports
    iii. Or equal

8. 12 and 24 VDC Power Supplies:
    a. Provide 12 and 24 VDC power supplies in the control panel to power field instruments, panel devices, etc., as required.
    b. No more than three internal panel devices or external field instruments requiring 12 or 24 VDC power shall be powered from a single 12 or 24 VDC power supply.
    c. Input voltage: 115 VAC
    d. Output voltage: 24 or 12 VDC.
    e. Ripple: <50 mVpp.
    f. The power supply shall be sized to accommodate 125% of the design load.
    g. Operating temperature: 32 to 140 °F.
    h. The power supply shall be provided with a means to protect instruments from over current and over voltage.
    i. Mounting: Din rail mount inside enclosures. Power supply shall be located in the enclosure such that heat generated does not cause other panel components to malfunction or become damaged.
    j. 12 or 24 VDC power supplies shall be:
        i. Sola SDN
        ii. Allen-Bradley 1606
        iii. or Equal
9. Hand Switches: HS
    a. Push buttons and selector switches shall be 30 mm and heavy duty oil-tight.
    b. Switches shall have the same NEMA rating as the panel that the switch is installed in.
    c. Contact blocks shall be stackable and provide all necessary contacts as shown on the Drawings.
    d. Each switch shall be labeled as indicated on the Drawings.
    e. Equal to:
        i. Allen Bradley 800H series
        ii. Eaton Cutler-Hammer HT800 series
        iii. Or equal
10. Potentiometer:
    a. Potentiometers shall be 30 mm and heavy duty oil-tight.
    b. Potentiometers shall have the same NEMA rating as the panel that the potentiometer is installed in.
    c. Potentiometer ohm value shall be compatible with the equipment and application.
    d. Equal to:
        i. Allen-Bradley 800H Series
        ii. Square D 9001 Series

11. Indicator Lights: YL, AL
    a. All indicator lights shall be 30 mm, heavy duty oil-tight, 120 VAC, LED with push to test option. Indicator Lights shall be wired such that they can be tested with Control or UPS Power source.
    b. Lights shall have the same NEMA rating as the panel that the light is installed in.
    c. Indicator lights shall be provided with a chrome-plated metal or anodized-aluminum mounting rings, engraved as indicated on the Drawings.
    d. All indicating lights will use the following light color convention: See Instrumentation Drawing I-1 “Indicator Light Color Legend”.
    e. Equal to:
        i. Allen Bradley 800H series
        ii. Eaton Cutler-Hammer HT800 series
        iii. Or equal
12. Fuses:
    a. Fuses shall be 3AB ceramic body fuses rated for at least 125 volts at the current ratings shown on the Drawings. Fuse size shall be ¼” by 1¼”.
    b. Blow time shall be: 110%, 4 hours minimum; 135%, 1-hour maximum; 200%, 15 seconds maximum for 1/8-12 amp fuses and 60 seconds maximum for 15-30 amp fuses.
    c. Fuses shall be:
        i. Entrelec
        ii. Bussmann,
        iii. Or approved equal.
13. Line Surge Protection:
    a. A UL1449 dedicated surge protection device (non-UPS) shall be installed for main power into a panel.
    b. A UL1449 dedicated surge protection device (non-UPS) shall be installed for panel powered instruments located outside of the building.
    c. Surge protection shall protect L-G, L-N and N-G.
    d. Surge arrestor shall be adequate for intended function and shall be by a nationally recognized manufacturer with a minimum of 3-years’ experience in manufacturer of such devices. Technology shall a hybrid of Silicone Avalanche Diodes and MOV or MOV and thermal fusing. GDT or sole MOV technology is not acceptable.
    e. Surge arrestor to include a dry contract for remote monitoring of a surge event.
    f. Surge arrestor shall be installed per manufacturer recommendations, as close to incoming power as possible, and incoming leads shall be as short as possible.
    g. Surge arrestor shall have a positive indication of device operation or failure.
    h. Surge arrestor shall have a Surge Current rating of 25kA per phase.
    i. Surge Arrestor shall be:
        i. Weidmuller SPD series
        ii. Citel DS40 series

iii. Or Equal

14. Control Relays:
    a. Scope: Control relays used for relay logic.
    b. Relays shall be electrically held, Form C, electrically operated with 120 volt coils except as noted otherwise on the Drawings. Contacts shall be rated 10 amps at 600 volts or higher as required by the application.
    c. The number of poles required shall be determined by the System Integrator depending on specific requirements of what the relay is used for. Each relay will be at minimum DPDT or one spare pole per relay.
    d. Control relay shall have an energized indicator in either the form of a mechanical flag, or neon lamp (LED for DC applications).
    e. Relays shall be provided with a suppression diode for inductive loads.
    f. Control Relays shall be:
        i. Allen Bradley 700-HF Series
        ii. Idec RU Series
        iii. Or equal
15. PLC Output Relays:
    a. Scope: Control relays used for PLC outputs (isolation relays)
    b. Each PLC discrete output shall be protected with an interposing relay including spare PLC discrete outputs. PLC output relays shall be SPDT electrically held, Form C, electrically operated with 120 volt coils. Contacts shall be rated at a minimum 5 amps at 300 volts. System Integrator shall use higher capacity relays for equipment that is being powered directly through the relay's contacts.
    c. Control relay shall have an energized indicator in either the form of a mechanical flag, or neon lamp (LED for DC applications).
    d. PLC output relays shall be DIN rail mounted and have a slim profile in order to conserve panel space.
    e. Relays shall be provided with a suppression diode for inductive loads.
    f. Control Relays shall be:
        i. Allen Bradley 700HK Slim Line Series
        ii. Phoenix Contact PLC relay series
        iii. Or equal
16. Automatic Transfer Relays (ATR)
    a. Scope: ATRs shall be Contactors or IEC control relays are used for the ATR circuit. Devices shall be IEC listed.
    b. Relays shall be 4NO and 4NC at a minimum and have an auxiliary contact to indicate to the PLC the ATR fail status. The number of poles required shall be the responsibility of the system integrator.
    c. Relay coil shall be actuated via 120VAC except as noted otherwise on the Drawings.
    d. Contacts shall be thermally rated for 16A continuously (for 20A panel, or as required by feeder circuit current) at 120VAC and shall be mechanically linked. Auxiliary contacts shall be rated for 5A at 120VAC.
    e. Relay shall provide positive safety for the N.O. and N.C. contacts which assure that the N.O. contacts will not close before any N.C. contact opens

f. Equal to:
    i. Allen Bradley 700-CF series
    ii. ABB N44 series
    iii. Or equal

17. Time Delay Relays:
    a. Time delay relays shall be used as required for use as shown on the drawings or described in the specifications. Time delay relays shall be capable of the following functions:
        i. On Delay (delay on make)
        ii. Off Delay (delay on release) / True Off Delay
        iii. Interval On
        iv. Single Shot
        v. Cyclic
        vi. Single Shot Momentary Interval
        vii. Or other functions specifically referred to on drawing schematics
    b. Delay timing relays shall be solid state, Form C, electrically operated with 120 VAC coils except as noted on the drawing.
    c. The number of poles required shall be determined by the System Integrator depending on specific requirements of what the relay is used for. Each relay will be at minimum DPDT or one spare pole per relay.
    d. Contacts shall be rated 5 amps at 240 volts.
    e. Minimum time range shall be adjustable from 1 second to 10 minutes. Other ranges as required by function and as indicated on the Drawings or within the Specifications.
        i. Final settings shall be indicated on the O&M drawings.
    f. Provide wiring to the relays as required by the function used.
    g. Basis of Design: Basis of design are multifunction time delay relays. System Integrator may provide single function relays as required, however a spare is required for every type.
    h. Time Delay Relays shall be:
        i. IDEC RTE Series
        ii. Square D RE Series
        iii. Magnecraft TDR Series
        iv. Allen Bradley 700 Series
        v. Or Equal

18. Terminal Blocks
    a. Field terminal strips with box type connectors shall be supplied to make all power, control, and signal connections to and from each control panel.
    b. All terminals shall be clearly marked for easy identification. A ground terminal strip shall also be provided.
    c. Field terminal blocks shall be single tier for ease of installation and maintenance.
    d. At least 20 percent of terminals supplied shall be spare. All wiring in and out of a control panel shall be terminated on field terminal blocks.
    e. All spare PLC I/O (including interposing relays) shall be wired to terminal blocks.
    f. Prewired terminal blocks from the PLC manufacturer as also acceptable. The prewired terminal blocks (PLC Terminal System) shall also meet the specifications herein.

g. Field Terminal Blocks shall be:
    i. Phoenix Contact UT Series
    ii. Allen-Bradley 1492 Series
    iii. Or equal

19. DIN Rail
    a. Size: 35mm
    b. Material: Aluminum or Bronze
    c. All field terminal blocks shall be mounted on 2" raised DIN rail
20. Cables:
    a. Provide all necessary antenna cable.
    b. Weatherproof flexible coax cable with a copper clad aluminum or braided core, foam dielectric and outer RF shielding in a weatherproof and UV resistant polyethylene jacket.
    c. Cables 100' or greater shall be have an attenuation loss of less than 2.0dB at 450MHz per 100'. Cables less than 100' shall be have an attenuation loss of less than 3.0dB at 450MHz per 100'.
    d. Cable shall be
        i. Times Microwave LMR-400/600
        ii. Amphenol LMR-400/600
    e. Connections:
        i. Provide N-Male/Female, TNC, RP-TNC, and RJ45 as required, between the antenna, surge arrestor, radio modem, and Ethernet switch. All outdoor connections shall be watertight and wrapped.
    f. Accessories:
        i. Short antenna whips that have loss no greater than 7.8dB at 450MHz per 100' may be used within control panels that have a radio to transition to the larger cable external from the control panel.
    g. All coax cable connectors to be soldered with all external connections wrapped with a vinyl wrap and coated with moisture barrier.
21. Lightening Arrestor & Enclosure:
    a. Provide a lightening arrestor / TVSS and enclosure for each antenna cable entering a building or enclosure. Enclosure not required in TVSS is mounted in control panel. Refer to Instrumentation Drawings for additional information regarding TVSS mounting locations and quantities.
        i. TVSS:
            (1) Four pole filter
            (2) DC grounded on equipment port
            (3) Wide frequency bandwidth
            (4) Multi-strike capability
            (5) Bulkhead mounting and grounding
            (6) N silver shell and gold center for low intermodulation generation
            (7) Frequency range: 500 to 3000 MHz
            (8) Throughput energy: 150 microjoules
            (9) Insertion loss: 0.1 dB over frequency range
            (10) Connectors: N-Type female

ii. Enclosure:
(1) Type: NEMA 4X Stainless Steel
(2) Size: Minimum of 12” x 16”. Final size to be determined by Radio Network
(3) Hasp and stable for padlocking
(4) Stainless steel door clamps
(5) Galvannealed subpanel

22. Spare Parts and Test Equipment:
a. The System Integrator shall furnish the following spare parts :
i. 2 surge suppressors of each type
ii. 1 24 VDC Power Supply of each type
iii. 1 Uninterruptible Power Supply
iv. PLC Components - Refer to section 13442
v. 3 of each type lamp, unless otherwise specified herein
vi. 3 of each color indicator light lens.
vii. 1-time delay relay (of each type)
viii. 5 control relays (of each type)
ix. 1 complete selector switch of each type.
x. 1 complete push-button of each type.
xi. 1 of each different contact block for control units.
xii. 1 breaker of each type
xiii. 1 fused disconnect of each type
xiv. 1 box of every type of fuse in every panel provided.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Refer to Section 13410.

PANEL SCHEDULE

Description	Abbreviation	Type	NEMA Rating	Panel Width*	Mounting*	Shelf & Keyboard	Marshaling Shelf
Harward Pump Station Control Panel	HARCP	CP	12	60”	Wall	No	No
Harward Pump Station Local Control Panel	HARCP-A	LCP	12	36”	Wall	No	No
Intrinsically Safe Panel	ISP-HAR	ISP	12	12”	Wall	No	No

*The panel width and mounting are the dimensions and arrangements shown on the electrical plans for reference. System Integrator is responsible for working with the General Contractor and Electrical Contractor for coordinating size and room layouts, and adhering to the specifications.

END OF SECTION

SECTION 14320

HOIST SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish, install, and test manual and electric hoist systems as shown on the Drawings and as specified herein.

B. The hoist systems shall be complete with S-beam track, monorail track, , trolley, hoist and all appurtenances necessary to complete the installation.

C. A source of 480 volt, three-phase electrical power will be furnished and installed to a disconnect switch adjacent to each system using an electrically operated hoist or trolley under Division 16 and as shown on the Drawings. All other conduit and wire as required for a complete system shall be furnished and installed under this section and in accordance with Division 16. All hoist equipment and associated electrical equipment shall meet the NEMA rating of the space as shown on the Electrical Drawings.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1.3 REFERENCES

A. AISC - American Institute of Steel Construction

B. AWS - American Welding Society

C. ASME B30.11 2010 - Monorails and Underhung Cranes

D. ASME B30.16 - 2007 -Overhead Hoists (Underhung)

E. HMI - Hoist Manufacturers Institute

F. MMA - Monorail Manufacturers Association

G. OSHA - Occupational Safety and Health Administration

1.4 SUBMITTALS

A. Submit complete shop drawings as specified in specification sections 01340 and 11000 and including but not limited to;

1. Equipment specifications and data sheets identifying all materials used and methods of fabrication. Weights of all component parts and assembled weight of units.
2. Complete assembly, layout and installation drawings with clearly marked dimensions.
3. Interconnection ladder-type wiring diagrams for power and control wiring required for final connections. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
4. Spare parts recommended by the manufacturer.
5. Special tools necessary to disassemble, service, repair and adjust the hoist systems.

6. Installation, start-up, operating and maintenance instructions.
7. Warrantee/guarantee

1.5 QUALITY ASSURANCE

A. All of the monorail trackand trolley equipment on the monorail track shall be provided by a single, experienced and qualified manufacturer who is a member of the Monorail Manufacturers Association.
B. All of the hoisting equipment shall be provided by a single, experienced and qualified manufacturer who is a member of the Hoist Manufacturers Institute.
C. All electrical equipment shall comply with the applicable requirements for materials, workmanship, construction and installation of the latest NEMA and National Electrical Code and Standards.
D. The current issue of Underhung Cranes and Monorail Systems by the MMA and the Hoist Manufactures Institute shall be included as a part of this section unless otherwise specified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Contractor shall be responsible to off load, store and cover hoisting systems and protect controls and electrical equipment from moisture.

PART 2 - PRODUCTS

2.1 HOIST SCHEDULE

Location	Capacity	Hoist	Trolley	Lift Height	Service Class	Remarks
H1: Electrical Room – Lift Hook Hoist	1 ton	E	N/A	20'-0"	H1	LHR
H2: Pump Room – Monorail Hoist	1 ton	E	E	15'-0"	H1	LHR,

M - Manual; E - Electric; LHR - Low headroom; SHR - Standard Headroom; XP - Class 1/Division 1 or Division 2; CR - Corrosion resistant materials; H1 - Infrequent Use

2.2 SYSTEM REQUIREMENTS

A. All components of all equipment, including hoist and trolley, wire rope or cable, and pushbutton control pendant, shall be rated to satisfy the requirements of the NEMA rating designated for the rooms in which the equipment will be used in and travel through. Space NEMA Classifications for equipment in rooms shall be as indicated on Contract Drawing E-l.
B. Electrical Hoists with Integral Trolleys for Monorail System
   1. Service Classification - H1 (infrequent use)
   2. Hazard Control - Motors and trolleys required to be explosion proof shall be as indicated in the Hoist Schedule.
   3. Hoist - Low Headroom, Electric, Cable Type, Lug or Hook Mounted, Spark Resistant as indicated in Schedule.
      a. Lift Capacity - As indicated in the Schedule
      b. Lift - As indicated in the Schedule
      c. Lift speed: Single speed, 8 feet per minute minimum.
      d. Totally enclosed; reversible, 460 volt, 3 phase, 60 cycle, 1/2 HP motor.

4. Trolley - Motor Driven Trolley
   a. Trolley drive; reversible 480 volt, 3 phase, 60 cycle, 1/4 HP motor.
   b. Trolley shall be 4-wheel type with side extensions beyond the wheel flange to provide bumper.
   c. Maximum chain pull to move rated load – 14 pounds.
5. Columbus-McKinnon Lodestar NH Electric Chain Hoist with Series 635 Motor Driven Trolley and Magnetek Radio Controller, or equal.

C. Electric Hoist with Lifting Hook
1. Hoist – Chain, Motor Driven
   a. Low headroom
   b. Lift Capacity – As indicated in the Schedule
   c. Lift – As indicated in the Schedule
   d. Lift Speed: Single Speed, 8 feet per minute minimum.
   e. 460V, 3 phase, 60 cycle, ½ HP motor
   f. Columbus-McKinnon Lodestar Electric Chain Hoist or equal.

2.3 MONORAIL TRACK

A. Monorail track shall be designed for the following loads:
1. Vertical load with electric hoist: Weight of the trolley, hoist and rated lifted capacity plus a 25% impact factor.
2. Vertical load with manual hoist: Weight of the trolley, hoist and rated lifted capacity plus a 15% impact factor.
3. Lateral load: 20% of the rated lift capacity.
4. Longitudinal load: 10% of the rated lift capacity.
5. Deflection: Not to exceed 1/600 of the distance between supports or the length of the cantilevered portion.

B. Fabricated section consisting of a steel top flange and web and a specially rolled Tee section bottom flange with a high carbon - manganese alloy steel raised operating flange.

C. Curves shall be of the same track as straight sections. Coordinate with trolley manufacturer that the trolley supplied will negotiate the curve designed into the monorail track as shown on the Contract Drawings.

D. All track hardware including splices, end stops or other items necessary to furnish a complete system shall be provided.

E. Provide all necessary clamps, hanger rods and other fittings from which monorail track is supported. Monorail track shall be mounted to superstructure at the locations as shown on the Contract Drawings. Hanger rods shall be sway and thrust braced as required by the manufacturer.

F. Provide additional supports at the monorail curve section in accordance with the monorail manufacturer's recommendations.

2.4 TROLLEYS

A. Trolleys shall be manufactured with heavy section rolled steel side frames.

B. Wheels shall be induction hardened to a minimum of 425 Brinnel. Bearings shall be double row, combination radial and thrust, anti-friction precision type. They shall be pre lubricated and sealed and have a minimum B-10 bearing life of 5,000 hours.

C. Trolleys shall fit on standard S type Monorail Track as indicated on the Structural Drawings.
D. Trolley wheel gears and pinions shall have machined cut geared teeth. Spacer washers shall be provided for trolley adjustments to various beam sizes.
E. Movement of hand-geared trolleys is accomplished by pulling on an endless zinc plated hand chain. .
F. Trolleys shall be provided with rubber bumpers capable of stopping a trolley at an average rate of deceleration not to exceed 4.7 ft/s/s when traveling in either direction at one-third of the rated load speed.
G. Drive motors for trolleys shall be totally enclosed non-ventilated (TENV).

2.5 HOISTS

A. Hoists shall have safety-type lug mounted connection.
B. Hoists shall have full blocks with safety latch swivel hook. Hooks shall be bronze or high bronze alloy in Explosion Proof areas.
C. Chain hoist shall meet the requirements of ASME B30.16 “Overhead Hoists”. Electric hoists shall meet the following requirements.
    1. Frame shall be fabricated from rolled steel to form a one-piece weldment. All ferrous surfaces shall have a factory applied epoxy coating for exterior applications and weather resistance.
    2. Gear case is to be machined aluminum alloy casting with sealed construction allowing the gears and load brake to operate in a bath of oil.
    3. Bearings shall be high quality anti-friction type of either needle or ball design and used throughout the hoist. Bearings, not considered lifetime lubricated by the manufacturer, should be provided with a means for lubrication.
    4. Brakes: Hoist shall have two types of brakes: One DC electrical multiple disc motor brake spring set electrically released, and one self-adjusting Weston type mechanical load brake located in the gear case. Either brake shall have the capability of holding rated load in the event of failure of either brake system.
    5. Overload device shall be provided to prevent lifting excessive overloads. This load-limiting device shall be preset at the factory to disengage the hoist motor from the gearing in event of excessive overload condition. Overload device is to be located between the motor and load brake, so that the load brake will hold the load in event of overload device failure.
    6. Motors shall be of high starting torque type designed specifically for hoist duty service with permanently lubricated ball bearings, rated for 30-minute duty cycle. The motor enclosure is to be totally enclosed non-ventilated, TENV. Motor insulation shall be class F Minimum. Motor is to have automatic reset temperature actuated switch (TAS) in motor windings to provide motor running over current protection.
    7. Gearing shall be a combination of spur and/or helical, precision cut and heat treated to ensure quiet, efficient operation. Gears shall be totally enclosed and run in a bath of oil to provide maximum lubrication. Gears are either splined or keyed to shafts.
    8. Hoisting cable shall be stainless steel.
    9. Limit Switch: An upper block operated control circuit limit switch shall be provided that shuts off the hoist motor when the load hook reaches its highest position.

10. Controls to be centralized and designed per NEC (National Electric Code) standards housed in a panel with a hinged door. The controls are to be provided with a step-down transformer within the panel that provides 120 volts power to the control circuits. Control circuit voltage to the push button station shall not exceed 120 volts. In addition, the panel shall be UL Listed.
11. All controls, including power transformer, shall be housed in NEMA rated enclosure mounted in an easily accessible location on the hoist. Controls shall include trolley travel and hoist raising and lowering. Limit switches shall be provided to prevent over travel of the hook in either direction. Motors shall be fully enclosed 30-minute duty cycle motors in a NEMA frame rated for 480 volts, 3-phase, 60 Hz power supply.

2.6 ELECTRIFICATION

A. Electrification other than cable reel shall be insulated (enclosed) conductor bars mounted on monorail track. The enclosed conductor system shall be supplied compete with all necessary support brackets, supports insulators, power feeds, splice assemblies and closures, and transfer insulators.
B. Cable reel electrification shall be provided using cable sized for the hoist and designed for use on a cable reel (to prevent twisting under tension). The reel shall be located to allow smooth operation of the hoist and be supplied with all brackets, swivels, and connectors to provide complete installation.
C. Power shall be provided to the hoist via a flat cable festoon system. The festoon system shall be supported from the beam and shall include cross-arm supports, track hanger clamps, festoon track, track joint assemblies, tow trolley, intermediate trolleys, end clamp, saddle assemblies, end caps, end stop, flat cable and flat cable connectors. Festoon support components shall be manufactured of stainless steel.
D. Power to festoon system shall be provided via a NEMA rated stainless steel junction box mounted on the support column at the start of the festoon system and a NEMA rated lockable stainless steel hoist control station. The hoist control station shall include a heavy duty 30A-3P disconnect switch.

2.7 ELECTRIC CONTROLS

A. Electrical Hoists with Integral Trolleys for Monorail System
    1. Provide integrated Radio Controller with the following requirements:
        a. Battery operated.
        b. In conformance with the NEMA rating of the room as indicated in the Electrica Drawings.
        c. Six-push button controller to operate both hoist and trolley.
    2. Magnetek Radio Controls or equal.
B. Electric Hoist with Lifting Hook
    1. Provide with a two push-button control for the hoist.
        a. Pushbutton station shall be of molded contour grip type and supported from hoist by strain relief cable to avoid damage from pull on the control wires. The enclosure is to be NEMA rated in conformance with the NEMA rating of the rooms as indicated in the Electrical Drawings.
        b. The pendant controls shall be supported by a strain cable.
        c. Pendant shall hang to a point 3' - 6" above the operating floor, elevation as shown on the drawings.

2.8 RATED LOAD

A. Each hoist shall be marked with its rated load. These markings shall be clearly legible from the loading position.

B. Both sides of the monorail track shall be marked with its rated load. These markings shall be clearly legible from the floor below.

2.9 SURFACE PREPARATION AND SHOP COATING

A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall verify all dimensions and clearances in the field prior to erection and shall be responsible for the proper fitting and operation of the equipment.

B. Install in strict accordance with the manufacturer’s instructions and Specification Section 11000. Installation shall include furnishing any required oil and grease in accordance with the manufacturer's instructions.

3.2 USE DURING CONSTRUCTION

A. At no time during the construction period shall the monorail, hoist and trolley be used by the Contractor for construction purposes. The hoist/trolley manufacturer shall render the equipment inoperable until final testing, checkout and startup.

3.3 START UP AND TESTING

A. In accordance with Specification Sections 01800 and 11000.

B. The monorail, trolley and hoist shall be tested at the rated load by the Contractor to demonstrate the ability to lift and continuously transport the load throughout the entire length of the runway.

C. Contractor shall provide necessary weights, slings, etc., necessary for conducting the test. Weights shall be calibrated.

3.4 CLEANING

A. Contractor shall thoroughly clean all installed materials and equipment and touch up factory finish as required.

END OF SECTION

SECTION 15050

PIPE & PIPE FITTINGS – GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, support, and test pipe and pipe fittings of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein. The Pipe Schedule is shown on the Drawings.

B. Other Trades: Cooperate with all other trades whose work is to be coordinated with piping work.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.

1. Section 01340 – Submittals
2. Section 01600 – Delivery, Storage and Handling
3. Section 09905 – Surface Preparation and Shop Coatings
4. Section 15094 – Prefabricated Pipe Hangers, Supports and Bracing
5. Section 15100 – Valves – General

1.3 REFERENCES

A. American National Standards Institute (ANSI)

1. ANSI B31.1 – Power Piping
2. ANSI B31.3 – Process Piping
3. ANSI B31.4 – Liquid Transportation Systems for Hydrocarbons,
4. Liquid Petroleum Gas, Anhydrous Ammonia, and Alcohol.
5. ANSI B31.5 – Refrigeration Piping
6. ANSI B31.9 – Building Services Piping
7. ANSI B31.8 – Gas Transmission and Distribution Piping Systems
8. NSF 61: Drinking Water System Components – Health Effects
9. NSF 372: Drinking Water System Components – Lead Content

1.4 SUBMITTALS

A. Submit shop drawings in accordance with Section 01340 and the General Conditions of the Construction Contract.

B. Submit manufacturer's "Certification of Conformance" that pipe and fittings and other piping appurtenances meet or exceed the requirements of these Specifications.

C. Submit other documents as specified in the appropriate Sections of this Division.

D. The design of the pipe support system shall include analyzing the system piping and service conditions to develop a detailed support system, specific to the piping material, pipe joints, valves and piping appurtenances.

E. The support system design shall include the criteria for each piping system.

F. The piping system analysis and design shall conform to ANSI B31.

G. Submit complete layouts, schedules, and location plans for all piping systems.
H. Submit complete piping drawings for each piping submittal indicating type of hanger and/or support, location, magnitude of load transmitted to the structure and type of anchor, guide and other pipe supporting appurtenances including structural fasteners.
I. Submittal shall include catalog cut for each different type of pipe hanger or support indicating the materials of construction, dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special anchor and/or support.
J. Summary of Contractor selected related components including joints, class, valves, appurtenances, etc., and commercial supports and piping materials.
K. Coordinate piping support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, Fire Protection and Electrical; to account for structural expansion joints and to maintain access for both personnel and for removal of equipment.
L. After the work is installed, but before it is filled for start-up and testing, the support system design engineer shall inspect the work and certify its complete adequacy. Each system shall be inspected and certified in the same way. Submit a report, including all field modifications and all certificates.

1.5 SEISMIC CONTROL
A. Not applicable.

1.6 DELIVERY, STORAGE AND HANDLING
A. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of pipe and fittings.
B. Do not drop pipe and fittings.
C. Store materials on the project site in enclosures or under protective coverings in accordance with manufacturer's recommendations and as required by the Engineer.
D. Assure that materials are kept clean and dry.
E. Do not store materials directly on the ground.
F. Follow manufacturer's specific instructions, recommendations and requirements.
G. Store in a manner to protect items with epoxy shop coatings from exposure to UV light which can cause chalking of the epoxy. Length of acceptable exposure prior to providing UV protective measures shall be in accordance with coating manufacturer’s recommendations. This includes protection from UV light after installation while awaiting covering or filling of tanks, or prior to field painting for items scheduled to be topcoated as specified in Section 09900.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Materials are specified in the following Sections in this Division.

2.2 BOLTS, ANCHOR BOLTS AND NUTS
A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers,

lock washers and, where so required, their nuts shall be hexagonal.

B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be carbon steel unless otherwise indicated below or as specified elsewhere.
   1. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
   2. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications as well as in wetwells, headworks, dewatering rooms, chemical rooms, clarifiers, aeration basins, splitter structures, equalization or storage tanks, high chloride conditions, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

C. Unless otherwise specified, stud, tap, and machine bolts shall be of the best-quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).

D. All bolts shall be suitable size for the intended purpose, with direct input from the product manufacturer.

2.3 SURFACE PREPARATION AND SHOP COATINGS

A. Provide surface preparation and shop coatings in accordance with Specification Section 09905.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.

B. Carefully inspect all materials at the time of delivery and just prior to installation.

C. Carefully inspect all pipe and fittings for:
   1. Defects and damage.
   2. Deviations beyond allowable tolerances for joint dimensions.
   3. Removal of debris and foreign matter.

D. Examine areas and structures to receive piping for:
   1. Defects, such as weak structural components that adversely affect the execution and quality of work.
   2. Deviations beyond allowable tolerances for pipe clearances.

E. All materials and methods not meeting the requirements of this Contract will be rejected.

F. Immediately remove all rejected materials from the project site.

G. Start work only when conditions are corrected to the satisfaction of the Engineer.

3.2 INSTALLATION

A. General:
   1. Install all pipe and fittings in strict accordance with the manufacturer's instructions and recommendations and as specified herein.
   2. Install all pipes and fittings in accordance with the lines and grades shown on the Drawings and as required for a complete installation.

3. Install adapters, acceptable to the Engineer, when connecting pipes constructed from different materials.
4. Support all piping not being installed in trenches in accordance with the "Pipe Hangers & Supports" Section in Division 15.

B. Installation in Trenches:
1. Firmly support the pipe and fittings on bedding material as shown on the Drawings and as specified in the appropriate Sections of these Specifications.
2. Do not permanently support the pipe or fittings on saddles, blocking stones, or any material which does not provide firm and uniform bearing along the outside length of the pipe.
3. Thoroughly compact the material under the pipe to obtain a substantial unyielding bed shaped to fully support the pipe.
4. Excavate suitable holes for the joints so that only the barrel of the pipe receives bearing pressure from the supporting material after placement.
5. Lay each pipe length so it forms a close joint with the adjoining length and bring the inverts to the required grade.
6. Set the pipe true to line and grade.
7. Do not drive the pipe down to grade by striking it with a shovel handle, timber, rammer, or any other unyielding object.
8. Immediately after making a joint, fill the holes for the joints with bedding material, and compact.
9. When each pipe length has been properly set, place and compact enough of the bedding material between the pipe and the sides of the trench to hold the pipe in correct alignment.
10. After filling the sides of the trench, place and lightly tamp bedding material to complete the bedding as shown on the Drawings.
11. Take all necessary precautions to prevent floatation of the pipe in the trench.
12. Bedding and backfill for all pipe materials shall be as specified in Section 02200, Earthwork, and as shown on the Drawings.

C. Temporary Plugs:
1. When pipe installation work in trenches is not in progress, close the open ends of the pipe with temporary watertight plugs.
2. If water is in the trench when work is resumed, do not remove plugs until all danger of water entering the pipe is eliminated.
3. Do not use the pipelines as conductors for trench drainage during construction.

3.3 CLEANING AND TESTING

A. Cleaning & Testing Piping - General:
1. Thoroughly clean all piping prior to testing. Remove all dirt, dust, oil, grease and other foreign material. Exercise care while cleaning to avoid damage to linings and coatings.
2. When the installation is complete, test all pipelines in the presence of the Engineer and the plumbing or building inspector in accordance with the requirements of the local and state plumbing codes and the appropriate Sections of these Specifications, at no additional cost to the Owner. When requested by the Engineer or local plumbing inspector, building gravity drains shall be tested prior to backfilling or concealing. All other piping must be tested after backfilling.

3. Equipment: Supply all labor, equipment, materials, taps, gauges, and pumps required to conduct the tests.
4. Retesting: Perform all retesting required by the Engineer at no additional cost to the Owner.

B. Building Interior or Exposed Water Lines: Clean and test in accordance with the "Plumbing General" Section in Division 15.

C. Building Interior or Exposed Sewer System: Clean and test in accordance with the "Plumbing General" Section in Division 15.

D. Outside Sewer Lines (CLASS II): CLASS II pipe testing shall be performed in accordance with Section 02755.

E. All Other Piping Systems:
1. CLASS IV and CLASS V Hydrostatic Pressure Test:
   a. The section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air the Contractor shall make the necessary excavations, backfilling and taps at such points and shall plug said holes after completion of the test.
   b. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.
   c. CLASS IV - Perform pressure and leakage test at the test pressure shown on the Pipe Schedule. If no test pressure is indicated, perform pressure and leakage test at 1-½ times the maximum system pressure or 100 psi whichever is greater (based on the elevation of the lowest point of the section under test and corrected to the gauge location).
   d. CLASS V - Perform pressure and leakage test at the test pressure shown on the Pipe Schedule. If no test pressure is indicated, perform pressure and leakage test at 1-1/2 times the maximum system pressure or 20 psi whichever is greater (based on the elevation of the lowest point of the section under test and corrected to the gauge location).
   e. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during a two-hour period on buried pipelines exceeds a rate calculated by the equation in paragraph 3.3,B,1,e of this Specification Section, the section shall be considered as having failed the test. All pipes within structures and chambers and all flanged joints shall have no visible leakage.
   f. If the section fails to pass the pressure and leakage test, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at their own expense and without extension of time for completion of the work. Additional tests and repairs shall be made until the section passes the specified test.
2. Connection to Work by Others.
   a. If work involves connection of pipe lines to pipes or structures provided by others, pressure tests pipe line prior to making the connection.
   b. After successfully passing the pipe line pressure test, make the necessary connections to the work by others, and pressure test the connection.

c. The connection shall be pressurized to the pipe line test pressure, for a minimum of 4 hours. The connection shall have no visible leakage.
d. Correct any leakage at no cost to the Owner and retest until connection passes.

3. Cleaning: Perform all specialized cleaning as specified or required by system.

3.4 PIPE SCHEDULE

A. Refer to the Drawings.

END OF SECTION

SECTION 15062

DUCTILE IRON PIPE & FITTINGS (INTERIOR/EXPOSED APPLICATIONS)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test ductile iron pipe and fittings of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
   1. Section 15050 – Pipe & Pipe Fittings – General

1.3 QUALITY ASSURANCE

A. Standards (As Applicable):
   1. Cement-mortar lining for water: ANSI A2l.4 (AWWA C104).
   2. Rubber gasket joints: ANSI A2l.ll (AWWA C111).
   3. Ductile iron pipe thickness: ANSI A2l.50 (AWWA C150).
   4. Ductile iron pipe centrifugally cast in metal or sand lined molds: ANSI A2l.5l (AWWA C151).
   5. Pipe flanges and fittings: ANSI Bl6.l and ANSI A21.10 (AWWA C110).
   6. Threaded, flanged pipe: ANSI A21.15 (AWWA C115).
   7. Cast and ductile iron fittings: ANSI A2l.l0 (AWWA C110).
   8. Ductile Iron Compact Fittings: ANSI 21.53 (AWWA C153).
   9. NSF 61: Drinking Water System Components – Health Effects.
   10. NSF 372: Drinking Water System Components – Lead Content
   11. All components in contact with potable water, or water being processed to become potable water, shall be compliant with NSF 61 and shall be constructed of “Lead-free” material in compliance with NSF 372.

B. Acceptable Manufacturers:
   1. Tyler Union
   2. Griffin
   3. US Pipe
   4. Victaulic Company (fittings only, where allowed)
   5. Or equivalent.

1.4 SUBMITTALS

A. In accordance with the requirements specified in Section 01340 and 15050. Submit such shop drawings, manufacturer’s literature, short-term and long-term storage requirements, and operations and maintenance manuals.

B. Submit Manufacturer’s “Certification of Conformance” that pipe and fittings meet or exceed the requirements of these specifications.

C. Submit Manufacturer's installation instructions for all pipe and fittings.

1.5 DELIVERY, STORAGE & HANDLING

A. Exercise extra care when handling cement lined pipe because damage to the lining will render it unfit for use.

B. Protect the spherical spigot ends and the plain ends of all pipe during shipment by wood lagging securely fastened in place.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. General:
   1. Unless otherwise shown on the Drawings, the minimum thickness of ductile iron pipe shall be Class 53.
   2. Pipe for use with sleeve type couplings shall have plain ends (without bells or beads) cast or machined at right angles to the axis.
   3. Pipe for use with split type couplings shall have ends with cast or machined shoulders or grooves that meet the requirements of the manufacturer of the couplings and AWWA C606.
   4. The outside of all interior pipe shall be coated in accordance with Section 15050.

B. Pipe Interior Lining:
   1. Pipe shall be double thickness cement lined and seal coated unless noted otherwise on the Drawings and except for air piping lines which shall be completely unlined.
   2. When required, glass lining shall meet the following requirements:
      a. Glass lining shall be fused to metal base by firing entire pipe or fitting to a temperature above 1,400 degrees F and held at that temperature for sufficient time to develop a smooth vitreous lining which has a molecular bond to the metal.
      b. Glass lining shall be a minimum of 0.008-inch thick and shall be capable of withstanding an instantaneous thermal shock of 350 degrees F temperature differential without crazing, blistering or spalling. Lining shall be free of pinholes which expose the metal.
      c. Glass lining shall have a hardness of 5-6 on the Mohs scale and a density of 2.5 to 3.0 grams per cubic centimeter.

C. Joints (as shown on Drawings or as specified):
   1. Flanged:
      a. Provide specially drilled flanges when required for connection to existing piping or special equipment.
      b. Flanges shall be flat face, long-hub screwed tightly on pipe by machine at the foundry prior to facing and drilling.
      c. Gaskets:
         i. Full face gaskets only.
         ii. Thickness of gaskets - Use standard 1/8-inch thickness gaskets, unless thinner gaskets are required for tight retrofit installations.

iii. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F to 250°F.

d. Bolting/Fasteners:
   i. Make joints with bolt, studs with a nut on each end, or one tapped flanged with a stud and nut.
   ii. The number and size of bolts shall meet the requirements of the applicable ANSI standard.
   iii. Nuts, bolts, and studs shall be per requirements of Section 15050 – Pipe and Fittings - General.

e. When applicable, provide and install flange clamps as shown on the Drawings.

2. Grooved Joint Couplings: Couplings shall consist of two or more ductile iron housing segments to ASTM A536, pressure responsive FlushSeal gasket to ASTM D2000, and zinc electroplated steel bolts and nuts to ASTM A449 or stainless steel to ASTM F593.
   a. For direct connection to grooved end IPS/steel pipe sizes transition couplings may be used. The coupling housings shall be cast with offsetting angle-pattern bolt pads for joint rigidity.
   b. Split ring couplings, sleeve couplings, flexible joints and couplings, shall be supplied as specified in "Couplings and Connectors" Section.
   c. All grooved joint couplings, fittings, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
   d. All castings used for coupling housings, and fittings shall be date stamped for quality assurance and traceability.

3. Joint Bracing:
   a. Provide joint bracing to prevent the piping from pulling apart under pressure as required and as shown on the Drawings.
   b. Types of bracing:
      i. Pipe and fittings furnished with approved lugs or hooks cast integrally for use with socket pipe clamps, tie rods, or bridles. Bridles and tie rods shall be a minimum of 3/4 inch diameter except where they replace flange bolts of a smaller size, in which case they shall be fitted with a nut on each side of the pair of flanges. The clamps, tie rods, and bridles shall be coated with bituminous paint in buried installations and shall be coated with the same coatings as the piping system in interior installations after assembly or, if necessary, prior to assembly.
      ii. Other types of bracing as shown on the Drawings.

2.2 FITTINGS

A. Standard Fittings:
   1. Either gray cast iron or ductile iron fittings may be furnished.
   2. Pressure rating of 250 psi unless indicated otherwise on the Drawings or as specified.

3. Flange fittings shall be ANSI B16.1, Class 125 unless indicated otherwise. Flanges shall be flat faced, with full face gaskets.
4. Grooved end fittings shall comply with ANSI A21.10/AWWA C110 for center-to-end dimensions, and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness. Ends shall comply with AWWA C606, and the fittings shall be of the same manufacturer as the grooved components.
5. Joints the same as the pipe with which they are used or as shown on the Drawings.
6. Provide fittings with standard bases where shown on the Drawings.
7. Cement lining and seal coat unless noted otherwise on the Drawings, and except for air piping applications where the fittings shall be unlined.
8. All interior fittings shall receive coating in accordance with Section 15050.
9. On high temperature applications such as air lines, the gaskets shall be suitable for service from 40°F. to 250° F.

B. Non-Standard Fittings:
1. Fittings having non-standard dimensions shall be subject to the Engineer's review and acceptance.
2. Non-standard fittings shall have the same diameter and thickness as standard fittings and shall meet the specification requirements for standard fittings.
3. The lengths and types of joints shall be determined by the particular piping to which they connect.
4. Flanged fittings not meeting the requirements of ANSI A21.10 (i.e., laterals or reducing elbows) shall meet the requirements of ANSI B16.1 in Class 125.

C. Wall Castings:
1. Size, type and location as shown on the Drawings.
2. Dimensions shall conform to ANSI A21.10 except where required. A flange substantially flush with the face of a concrete or masonry wall shall be drilled and tapped for studs.
3. Other dimensions shall be identical to the corresponding parts of standard bell and spigot fittings.
4. Sealing/anchoring collar shall be not less than 0.38-inch thick up to 36-inch diameter pipe and not less than 0.5-inch thick for 42-inch diameter pipe and larger.
5. Sealing and anchoring collar shall be the same diameter as the flange and shall be welded to the barrel at a point that will locate it midway through the wall.

PART 3 - EXECUTION

3.1 INSPECTION

A. Provide all labor necessary to assist the Engineer to inspect pipe, fittings, gaskets, and other materials.
B. Carefully inspect all materials at the time of delivery and just prior to installation.
C. Carefully inspect all pipe and fittings for:
1. Defects, such as weak structural components, that adversely affect the execution and quality of work.
2. Deviations beyond allowable tolerances for pipe clearances.

D. Immediately remove all rejected materials from the project site.

3.2 INSTALLATION

A. General:
   1. Install in strict accordance with the pipe and fitting manufacturer's instructions and recommendations and as specified or as shown on the Drawings.
   2. Acceptable thrust resistant system is required at all fittings on pressure pipe.

B. Assembling Joints:
   1. Flanged Joints:
      a. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
      b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
   2. Grooved Joints:
      a. Grooved joint shall be installed in accordance with the manufacturer’s written recommendations.
      b. Grooved ends shall be clean and free from indentations, projections, or roll marks.
      c. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service.
      d. The coupling manufacturer’s factory trained representative shall provide on-site training for the contractor’s field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor’s representative is not considered qualified to conduct the training.)
   3. Bolted Joints:
      a. Remove rust preventive coatings from machined surfaces prior to assembly.
      b. Thoroughly clean and carefully smooth all burrs and other defects from pipe ends, sockets, sleeves, housings and gaskets.
      c. All stainless steel fasteners for piping and supports shall be hand tightened to limit the potential for galling.

C. Fabrication:
   1. Tapped Connections:
      a. Make all tapped connections as shown on the Drawings or as required by the Engineer.
      b. Make all connections watertight and of adequate strength to prevent pullout.
      c. Drill and tap normal to the longitudinal axis of the pipe.
      d. The maximum sizes of taps in pipes and fittings without busses shall not exceed the sizes listed in the appendix of ANSI A2l.5l based on 3 full threads for ductile iron.
      e. Taps in fittings shall be located where indicated by the manufacturer for that particular type of fitting.

D. Castings in Masonry:
   1. Accurately set and align castings to be encased in masonry.
   2. Thoroughly clean castings immediately prior to being set in place. Remove all rust, scale and other foreign material.

END OF SECTION

SECTION 15088

COUPLINGS & CONNECTORS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install couplings and connectors of the type(s) and size(s) in the location(s) shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
   1. Section 15050 – Pipe & Pipe Fittings – General

1.3 QUALITY ASSURANCE

A. Minimum pressure rating equal to that of the pipeline in which they are to be installed.
B. Couplings and connectors, other than those specified herein, are subject to the Engineer's approval.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All Couplings and Connectors:
   1. Gasket Materials: Composition suitable for exposure to the liquids to be contained within the pipes.
   2. Diameters to properly fit the specific types of pipes on which couplings and connectors are to be installed.
B. Sleeve Type Couplings (When Applicable):
   1. Exposed Couplings (When Applicable):
      a. Steel middle ring,
      b. Two steel follower rings,
      c. Two wedge-section gaskets,
      d. Sufficient steel bolts to properly compress the gaskets,
      e. Acceptable Manufacturers:
         i. Smith-Blair – Style 411
         ii. Romac – Style 400
         iii. Baker Hughes (GE Company) – Style 38
         iv. Or equal
   2. Buried Couplings (When Applicable):
      a. Refer to Section 02655.
C. Split Type Couplings (When Applicable):
   1. Constructed from malleable or ductile iron.
   2. For use with grooved or shouldered end pipe with minimum wall thickness as required so as not to weaken pipe.
   3. Cast in two segments for 3/4 inch through l4 inch pipe sizes, four segments for 15 inch through 24 inch pipe sizes, and six segments for pipe sizes over 24 inch.

4. Coating: Enamel.
5. Bolts: Carbon steel.
6. All gaskets shall be Manufacturers Standard or as required for intended service with respect to fluid, temperature and pressure.
7. Acceptable Manufacturers:
    a. Victaulic Company of America, Style 77 for IPS Pipe, Style 31 for Ductile Iron Pipe.
    b. Star Pipe Products,
    c. Or equal.

D. Flanged Adapters (When Applicable):
1. For joining plain end or grooved end pipe to flanged pipes and fittings.
2. Adapters shall conform in size and bolt hole placement to ANSI standards for steel and/or cast iron flanges 125 or 150 pound standard unless otherwise required for connections.
3. Exposed Sleeve Type:
    a. Constructed from steel.
    b. Coating: Enamel.
    c. Bolts: Carbon steel or ASTM A588 steel.
    d. Acceptable Manufacturers:
        i. Dresser Manufacturing Co. - Style 128 for cast iron, ductile iron and steel pipes with diameters of 2 inches through 96 inches,
        ii. Smith Blair
        iii. Or equal.
4. Exposed Restrained Type
    a. Constructed of ductile iron, ASTM A536
    b. Coating: Fusion bonded epoxy
    c. Acceptable Manufacturers:
        i. Romac Style RFCA
        ii. Mueller/Krausz Hymax Grip Flange Adaptor
        iii. Or equal
5. Split Type:
    a. Constructed from malleable or ductile iron.
    b. For use with grooved or shouldered end pipe.
    c. Coating: Enamel.
    d. Acceptable Manufacturers:
        i. Victaulic Company of America - Style 741 for IPS pipe, or Style 341 for Ductile Iron Pipe, for pipe diameters of 2 inches through 12 inches,
        ii. Victaulic Company of America - Style 742 for IPS pipe, or Style 342 for Ductile Iron Pipe, for pipe diameters of 14 inches through 16 inches,
        iii. Star Pipe Products,
        iv. Or equal.

E. Flexible Joints:
1. Expansion Joints:
    a. Materials shall be capable of withstanding the temperature, pressure and type of material in the pipeline.

b. Shall be the filled arch type that will prevent sediment build up for all sludge, sewage, and other lines with similar service.
c. Supplied with control rods to restrict elongation and compression.
d. Metal retaining rings shall be split and beveled galvanized steel for placement against the flange of the expansion joint.

2. Expansion Joint (Air Service)
   a. Rubber expansion joints for all low pressure process air piping shall be of the non-filled arch double bellow type, unless otherwise noted.
   b. The expansion joint shall have ANSI 125-pound flanges.
   c. All low pressure process air piping rubber expansion couplings shall be capable of withstanding a pressure of 15 psig at a temperature of 250°F.
   d. Rubber expansion couplings shall be as manufactured by General Rubber Corp., Mercer Rubber Co., or equal.
3. Deflection Joints:
   a. Joints designed to permit a nominal maximum deflection of 15 degrees in all directions from the axis of the adjacent pipe length, will prevent pulling apart, and will remain watertight at any angle of deflection under 15 degrees.
   b. Material to be manufactured from a composition material suitable for exposure to the liquid, pressure and temperature to be contained within the pipe.
   c. Supplied with control rods as required.
4. Dismantling Joints:
   a. Service: Provide flexibility for installation and dismantling of flanged pipe interfaces with valves, pumps, blowers, meters, compressors and various appurtenances.
   b. Restraint: Tie rods.
   c. Size: 4" to 24"
   d. Finish: Epoxy
   e. Double-ended flange adapter capable of 2 to 20 inches longitudinal adjustment.
   f. Pressure: Minimum 150 pound design working pressure, or match pipe rating, whichever greater.
   g. Fabricated steel body, welded construction.
   h. Materials: flange carbon steel, body carbon steel; follower ductile iron for 12" and less and carbon steel for 14" and larger; wedge gasket Buna-S or Buna-N and suitable for fluid.
   i. Connection: 150 pound ANSI flanges welded to spool piece and flange adapter.
   j. Acceptable Manufacturer:
      i. Dresser Style 131
      ii. Smith Blair Model 975
      iii. Or equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sleeve Type Couplings (When Applicable):
   1. Thoroughly clean pipe ends for a distance of 8 inches from the ends prior to installing couplings, and use soapy water as a gasket lubricant.
   2. Slip a follower ring and gasket (in that order) over each pipe and place the middle ring centered over the joint.
   3. Insert the other pipe length into the middle ring the proper distance.
   4. Press the gaskets and followers evenly and firmly into the middle ring flares.
   5. Insert the bolts, finger tighten and progressively tighten diametrically opposite nuts uniformly around the adapter with a torque wrench applying the torque recommended by the manufacturer.
   6. Insert and tighten the tapered threaded lock pins.
   7. Insert the nuts and bolts for the flange, finger tighten and progressively tighten diametrically opposite bolts uniformly around the flange to the torque recommended by the manufacturer.

B. Split Type Flange Adapters (When Applicable): Install in the same manner as Split Type Couplings.

C. Buried Cast Iron Couplings, Adapters and Connectors (When Applicable): Thoroughly coat all exterior surfaces, including nuts and bolts, after assembly and inspection by the Engineer with a heavy-bodied bituminous mastic as approved by the Engineer.

D. Buried Epoxy Coated Steel Couplings: Thoroughly coat all exterior surfaces, including nuts and bolts after assembly and inspection by the Engineer with a coal tar approved by the Engineer. Prior to coating, roughen the epoxy with emory paper and follow with a solvent cleaner (aeromatic similar to xylol). Dry film thickness of the coal tar is to be 12-16 mils.

E. Install thrust rods, supports, and other provisions to properly support pipe weight and axial equipment loads.

F. All interior sleeve type couplings shall be restrained with tie rods when used on pressurized lines. All buried couplings on pressure lines shall be restrained (solid sleeve) type.

END OF SECTION

SECTION 15092

PIPE SLEEVES & SEALS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install wall sleeves and seals of the type(s) and sizes(s) and in the location(s) shown on the Drawings and specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
   1. Section 15050 – Pipe & Pipe Fittings – General

1.3 QUALITY ASSURANCE

A. Provide and install all sleeves of the types specified herein, as shown on the Drawings and as directed by the Engineer.
B. Provide sleeves that are airtight, gastight or watertight as required.
C. Penetrations through fire rated walls, floors and ceiling shall have proper fire stopping, as specified in Section 07270.

PART 2 - PRODUCTS

2.1 TYPES AND LOCATIONS

A. General
   1. Refer to details on Process Drawings.
B. Penetrations through New Construction:
   1. Interior Masonry, Drywall, or Wood Partition (Non-Load Bearing) - Air to Air:
      a. 24 gauge, zinc coated (galvanized) steel tubes with wired or hemmed edges.
      b. Minimum 1/4 inch annular space between sleeve and pipe or insulation.
      c. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
      d. Install split cover plates in all finished areas. Both sides of wall if required. Plates shall be chrome finished, suitably sized to fit pipe in question and cover opening.
   2. Exterior Masonry and Wood Walls
      a. Schedule 40 galvanized steel pipe, hot-dip galvanize after fabrication.
      b. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
      c. Minimum ¼-inch annular space between sleeve and pipe or insulation.
      d. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
   3. Interior Concrete Partitions - Air to Air:

a. Schedule 40 galvanized steel pipe with 1 inch x 1/8 inch thick welded sealing and anchoring collar in middle, hot-dip galvanize after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
b. Minimum 1/4 inch annular space between sleeve and pipe or insulation.
c. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
d. Refer to details on Process Drawings.

4. Concrete Floor Penetrations - Air to Air; and Air to Ground:
   a. Same as “Interior Concrete Partitions - Air to Air”.
   b. Pipe sleeve to extend 2 inches above finished floor.
   c. Pipe sleeve bottom to be set flush with underside of slab.
   d. Galvanized steel pipe riser clamp with threaded rod embedded into concrete floor to be installed on topside of penetration to support the pipe vertically.
   e. Refer to details on Process Drawings.
5. Roof Penetrations - Air to Air:
   a. Same as “Interior Concrete Partitions” and as shown on the Drawings.
6. Exterior Concrete Walls - Air to Air; and Air to Ground:
   a. Schedule 40 galvanized steel pipe with 1 inch x 1/4 inch integrally cast sealing and anchoring collar in middle, hot-dip galvanize after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
   b. Size of pipe sleeve as required by seal manufacturer.
   c. Seal with rubber link compression seal.
   d. Alternate wall sleeve system as manufactured by Omni Sleeve, Malden, MA can be utilized as reviewed and accepted by Engineer, in place of above specified wall sleeve system.
   e. Refer to details on Process Drawings.
7. Concrete Tank Walls - Liquid Containing Structures to Air, Ground, or Liquid
   a. For ductile iron and steel piping systems, utilize wall castings, or sleeve and double rubber link compression seal. Materials, schedule, class and size to match pipe.
      i. For galvanized steel piping systems, use SCH 40 galvanized steel pipe with 1-inch x 1/4-inch welded sealing and anchoring collar in middle, hot-dip galvanized after fabrication. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
      ii. For stainless steel piping systems, use Schedule 40 stainless steel pipe with 1-inch x 1/4-inch welded sealing and anchoring collar in middle. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
      iii. For ductile or cast iron piping systems, use wall casting with 1-inch x 1/4-inch integrally cast sealing and anchoring collar in middle; or sleeve with 1-inch x 1/4-inch welded sealing and anchoring collar in middle, hot-dip galvanized after fabrication.

iv. Refer to details on Process Drawings.

b. For plastic piping systems, sleeve and seals to be in accordance with "Exterior Concrete Walls - Air to Ground" requirements noted above. These type penetrations will be allowable only in those locations specifically depicted on the drawings.

8. Foundation Walls Below Grade - Ground to Ground:
   a. Schedule 40 or max. 3/8 inch thick wall galvanized steel sleeve. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness.
   b. Minimum 1/2 inch annular space.
   c. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
9. Other conditions shall be sleeved or as reviewed and accepted by the Engineer.

C. Penetrations Through Existing Construction:
1. Interior masonry, drywall, or wood partition - Air to Air:
   a. Cleanly cut brick or block as required. Grout sleeve into place using non-shrink grout.
   b. Cleanly cut wood frames partitions as required. Set sleeve into position and secure.
   c. Sleeves to be as required for New Construction - Interior masonry, drywall, or wood partition - Air to Air.
   d. Holes bored with equipment leaving a smooth hole in masonry walls less than l/2 inch larger than the pipe will not require a sleeve, unless otherwise specified.
   e. Minimum 1/4 inch annular space between cored opening or sleeve and pipe or insulation.
   f. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
   g. Install split cover plates in all finished areas. Both sides of wall if required. Plates shall be chrome finished, suitably sized to fit pipe in question and cover opening.
2. Interior Concrete Partitions - Air to Air:
   a. Core smooth-walled opening with coring machine. Grout sleeve into place using non-shrink grout.
   b. Sleeves to be as required for "New Construction - Interior Concrete Partitions - Air to Air".
   c. Holes cored with equipment leaving a smooth hole, less than l/2 inch larger than the pipe will not require a sleeve, unless otherwise specified.
   d. Minimum 1/4 inch annular space between cored opening or sleeve and pipe or insulation.
   e. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.
3. Interior Concrete Partitions - Air to Air:
   a. Same as "Exterior Concrete Wall".
4. Interior Concrete Partitions - Air to Air (Unclassified to Classified):
   a. Same as "Concrete Tank Wall".

5. Exterior Masonry Walls
    a. Core drill a smooth hole through all layers of the existing masonry. Hole shall be sized to facilitate standard rubber link compression seal installation.
    b. Install rubber link compression seal at each layer of masonry.
    c. Seal each face with polyurethane sealant.
    d. If a clean, smooth hole cannot be achieved, remove the masonry as required to install Schedule 40 galvanized wall sleeve. Pipe sleeve thicknesses for sizes larger than 24-inch diameter shall be the standard 0.375-inch thickness. Grout sleeve in place. Install rubber link compression seal and sealant as noted above.
6. Exterior Wood Walls
    a. Remove existing siding and other materials, as required to install the new item.
    b. Restore the wall and siding to provide a weather-tight seal acceptable to the Engineer.
7. Concrete Floor Penetrations - Air to Air:
    a. Same as “Interior Concrete Partitions - Air to Air”, except that sleeve will not be required.
    b. Stainless steel pipe riser clamp with stainless steel threaded rod embedded into concrete floor to be installed on topside of penetration to support the pipe vertically.
    c. Install rubber link compression seal, as shown, covered by self-leveling sealant (SikaFlex or equivalent).
    d. Refer to details on Process Drawings.
8. Roof Penetrations - Air to Air:
    a. Same as “Interior Concrete Partitions - Air to Air” and as shown on the Drawings.
9. Concrete Exterior Walls - Air to Ground:
    a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
    b. Size of cored opening as required by seal manufacturer.
    c. Seal with rubber link compression seal.
10. Concrete Tank Walls - Liquid Containing Structures to Air or Ground:
    a. Core smooth-walled opening with coring machine. Grout smooth any irregularities in opening.
    b. Size of cored opening as required by seal manufacturer.
    c. Seal with two, back to back rubber link compression seals.
11. Foundation Walls Below Grade - Ground to Ground:
    a. Core smooth-walled opening with coring machine. Grout sleeve into place using non-shrink grout.
    b. Sleeves to be as required for “New Construction - Foundation Walls Below Grade - Ground to Ground”.
    c. Holes cored with equipment leaving a smooth hole, less than 1-inch larger than the pipe will not require a sleeve, unless otherwise specified.

d. Minimum 1/2 inch annular space between cored opening or sleeve and pipe or insulation.
e. Firmly pack with oakum and seal both ends with polyurethane sealant, per Section 07920 for standard penetrations.

12. Other conditions shall be installed as reviewed and accepted by the Engineer.

D. Pipe openings in and penetrations through precast concrete structures shall be as specified in Division 2 and 3.

E. Rubber Link Compression Seals:
1. Acceptable Manufacturers:
a. Link Seal
b. Flexicraft
c. Or equivalent.
2. Multi-rubber link type with pressure plates, bolts, nuts and sealing element providing a leak proof seal. Model numbers provided below are based on Link Seal and are to establish type and level of quality.
3. General Service (Model C):
a. Glass Reinforced Nylon Pressure Plate.
b. Carbon steel zinc-dichromate nut and bolt.
c. Sealing element: EPDM rubber.
d. Temperature Rating: -40°F to 250°F.
4. Corrosive Service: (Model S-316):
a. Use in the following locations: Sludge tanks, scum tanks, digesters, wetwells, manholes, dewatering rooms, headworks rooms, exterior tanks, chemical rooms, as shown on the Drawings.
b. Glass Reinforced Nylon Pressure Plate.
c. Bolt and nut, l8-8 stainless steel.
d. Sealing element: EPDM rubber.
e. Temperature Rating: -40ºF to 250ºF.
f. .
5. High Temperature Service (Model T)
a. Steel zinc dichromate pressure plates.
b. Carbon steel with zinc dichromate finish nuts and bolts.
c. Sealing element: Silicone.
d. Temperature Rating: -67º to 400º F.
6. Refer to details on Process Drawings.

F. Wall Plates: Provide split type cast iron or brass wall plates on pipes penetrating walls in finished spaces such as labs and offices. Refer to details on Process Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. New construction:
1. Concrete: Set sleeves in proper location prior to placing concrete. Sleeves set by mechanical, plumbing, and HVAC trades as appropriate.
2. Masonry: Mechanical, plumbing, and HVAC trades to provide sleeves and locations to masonry trades for installation.

3. Partitions: Set sleeves in place as work progresses.

B. Hollow Concrete Roof or Floor Planks:
   1. Provide planks with sleeve cast-in-place at time of construction,
   2. Or core drill planks in location reviewed and accepted by Engineer and plank manufacturer. Submit written approval of locations from pre-cast concrete plank manufacturer.
   3. Firmly grout sleeve in place.

C. Existing Construction:
   1. The location will be reviewed and accepted by the Engineer prior to coring or cutting hole.
   2. For concrete, holes shall be located to avoid the reinforcing steel when possible.
   3. Patch all damaged work as required to maintain a neat and clean appearance.

D. Rubber Link Compression Seals: Install as required and in strict accordance with the manufacturer's instructions and recommendations.

END OF SECTION

SECTION 15094

PREFABRICATED PIPE HANGERS, SUPPORTS AND BRACING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Design, furnish and install prefabricated pipe hangers, supports, and braces to support pipes, maintain the necessary pitch, minimize vibration, prevent movement, and allow expansion and contraction of the pipes shown on the Drawings, as specified in Section 15050, as specified herein and as referenced. Supports shall be designed for all tributary gravity loads and lateral loads from operating pressures, seismic forces, and startup/shutdown water hammer thrust. This Specification covers hangers, supports, and braces for process and mechanical piping systems including ductile iron, carbon steel, galvanized steel, stainless steel, fiberglass, PVC and copper piping.

B. Hangers for electrical conduit, plumbing piping, HVAC ducts, and other utilities are found within their respective Specification sections.

C. Structural steel pipe support frame systems required specifically for supporting prefabricated pipe hangers are detailed on the Structural Drawings and shall be supplied under Specification Section 05120 [Pipe hangers and supports that are detailed on the Structural or Process Drawings and do not utilize prefabricated hangers or supports shall be supplied under Specification Section 05120.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.

1. Section 15050 – Pipe & Pipe Fittings – General

1.3 REFERENCES

A. This section contains references that are applicable to this Specification Section. The applicable edition of the indicated references shall be the version that was the most current at the time of the Advertisement of Bids.

B. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

1. MSS SP-58 Pipe Hangers and Supports – Materials, Design and Manufacture
2. MSS SP-69 Pipe Hangers and Supports – Selection and Application
3. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
4. MSS SP-90 Guidelines on Terminology for Pipe Hangers and Supports

C. ASTM A123/A123M - Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron & Steel Products

D. ASTM A153/A153M - Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

E. ASTM C881/C881M - Specification for Epoxy-Resin-Base Bonding Systems for Concrete

F. ASCE 7 – Minimum Design Loads for Buildings and Other Structures, American

Society of Civil Engineers – Refer to the Structural Drawings.

G. Building Code of the Project State – Refer to the Structural Drawings.

1.4 DESIGN REQUIREMENTS

A. Contractor shall provide all necessary hangers, supports and braces as needed to provide a fully functional and adequately supported and restrained system.

B. This Specification requires the delegated design of pipe hangers, supports and bracing. The performance criteria, design requirements and materials of construction are specified herein. Refer to the Structural Drawings for a list of prohibited and allowed structural components from which piping can be hung, supported or braced. The absence of specific pipe support details shall not relieve the Contractor of the responsibility for designing and providing a fully functional system meeting the requirements of this Specification. The General Drawings identify which piping systems will and will not require a pipe support design by a Professional Engineer.

C. Prefabricated pipe supports shall be provided for all pipes shown on the Contract Drawings. Unless otherwise indicated, the terms “pipe support”, “pipe hanger” and “pipe guide” shall refer to prefabricated pipe supports, hangers, guides, and braces specified herein.

D. All structural steel pipe support frames and shop fabricated pipe support assemblies shown on the Contract Drawings are specified elsewhere and not required as part of this Specification.

E. Where flexible joints or couplings are indicated on the Contract Drawings at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported, to prevent transfer of system forces to the equipment. No fixed or restraining supports shall be installed between a flexible joint or coupling and the piece of equipment.

F. All pipe and appurtenances connected to the equipment shall be supported in a manner to prevent any strain or load from being imparted on the equipment or piping system.

G. Pipe supports shall be provided to minimize forces through valves, split and sleeve type couplings, flexible expansion joints and to minimize all pipe forces on equipment housings. Equipment housings shall not be utilized to support connecting pipes.

H. Unless otherwise indicated on the Drawings, maximum hanger and support spacing shall not exceed the following:

1. Copper Pipe:
   a. 1” diameter and smaller – 5 feet
   b. 1 1/4”, 1 1/2” and 2” diameter – 7 feet
   c. Greater than 2” diameter – 9 feet
2. Steel and Stainless Steel Pipe:
   a. 2” diameter and smaller – 7 feet
   b. 2 ½” - 4” diameter – 11 feet
   c. 5” – 8” diameter – 16 feet
   d. Greater than 10” diameter – 22 feet
3. Ductile and Cast Iron Pipe:
   a. All diameters – 10 feet
4. PVC and FRP Pipe:
   a. Hanger and support spacing shall be as recommended by the pipe manufacturer based on pipe size and service temperature. Individually

supported PVC pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3-feet.

5. The maximum support spacings listed above are based on the specific pipes being full of liquid without any additional vertical loads or thrusts. The actual required support spacings may be limited to the hangers selected or the presence of additional loads.
6. Supports shall be spaced such that the resulting concentrated load at any suspended support does not exceed 2,000 pound maximum and combined load shall not exceed 25 pounds per square foot over each slab panel the supports extend into, or as indicated on the Structural Drawings.
7. Pipe alignment guides shall not be used as vertical support of the piping.
8. Wall penetration sleeves (link-seal type or equivalent) shall not be used as support of the piping.

I. Contractor shall provide pipe supports at the following locations:
1. At all locations indicated on the Contract Drawings.
2. At all locations such that the maximum support spacing listed above are not exceeded.
3. At all locations such that the allowable load capacity of the prefabricated hangers are not exceeded.
4. At the end of all pipe runs.
5. At all changes in pipe direction greater than 22 degrees.
6. Within 1 foot of all valves, couplings, expansion joints and pipe joints.
7. All other locations deemed necessary by the Contractor, or pipe manufacturer, as shown on the Drawings..
8. Spaced such that the deflection in the pipe under operating conditions does not exceed L/360, where L is the distance between supports.

J. All drilled anchors used in suspended pipe supports shall meet the following requirements:
1. All supports shall have a minimum of 2 anchors per support.
2. Anchors shall be sized such that the ultimate capacity of the anchor is a minimum of 5 times greater than the anticipated design forces (Minimum Factor of Safety of 5).
3. Anchors shall have a minimum embedment depth of 6 inches, minimum spacing of 6 inches and a minimum edge distance of 6 inches.
4. Concrete anchors shall either be the epoxy adhesive or expansion anchor type, except expansion anchors are not permitted in exterior or wet service applications.
5. Masonry anchors shall either be the epoxy adhesive or expansion anchor type, except expansion anchors are not permitted in exterior or wet service applications. Masonry cells shall be grouted at the anchors. Drop-in, Toggle or epoxy anchors with screen tubes shall not be permitted.

K. All pipe supports shall be designed for the following loads:
1. Dead loads (including cement lining, insulation, etc)
2. Liquid Density – use a liquid specific gravity of 1.10 for water, wastewater and sludges and use the appropriate liquid specific gravity for chemicals, unless otherwise noted

3. Operational Thrust – refer to Specification Section 15050
4. Water Hammer Thrust – refer to Specification Section 15050
5. Thermal forces – refer to Specification Section 15050
6. Wind Load – In accordance with ASCE 7. Refer to the Structural Drawings for wind design parameters
7. Snow Load – In accordance with ASCE 7. Refer to the Structural Drawings for snow design parameters
8. Ice Load – In accordance with ASCE 7

1.5 SUBMITTALS

A. Submit a complete set of shop drawings of all items to be furnished under this Section and as required by Section 01340 and 15050.

B. Technical submittals for all projects shall include the following information:

1. Layout drawings with all pipe supports clearly labeled, located, and coordinated with the tabulated list noted below. Layout drawings shall include both Plan and Section views with the pipe supports clearly labeled in each view. All pipe layout changes proposed by the General Contractor shall be incorporated in the layout and identified as a proposed modification. Layout drawings shall address gravity loads and dynamic loads including thermal effects, pressure thrusts and seismic forces.
2. Summary of Pipe Hangers, Supports and Bracing: Submit a tabulated list of pipe support information which includes the following information at a minimum:
    i. Hanger/Support/Brace Number
    ii. Location
    iii. Pipe Diameter (nominal ID)
    iv. Pipe centerline elevation
    v. Pipe material
    vi. Additional dead weight (Cement lining, insulation, etc)
    vii. Lineal foot dead weight of pipe
    viii. Contents of pipe
    ix. Total lineal foot weight (dead weight and live weight)
    x. Length of pipe tributary to support
    xi. Total gravity and dynamic load at support
    xii. Type of support (as identified on the Drawings)
    xiii. Fixity of support (as identified on the Drawings)
    xiv. Structure supporting pipe support (Section 1.3.E above)
3. Representative catalog cut for each different type of pipe hanger, brace, or support indicating the materials of construction, material finishes, pipe sleeve or insulation information, protective shields, important dimensions and range of pipe sizes for which that hanger is suitable. Where standard hangers and/or supports are not suitable, submit detailed drawings showing materials and details of construction for each type of special hanger and/or support.
4. Representative catalog cuts for accessories (e.g., threaded rod, insulation shields and saddles, never-seize compound, etc.)
5. Letter from the General Contractor stating that the following has been coordinated:

i. Each pipe support system will not interfere with the other pipe support or seismic bracing systems.
ii. Components from the pipe support systems shall not extend within any means of egress or walking pathways in building spaces or at tanks.
iii. Components from the pipe support systems shall not interfere with the normal maintenance or operation of a component or equipment.

C. After the installation is completed and certified, submit as-built drawings for record purposes.

PART 2 - PRODUCTS

2.1 GENERAL

A. All uninsulated non-metallic piping such as PVC, CPVC, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by pipe insulation shields or other methods after review with no exceptions taken by the Engineer. All shields shall cover the pipe where it is in contact with the support.

B. All insulated pipe shall be furnished with a pipe insulation shield and/or saddle at each pipe support location as specified herein.

C. Where pipe hangers and supports come in contact with copper piping, provide protection from galvanic corrosion by wrapping pipe with 1/16-inch thick neoprene sheet and galvanized protection shield; isolators similar to Eleen, Figure No. 228; or PVC-coated hangers and supports. All stainless steel piping shall be isolated from all ferrous materials, including galvanized steel, by use of neoprene sheet material and protection shields, similar to above methods.

D. Pipe supports PVC piping:
1. Pipe supports for multiple PVC plastic piping shall be continuous wherever possible.
2. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays.
3. Ladder shall be of galvanized steel construction.
4. Rung spacing shall be 12 inches.
5. Tray width shall be approximately 6 inches for single runs and 12 inches for double runs.
6. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required by a complete support system.
7. Acceptable manufacturers:
   a. Electray Ladder by Husky-Burndy;
   b. Globetray by the Metal Products, a division of United States Gypsum,
   c. Or equal.
8. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to Globe, Model M-CAC; Husky-Burndy, Model SCR or equal.
9. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers and supports in contact with plastic PVC pipe shall provide firm support but not

so firm as to prevent longitudinal movement due to thermal expansion and contraction.

E. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet (whichever is less) by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

F. Link-seal compression type wall penetration sleeves shall not be used to support static or dynamic loads. Additional supports shall be provided such that static gravity loads and horizontal dynamic loads are not transferred to these penetration sleeves.

2.2 MATERIALS

A. Unless otherwise specified herein, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-SP-58, MSS SP-69 and MSS SP-89.

B. Pipe hangers, supports, braces and accessories shall be standard catalogued components as manufactured by Anvil International, Inc , Carpenter & Peterson, Inc. or equivalent (metallic pipe) or Jove (non-metallic pipe). Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary.

C. Materials of all prefabricated pipe hangers, supports, braces and accessories (including bolts, nuts, washers) shall be as follows:

1. For steel, stainless steel, ductile iron, HDPE, FRP and PVC piping:
    a. Exposed interior or exterior and all other spaces not otherwise defined below shall be **hot-dipped galvanized steel** conforming to ASTM A123 and ASTM A152.
    b. Submerged or within/directly above tanks shall be Type 316 stainless steel.
    c. Exposed interior spaces subjected to a damp or corrosive environment including the following spaces shall be **Type 316 stainless steel**.
        i. Wet Well and Wet Well Entrance
    d. Exposed interior spaces subjected to chemical/ corrosive environment including the following spaces shall be FRP or PVC.
        i. All chemical rooms
2. For copper piping: shall be copper plated steel.

D. Concrete Anchorage:

1. Epoxy anchors. ASTM C881, non-expanding, two-component epoxy resin with AISC Type 316 Stainless Steel threaded road with washer nut. Manufactured by Hilti Fastening Systems (HIT RE500SD); Ramset Fastening Systems (Chemset Capsule Series); Power Fasteners (T308 Plus); or equivalent.
2. Expansion anchors. Stainless steel AISI Type 316 for galvanized and aluminum fabrications; cadmium plated for painted steel fabrications. Manufactured by Hilti Fastening Systems (Kwik Bolt III); Ramset Fastening Systems (Tru Bolt Stud Anchor); Power Fasteners (Power Stud); or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install prefabricated hangers and supports in accordance with the pipe support shop drawings, in accordance with MSS SP-89 and as specified herein.

B. Hangers shall be used for their intended purpose only. They shall not be used for rigging or erection purposes.

C. General Contractor shall coordinate the installation of field run conduit, piping and other utilities to avoid interference with the pipe supports.

D. All pipe supports shall include features to permit adjustments of pipe elevations. Once all piping is properly aligned and at the correct elevations, the supports shall be locked into place. Locking nuts, cotter pins, temporary locking devices and other locking means should be properly engaged. Tack welding shall not be utilized to lock supports in place.

E. Install all drilled anchors in accordance with the anchor Manufacturer’s instructions.

F. PVC Piping and Fiberglass Piping: Support in strict accordance with the manufacturer's instructions and recommendations for the conditions of operation, temperature and size of pipe. Support in a manner which will prevent subsequent visible sagging of the pipe between supports due to plastic deformation.

G. All surfaces of steel and aluminum in contact with or embedded in concrete or masonry shall be coated with epoxy paint (min 5 mils dry film thickness).

H. Drain, waste, and vent piping: Support by adjustable hangers.

I. Valves, Fittings & Specialties: Independently support pipe connected to pumps, equipment and piping systems.

J. Temporary pipe supports:

1. General Contractor shall be responsible for providing all temporary pipe supports and rigging.
2. Lay out each section of pipeline and make connections while the pipe is held in temporary supports.
3. After the completion of connections in each section of pipeline, hold the section in place with temporary clamps.
4. Do not remove the temporary clamps until the piping is correctly installed on the permanent supports.

3.2 TESTING

A. All permanent pipe supports shall be installed prior to testing.

B. Demonstrate compliance with the requirements of this section with respect to support, pitch, vibration, movement, and expansion and contraction during start-up testing of the equipment and associated piping systems as indicated in Section 01800.

C. Systems which do not meet the requirements of this section with respect to support, pitch, vibration, lateral movement, and expansion and contraction shall be supplemented with additional braces as required and re-demonstrated until compliance is achieved.

3.3 COATINGS

A. Provide shop coatings in accordance with Section 09905.

B. Provide field coatings for steel items in accordance with Section 09900.

C. Provide touch-up field galvanizing for hot dipped galvanized items in accordance with Section 09900.
D. Provide field coatings on surfaces with dissimilar metals. Utilize epoxy paint (minimum 5 mil thickness) in accordance with Section 09900.
E. Provide temporary support or bracing as necessary to allow complete and continuous coats.

END OF SECTION

SECTION 15100

VALVES & SPECIALTIES – GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, support, and test valves, gates, hydrants, cocks, stops, and faucets, when applicable, (hereinafter referred to as "valves") in the location(s) and of the size(s) and quantities shown on the Drawings and/or as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
   1. Section 01010 – Summary of Work (construction sequencing requirements that affect number and duration of equipment startups and certifications)
   2. Section 01340 – Submittals
   3. Section 01600 – Delivery, Storage and Handling
   4. Section 01800 – Equipment Startup, Certification and Operator Training.
   5. Section 09905 – Surface Preparation and Shop Coatings
   6. Section 15050 – Pipe & Pipe Fittings – General
   7. Section 15094 – Prefabricated Pipe Hangers, Supports and Bracing
   8. Valves specified in Division 15.

1.3 QUALITY ASSURANCE

A. Provide valves of proven reliability manufactured by reputable manufacturers.

B. Acceptable manufacturers are listed in each section of this Division. Substitute or "or-equal" valves will be allowed only when indicated.

1.4 SUBMITTALS

A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340 and as specified herein. Shop drawings shall contain the following information at a minimum:
   1. Completed Submittal Certification Form. Shop drawing submittals will be returned unreviewed without this form.
   2. Certified shop drawings.
   3. Manufacturer's literature and illustrations for all equipment to be installed to supplement certified shop drawing information.
   4. Short-term and long-term storage requirements.
   5. Seismic analysis, design and calculations as specified herein.
   6. Shop preparation and shop coatings.
   7. Proposed valve identification tag information

B. Provide Operation and Maintenance Manuals in accordance with the requirements of Section 01340.

1.5 DELIVERY AND HANDLING

A. Shipping:
   1. Prepare valves and accessories for shipment as required for complete protection.
   2. Seal valve ends to prevent entry of foreign matter into valve body.
   3. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.

B. Storage:
   1. Store valves and accessories in an area on the construction site protected from weather, moisture, or possible damage.
   2. Do not store valves or accessories directly on the ground.

C. Handling: Handle valves and accessories to prevent damage of any nature to the interior and the exterior surfaces.

1.6 INSPECTION

A. Carefully inspect all materials for:
   1. Defects in workmanship and materials.
   2. Removal of debris and foreign material in valve openings and seats.
   3. Proper functioning of all operating mechanisms.
   4. Tightness of all nuts and bolts.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials are specified in appropriate Sections in this Division.

B. The specifications direct attention to certain required features of the valves and gates but do not purport to cover all details entering into their design and construction. Nevertheless, the Contractor shall furnish the valves and gates complete in all details and ready for operation for the intended purpose.

2.2 BOLTS, ANCHOR BOLTS AND NUTS

A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.

B. All bolts, anchor bolts, nuts, washers, lock washers, plates, and bolt sleeves shall be carbon steel unless otherwise indicated below or as specified elsewhere.
   1. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
   2. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all submerged applications as well as in wetwells, headworks, dewatering rooms, chemical rooms, clarifiers, aeration basins, splitter structures, equalization or storage tanks, high chloride conditions, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

C. Unless otherwise specified, stud, tap, and machine bolts shall be of the best-quality refined bar iron. Hexagonal nuts of the same quality of metal as the bolts shall be used. All threads shall be clean cut and shall conform to AN Standard B 1.1-1974 for Unified Inch Screw Threads (UN and UNR Thread Form).

D. All bolts shall be suitable size for the intended purpose, with direct input from the product manufacturer.

2.3 SURFACE PREPARATION AND SHOP COATINGS

A. Provide surface preparation and shop coatings in accordance with the applicable section of Division 9.

2.4 VALVE LOCK-OUT/ TAG-OUT HARDWARE

A. Provide accessory hardware for the purpose of locking out valves utilizing standard padlock. Lockout hardware shall be provided for all valves provided for the project.

2.5 VALVE ACTUATORS

A. Unless otherwise specified or shown on the Drawings, all valves shall be manually actuated. All valves shall have an operating handwheel or a handle/lever mounted on the operator. Valves with operating nuts shall be of non-rising stem design and be provided with an AWWA 2 inch square operating nut. The valves shall be provided with handwheel actuators on all manually actuated valves 8 inch and larger in size unless otherwise specified or shown on the Drawings.

B. The valve Manufacturer shall supply and factory mount all actuators; including any type of manual or powered actuators. The valves and actuators shall be shipped as a single unit. All valve actuators shall be sized to operate the associated valve for the full range of pressures and velocities. Position indicators shall be provided for all interior valves.

C. The force in a manual actuator shall not exceed 40 pounds of rim-pull under any operating condition, including initial breakaway. The actuator shall be equipped with gear reduction when force exceeds 40 pounds of rim-pull. All manual actuators shall be self-locking type or shall be equipped with a self-locking device. The actuators shall be capable of moving the valves from a fully open to a fully closed position and a fully closed position to a fully open position. The actuator shall be capable of holding the valve at any position in between the fully open and fully closed positions. A position indicator shall be supplied on quarter-turn valves. Each actuating device shall have the word "OPEN" permanently cast as well as an arrow indicating the direction of operation. Handwheels shall be cast iron or cast aluminum.

D. Unless otherwise specified or shown on the Drawings chainwheel actuators shall be provided for all valves 3 inches and larger with the valve center line located 6 feet or greater above the operating floor. All chainwheel actuators shall be provided complete with chain guides and hot dipped galvanized or cadmium-plated steel chain. The chain loop shall extend to within 4 feet from the operating floor level. Where chains hang in normally traveled areas, appropriate "L" type tie-back anchors shall be used.

E. All chainwheel actuators of the same type, style, and duty shall be supplied by a single Manufacturer. Where applicable and whenever possible, chainwheel actuators shall be provided by the Manufacturer of the valve being served.

2.6 GEAR ACTUATORS

A. Unless otherwise specified or shown on the Drawings, all valves larger than 6 inches shall be provided with gear actuators (totally enclosed type). All manually actuated valves with a rim pull greater than 40 ft-lbs shall also be provided with gear actuators. Worm and gear actuators shall be a one-piece design with worm-gears of gear bronze or machine cut steel material. Worm shall be hardened alloy steel with the thread ground and polished. Traveling nut type actuators shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut.

B. The output shaft shall be perpendicular to the valve shaft and be provided with a removable handwheel. Unless otherwise noted or specified all gear actuators shall conform to AWWA C504 standards. All gear actuators shall be removable from the valve without removing the valve from the line or dismantling the valve.

C. All gear actuators shall indicate the valve position and have adjustable stops. The maximum handwheel size shall be 24 inches in diameter. All position indicators shall be of the embossed, stamped, engraved, etched, or raised types.

D. Unless otherwise specified or shown on the Drawings, all gear actuated valves 3 inches and larger shall be provided with position indication at the point of operation. Valves smaller than 3 inches shall have position indication on their respective handwheels or lever actuators.

2.7 FLOOR STANDS

A. Provide floor stands where required on the Drawings.

B. Floor stands shall be of the non-rising stem, indicating type, and designed for counterclockwise operation. The distance from the base flange to the handwheel shall not be less than 34”.

C. The pedestal shall be cast of ductile iron grade 65-45-12 and meet ASTM-A536. The pedestal shall have a vertical indicating slot. The word “OPEN” shall be cast in the pedestal at the top of the indicating slot. A “CLOSED” tag will be field mounted to the pedestal, to indicate the closed position of the valve. A bronze indicator shall travel on a carbon steel threaded stem to indicate the position of the valve.

D. The stem shall be Xylan coated to prevent corrosion.

E. The floor stand shall be coated in a two-part epoxy for corrosion resistance.

F. Where a floor is not directly over the valve and extension stem, the floor stands shall be supported by a ductile iron wall bracket mounted to the side wall. Wall brackets shall contain a carbon steel plate designed to support the floor stand.

G. Stem guides with corrosion resistant bushing shall be provided as recommended by the floor stand Manufacturer.

H. Provide intermediate shaft supports as recommended by the Manufacturer based on shaft length.

I. The floorstand shall be operated by a cast iron handwheel of no less than 12” in diameter.

J. Floorstands shall be as manufactured by:
   1. Trumbull Industries, Youngstown, Ohio.
   2. Troy Valve, Troy, Pennsylvania.
   3. Or Equivalent

2.8 VALVE IDENTIFICATION TAGS

A. All valves in piping including individual valves provided with equipment shall be tagged in accordance with that shown on the Drawings. The tags shall be provided with identifying numbers and letters to match those shown on the Drawings. Identification tag numbering shall be reviewed/confirmed with the Engineer and Owner through the submittal process prior to ordering any tags. Refer to Section 11000 for additional information regarding valve tagging.

B. All identification tags shall be provided with sufficient lengths of chain for attachment to the respective valve.

C. Tags shall conform to the following specifications:
   1. The tags shall be 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. Top hole size is 5/32" for hanging tags.
   2. Tags shall be available in 7 different outside colors. Owner and Engineer shall select up to 4 different colors for the project.
   3. Tags shall have up to three lines engraved on a side and eight characters per line of identification information. Tags shall be engraved one side.
   4. Tags shall be secured to valves with nylon cable ties or adjustable metal bead chain. Securing method shall be selected by the Owner and Engineer.
   5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two SS screws or SS pop rivets.
   6. Tags shall have a service temperature of -40°F to 175°F
   7. Manufactured by Seton Name Plate Corporation, New Haven, CT, Brimar Industries, Garfield, NJ or equal.

D. All buried valves shall be provided with tags embedded in a concrete pad surrounding the valve box.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install valves and accessories in strict accordance with manufacturer's instructions and recommendations, as shown on the Drawings and/or as specified herein.

B. Install valves with stems pointed up in vertical position, or horizontally on high valve for chain wheel use, but in no case with stems pointed downward of the horizontal plane. Allow sufficient room for maintenance, removal and proper operation. All valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

C. Valve Orientation: The stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations of 4.5 feet or less above finished floor, unless otherwise shown on Contract Drawings. The stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6 feet above the finish floor, unless otherwise shown on Contract Drawings. All manually actuated valves 3 inches and smaller shall have the valve indicators and operators located to display toward the normal operational locations.

D. Carefully erect all valves and support them in their respective positions free from distortion and strain.

E. Independently support all valves connected to pumps and equipment, and in piping systems that cannot support valves.
F. Repair any scratches, marks and other types of surface damage etc. with original coating as supplied by the factory.
G. Install valves such that "open" and "close" position indicators are easily visible.
H. All valves (and actuators where specified) shall be installed in a manner that will provide for proper clearances and ease of operation. In addition, valve actuators must be capable of being rotated in 90° increments to facilitate field installation.
I. Check and adjust all valves and accessories for smooth operation.

3.2 TESTING

A. The Contractor shall test all valves and gates in the presence of the Engineer to demonstrate that each valve and gate complies with specified requirements and allowable leakage rates.
B. The contractor shall test all valves visually for leaks and proper operation under pressure. The contractor shall also test the valves to ensure proper valve function and actuation.
C. Valves may either be tested while testing pipelines, or as a separate step. It shall be demonstrated that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications. The Contractor shall count and record the number of turns required to open and close each valve and account for any discrepancies with the Manufacturer's data.
D. Air and vacuum relief valves shall be examined as the associated pipe is being filled to verify venting and seating is fully functional. The Contractor shall set, verify, and record set pressures for all relief and regulating valves. Self-contained automatic valves shall be tested at both maximum and minimum operating ranges, and reset upon completion of test to the design value.
E. The contractor shall take care not to overpressure any valve and appurtenances during testing.

3.3 RETESTING

A. If the equipment does not successfully pass the tests listed above, the Manufacturer/Contractor shall repair the equipment and perform the tests again until passing the tests successfully. If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be re-conducted at no additional cost to the Owner.

3.4 CLEANING

A. All items, including but not limited to all valves and valve interiors, shall be thoroughly cleaned prior to installation, testing, and final acceptance. All dirt, debris, and other foreign materials shall be removed.

3.5 FIELD COATINGS

A. In accordance with Section 09900.

END OF SECTION

SECTION 15101

GATE VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test gate valves of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
   1. Section 15100 – Valves & Specialties – General

1.3 QUALITY ASSURANCE

A. All gate valves of same type and style shall be manufactured by one manufacturer.
B. Acceptable Manufacturers: as noted herein.
C. All components in contact with potable water, or water being processed to become potable water, shall be compliant with NSF 61 and shall be constructed of "Lead-free" material in compliance with NSF 372.

PART 2 - PRODUCTS

2.1 VALVE, LOCATION AND USE

A. Type, location and use as shown on the Drawings.
B. Bolts, nuts, washers, fasteners shall be as defined in Section 15100.
C. For Water Supply Piping:
   1. Buried: AWWA Type, NRS.
   2. Exposed: AWWA Type NRS.
D. For General Service Piping (liquids containing solids):
   1. Includes plant water, and liquids containing solids.
   2. 2-l/2 inches and smaller: l25 bronze.
   3. 3 inches and larger Buried: NRS, resilient wedge.
   4. 3 inches and larger Exposed: NRS.
E. Accessories: As shown on the Drawings and required for proper operation.

2.2 MATERIALS

A. Waterworks type NRS valves (AWWA):
   1. Valve Body, bonnet and stuffing box - Cast iron (ASTM A126, C1B), or Ductile iron (ASTM A536), coated inside and out with fusion bonded epoxy meeting AWWA C550. Face-to-face dimensions shall comply with ANSI B16.10 and flanges to comply with ANSI B16.1.
   2. Resilient Wedge - Ductile iron wedge with bonded EPDM or Nitrile (Buna-N/NBR) rubber covering.
   3. Stem - Manganese bronze, ASTM B584

4. Stuffing box O-rings
    a. Two O-rings, each nitrile rubber.
    b. Capable of changing under pressure.
5. Wedgenut - Bronze, ASTM B62 or Manganese bronze, ASTM B584
6. Water working pressure: 250 psi
7. End Connections
    a. Buried valves – gasketed and bolted mechanical joints in conformance with AWWA standards for appropriate pipe material. Restrain valve as required for installation.
    b. Exposed valves – flanged and bolted joints in conformance with ANSI/ASME B16.1 and AWWA standards for appropriate pipe material.
8. Operation
    a. Buried valves
        i. 2-inch square nut, cast iron, ASTM A126, C1B or ductile iron, ASTM A536
        ii. Gear actuator is required if rim pull is greater than 40 ft-lbs. Offset gear required if needed based on valve position and bury depth.
        iii. Gate box required.
        iv. Provide sufficient quantity of tee-handle valve wrenches for operating valves of various depths.
    b. Exposed valves
        i. Manual – Refer to 15100
            (1) Handwheel, Chainwheel where required based on height above finished floor.
            (2) Floor stand actuators where indicated on the Drawings.
            (3) Floor boxes where indicated on the Drawings.
    c. Opening Direction – counterclockwise (open left)
9. Standards - valves shall meet or exceed AWWA C509, latest edition.
10. Manufacturer
    a. American Flow Control
    b. Kennedy/McWane
    c. Clow/McWane
    d. Mueller
    e. Or equal

B. General Service - 2-l/2 inch and smaller:
1. Bronze construction - 125 pound stem.
2. Union bonnet.
3. Inside screw, rising stem.
4. Solid disc, taper wedge.
5. End connections:
    a. Threaded.
    b. Or solder ends for copper pipe systems.
6. 200 psi non-shock WOG.
7. Operation
    a. Exposed valves
        i. Manual – Refer to 15100

(1) Handwheel, Chainwheel where required based on height above operating floor.
(2) Floor boxes where indicated on the Drawings.

b. Opening Direction – counterclockwise (open left)

8. Acceptable Manufacturers:
   a. Stockham B-l05.
   b. Crane 428-UB.
   c. Powell 2700S.
   d. Jenkins 47U.
   e. Kennedy/McWane 525.
   f. Or approved equal.

C. General Service - 3 inches and larger NRS valves:
   1. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber, except for guide and wedge nut areas.
   2. Non-rising stem (NRS).
   3. 125 class body.
   4. Meet or exceed AWWA C-509.
   5. Face to Face dimensions: ANSI B16.1.
   6. Water working pressure:
      a. 12 inches and smaller: 200 psi.
      b. 14 inches and larger: 150 psi.
   7. End Connections
      a. Buried valves
         i. Gasketed and bolted mechanical joints in conformance with AWWA standards for appropriate pipe material. Restrain valve as required for installation.
         ii. All mechanical joint gate valves shall meet ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11.
         iii. Mechanical joint type coated inside and out with fusion bonded epoxy meeting AWWA C550.
      b. Exposed valves
         i. Flanged and bolted joints in conformance with ANSI/ASME B16.1 and AWWA standards for appropriate pipe material.
   8. Operation:
      a. Buried valve
         i. 2-inch square nut, cast iron, ASTM A126, C1B or ductile iron, ASTM A536
         ii. Gate box required.
         iii. Provide sufficient quantity of tee-handle valve wrenches for operating valves of various depths.
      b. Exposed valves
         i. Manual – Refer to 15100
            (1) Handwheel, Chainwheel where required based on height above operating floor.
            (2) Floor stand actuators where indicated on the Drawings.
            (3) Floor boxes where indicated on the Drawings.

c. Opening Direction – counterclockwise (open left)

9. Acceptable Manufacturers:
   a. American Flow Control
   b. Kennedy/McWane
   c. Clow/McWane
   d. Mueller
   e. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and test in accordance with Section 15100, AWWA C500 and AWWA C-509, latest revision.

B. For horizontal piping, install valves with stem position between horizontal to vertical upward.

END OF SECTION

SECTION 15110

CHECK VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install and test check valves of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.
   1. Section 15100 – Valves & Specialties – General

1.3 QUALITY ASSURANCE

A. All check valves of same type and duty shall be by one manufacturer.
B. All components in contact with potable water, or water being processed to become potable water, shall be compliant with NSF 61 and shall be constructed of "Lead-free" material in compliance with NSF 372..

PART 2 - PRODUCTS

2.1 SWING CHECK VALVES - 2-½ INCHES AND SMALLER – GENERAL USE

A. Standard, all brass or bronze, swing check with screwed ends.
B. Suitable for l50 psi working steam pressure.
C. Shall meet MSS SP-80 standards, Class 125, cast-bronze body and cap conforming to B62.
D. Acceptable Manufacturers:
   1. Watts
   2. Apollo
   3. Or equal.

2.2 SWING TYPE CHECK VALVES – 3 INCH AND LARGER – GENERAL USE

A. The check valve shall conform to the materials of construction, pressure rating and test requirements of AWWA C508 and be suitable for installation in a horizontal or vertical flow up pipe.
B. The body shall be made of cast iron conforming to ASTM A126 Class B with a bolted steel cover allowing complete access to and removal of all internal components while the valve is in the line.
C. The valve body shall have integral flanges, flat faced and drilled per ANSI B16.1 Class 125 or Class 250, as required.
D. The valve body shall have a removable Type 316 stainless steel body seat held in place with stainless steel pins.
E. The disc arm shall be ductile iron and the disc shall be cast iron with a replaceable aluminum bronze metal disc seat held in place by a type 316 stainless steel follower ring and stainless steel screws. The disc shall be attached to the disc arm by means

of a center pin, disc nut and washer providing 360 degree angular articulation but not rotation.

F. The disc arm shall be suspended from and keyed to a stainless steel shaft that is supported at each end by stainless steel or no-lead bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing.

G. Bosses shall be provided on check valves which may be tapped for draining or used for by-pass. The inside and outside of all valves together with the working parts, except bronze and machined surfaces, shall be coated in accordance with AWWA C-550.

H. Marking shall be in accordance with AWWA C-508 and shall include size, working pressure, and cast arrow to indicate direction of flow, name of manufacturer, and year of manufacture.

I. The valve shall be supplied with an outside lever and adjustable counterweight. The lever and weight shall be on the right hand side of the valve (looking in the direction of flow) but shall be field convertible to the left hand side without additional parts. Fitted with an adjustable dashpot or snubber to control speed of valve closure.

J. The valve shall also be provided with a single, side mounted air-cushion assembly directly mounted to the valve body. The amount of cushioning shall be adjustable without the need for pre-charged air chambers.

K. Acceptable Manufacturers:
   1. Val-Matic Series 7800LW
   2. Or equal.

2.3 DUCK-BILL TYPE CHECK VALVES

A. Duck-Bill type check valves shall be of the flow operated check type designed to allow passage of flow in one direction while preventing reverse flow.

B. Valves shall be all rubber construction with reinforcement as necessary.

C. Valve shall be either slip-on type with 316 stainless steel clamps or flanged as indicated on the drawings.

D. Anchor bolts shall be 316 stainless steel.

E. Maximum allowable headloss and end connections for each size of valve shall not exceed 0.5-psig back pressure.

F. Valve materials shall be compatible with service indicated.

G. Acceptable Manufacturers:
   1. Red Valve/ Tideflex
   2. EVR Products
   3. Proco
   4. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. In accordance with Section 15100.

B. Install check valves in horizontal sections of pipeline unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 15124

STAINLESS STEEL SLIDE GATES AND GUIDE FRAMES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install gates and frames of the type(s) and size(s) and in the location(s) shown on the Drawings and as specified herein.

B. This specification section covers all work and materials related to slide gates, as indicated in the Drawings. These gates may be wall mounted with grout, channel mounted, embed mounted, or as detailed in the Gate Schedule.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Requirements Specified Elsewhere: Additional requirements are specified elsewhere including, but not limited to General Conditions, Supplementary Conditions, and Division 1.

1. Section 15100 – Valves & Specialties – General

1.3 REFERENCES

A. Design, manufacturing and assembly of elements of the equipment herein specified shall be in accordance with the standards of the below listed organizations.

1. American Society for Testing and Materials (ASTM)
   a. ASTM A240 - Standard Specification for Cold Rolled, Annealed Plate
   b. ASTM A276 - Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes.
   c. ASTM B98 - Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
2. American Water Works Association
   a. AWWA C561- Fabricated Stainless-Steel Slide Gates

1.4 QUALITY ASSURANCE

A. All gates shall be the product of one manufacturer.

B. Gates specified under this Section shall be furnished by a manufacturer who shall have a minimum of 10 years of experience in the production of gate equipment and has a minimum of 100 installations in the United States, and who shall be reputable and qualified in the manufacture of the equipment specified. The manufacturer shall provide an installation list, certified by an official of the company, for those gates supplied by the Manufacturer. Installation list acquired via purchase of a company will not be considered.

C. If the gate(s) is imported, the gate manufacturer must perform a shop test in a facility located within the United States prior to shipping the gate(s) to the job site.

D. Although manufacturers may be named as acceptable manufacturers, all gates must be designed in accordance with all the requirements of the specifications.

E. All equipment shall be of highest quality throughout and shall meet or exceed the requirements of AWWA C561.

F. All components in contact with potable water, or water being processed to become potable water, shall be compliant with NSF 61 and shall be constructed of "Lead-free" material in compliance with NSF 372.
G. Manufacturers shall have proven, reliable products in use in similar installations.
H. Acceptable Manufactures:
   1. Whipps, Inc., Athol, MA
   2. WACO Products; Baltimore, MD.
   3. Or Approved equivalent.

1.5 SUBMITTALS

A. Submit shop drawings, spare parts list, manufacturer's literature, maintenance data, operating instructions and maintenance materials in accordance with the General Conditions of the Construction Contract and in accordance with Section 01340 and 11000. Specific information to include:
   1. Schedule of all gates.
   2. Fully dimensioned layout drawing of all gates, indicating thicknesses of all material of the gate and ancillary equipment. Catalog cuts and general arrangement drawings are not considered acceptable layout drawings.
   3. Shop test procedure for gate(s) requiring shop test, as detailed below.
   4. Location of manufacturing facility and shop testing facility.
B. Any submittal that does not contain all this information will be returned without any review.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver as job progress requires and in the largest sections recommended by the manufacturer.
B. Store in accordance with manufacturer's written instructions and prevent damage of any nature. As a minimum, the units shall be stored inside on a pallet and off the floor/ground.
C. If damage occurs, immediately make all repairs and replacements necessary to the satisfaction of the Engineer at no cost to the Owner.

1.7 JOB CONDITIONS

A. All gate components shall be designed to safely withstand the head and operating conditions of the installation as shown on the Drawings and/or specified herein.

PART 2 - PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

A. Stainless steel slide gates shall be self-contained, or non-self-contained frame type as indicated on the drawings gate schedule, rising stem or non-rising stem as indicated on the drawings gate schedule, fabricated of 316L stainless steel as indicated, having adequate strength to prevent distortion in handling and placing and under any condition of service outlined herein.
   1. At gate locations which interrupt safety railings, the gate frame shall meet the OSHA requirements to serve as a guard. Provide top member of the gate frame at 3'-6" above the top of walkway elevation. Provide intermediate horizontal

member at 1'-9" above the top of the walkway elevation which shall be welded to the vertical members of the gate frame. Provide toe plates where the adjacent railings include a toe plate. All materials for intermediate horizontal member and toe plate shall match the materials of the gate frame.

B. Guide Rails: The guide rails shall be constructed of formed plate with a minimum thickness of ¼-inch and incorporating a slot in which the disk (gate plate) shall be guided. Frame design shall be flange back to allow for mounting directly to an end wall or flange side for mounting within an existing channel with stainless steel adhesive style anchor bolts and non-shrink grout or embed type installed in a wall blockout with non-shrink grout as shown on the Drawings. The anchor bolts shall be sized to transfer the forces imparted by the frame to the structure and the design, sizes and quantity of anchor bolts shall be determined by the gate manufacturer. The anchors and mounting hardware shall be supplied as part of the gate assembly by the gate manufacturer. A rigid stainless steel invert shall be provided across the bottom of the frame for upward opening (slide) gates and across the frame at the weir invert elevation on downward opening (weir) gates.

C. Slide:
   1. The disc or sliding member shall be of stainless steel plate, minimum ¼" thickness reinforced with structural members welded to the plate. The disc shall not deflect more than 1/360 of the span of the gate under the design operating head or 1/16-inch, whichever is less.
   2. Gates with a disc width of 60 inches or greater and two or more times the disc height shall be supplied with dual stem assemblies. Each assembly shall have a primary and secondary actuator with an interconnecting shaft of extruded aluminum tube or stainless steel round bar.

D. Seals: The frame shall be equipped with seats / seals to prevent metal to metal contact and restrict leakage. The guides of all gates shall incorporate ultra high molecular weight polyethylene (UHMW) seat / seals on both the upstream and downstream sides of the slide. Each seat / seal will be shaped to act as both a bearing surface and a seal. Downward opening gates (weir gates), shall have low friction polymer seals mounted on the frame member at the invert of the waterway. Seats / seals shall be self-adjusting "UHMW" seal, as specified below, to meet the specified leakage requirements. No seals shall intrude upon the clear opening required by the plans.
   1. Upward opening gates (slide gates) shall incorporate a replaceable, flush bottom neoprene or EPDM invert seal mounted to the frame. Upward opening gates used to control port or pipe openings shall also have low friction polymer seals mounted on the frame above the upper elevation of the opening.
   2. Downward opening gates (weir gates), shall have low friction UHMW polymer seals mounted on the frame member at the invert of the waterway.

E. Leakage: Leakage for all sizes shall be equal to ½ that allowed by AWWA C561 standards for "Fabricated Stainless Steel Slide gates", leakage shall not exceed 0.05 GPM /Ft. of wetted perimeter in the seating and unseating head conditions.

F. Stem: The stem shall be of solid, Type 304 stainless steel for the entire length, the metal having a tensile strength of not less than 60,000 psi. L/r of less than 200 and to withstand compression at least 2.5 times the output of the manual actuator with an 80 lb effort. The minimum stem diameter shall be 1.5". The threaded portion of the

stem shall have machine cut or rolled threads of the full depth Acme type. Stem threads shall have a 16 micro inch finish or better. Stems of more than one section shall be joined by bronze or stainless steel couplings threaded and bolted to the stems. All threaded and keyed couplings of the same size shall be interchangeable. The gates with manual operators shall be provided with adjustable stop collars on the stem to prevent over closing and opening of the gate. Tubular stems or pipe extensions will not be accepted.

G. Stem guides shall be stainless steel, UHMW bushed, mounted in a fabricated stainless steel bracket. Guides shall be adjustable in two directions and spaced at sufficient intervals to adequately support the stem. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.

H. All attaching bolts, anchor bolts, etc. shall be type 316 stainless steel and shall be furnished by the weir gate manufacturer. Anchor bolts shall have a minimum diameter of ½-inch.

I. Pedestals: Pedestals, where required, shall be fabricated stainless steel of the same alloy as the gate. Aluminum or cast iron pedestals are not acceptable.

J. Wall Brackets shall be provided as shown on the contract drawings. Wall Brackets shall be fabricated from Stainless Steel Type of the same alloy as the gate.

K. Materials:

Components	Materials
Guide Rails, Yokes, Slide and Retainers	Stainless Steel, Type 316L, ASTM A-276
Invert and Stiffeners	Stainless Steel, Type 316L, ASTM A-240
Stems	Stainless Steel, Type 316, ASTM A-276
Fasteners and Bolts	Stainless Steel, Type 316, ASTM F-593, F-594
Seat / Seal and Facing	Ultra-High Molecular Weight Polyethylene ASTM D4020
Lift Nuts, Stop Nuts	Bronze ASTM 660
Stem Block	Stainless Steel, Type 316, ASTM A-240
Pedestal	Stainless Steel, Type 316L, ASTM A-240

L. Finish: Mill finish on stainless steel. All weld and weld burn shall be sandblasted after fabrication in accordance with ASTM A380 to provide a uniform finish.

2.2 GATE OPERATORS

A. Manual Operators

1. Manual operators shall be furnished with crank operator mounted as per the gate schedule or as indicated in the Drawings. Operating effort shall not exceed 40 lbs. when opening or closing the gate at maximum head.
2. Operation of the gate shall be by means of a crank operated bevel gearbox mounted on the gate bench (yoke) for self-contained frame gates or a pedestal for non-self-contained frame gates. Any crank shall have a minimum radius of 12” and a maximum radius of 15”. The crank shall be of cast iron or aluminum with a revolving brass grip. The crank shall be keyed to match the gearbox input shaft and shall be removable. The gearbox centerline height shall be between 36-inches and 48-inches above the operating floor level and crank circle of rotation shall be coordinated by the Contractor at the time of shop drawing review to prevent interferences with adjacent handrails, structures or

equipment. Provide alternate remote crank position if required to attain specified gearbox centerline height.

3. Each gearbox shall be provided with a threaded cast bronze lift nut to engage the operating stem. Ball or roller thrust bearings shall be provided above and below the operating nut to support both opening and closing forces.
4. A stainless steel input (pinion) shaft, minimum 1” diameter, with integral bevel gear shall be provided, sized and keyed to match the handcrank. Crank operators shall have single gear reduction. Gears shall be steel with machined cut teeth designed for smooth operation. The pinion shafts on all crank operators shall be supported on ball or roller bearings.
5. Positive mechanical seals shall be provided on the operating nut and the input shaft to exclude moisture and dirt and prevent leakage of lubricant out of the operator gearbox.
6. The gearbox shall have a body made of cast iron, ductile iron or aluminum, and capable of supporting and transmitting all gate operation loads with the gate under the highest design head. Lubricating fittings shall be provided on the gearbox body for the internal lubrication of all gears and bearings.
7. Operators shall be equipped with fracture-resistant clear butyrate or lexan plastic stem covers which shall not discolor or become opaque for a minimum of 5 years after installation. The top of the stem cover shall be closed. The bottom end of the stem cover shall be mounted in a housing or adapter plate for easy field mounting. Stem covers shall be complete with field calibrated indicator markings to indicate gate position.
8. An arrow with the word "RAISE" or “OPEN” shall be cast onto the operator or handcrank to indicate the direction of rotation to raise the gate. The direction of rotation to open/raise slide gates shall be counter-clockwise and to open/lower weir gates shall be clockwise.
9. Gates with widths of 4 feet or greater AND a width equal to two times the height of the gate, or as otherwise indicated in the gate schedule or plans, shall be provided with a dual stem operator. The dual stem operator gearboxes shall have interconnecting shafting linked to the gearboxes with solid and flexible couplings to provide simultaneous operation of the two stems. One operator gearbox shall be designated the "Primary" operator, while the others shall be designated as "Secondary". Interconnecting shafting shall be stainless steel rod or aluminum pipe as required by the manufacturer. The Primary gearbox will have the operator input shaft and crank; the Secondary gearbox will only have input torque from the interconnecting shafting. Operator and shaft shall be of adequate design to allow no more than 0.05 feet difference in elevation between left and right sides of the gate. The interconnecting shafting shall not require a protective cover.
10. For bench (yoke) mounted operators the maximum deflection of the bench shall be limited to 1/360th of the span when operating at the maximum specified head.
11. Pedestals and wall brackets (if required) shall be fabricated from the same alloy as the gate and appurtenances. Pedestals and wall brackets shall be designed to withstand maximum design operating loads. The pedestal height shall be such

that the operator input shaft centerline is approximately 36-inches above the operating floor level and as required per Paragraph 2.2-A.2 above. Wall brackets shall be used to support pedestals that are not directly mounted to floor slabs. Pedestals which cannot be slab mounted or wall bracket mounted, shall use offset type pedestals mounted on the floor surface. Pedestals or wall brackets shall be anchored to the concrete with matching alloy stainless steel anchors. The anchor bolts shall be sized to transfer the upward or downward thrusts required to ultimately fail the stainless steel stem. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer. The bracket, anchors and accessories shall be supplied as part of the gate assembly by the gate manufacturer.

2.3 SHOP AND FIELD COATINGS

A. Provide surface preparation and shop coatings in accordance with Section 09905.
B. Provide field coats in accordance with Section 09900.

2.4 SPARE PARTS

A. One spare set of replaceable seals per gate type (if applicable).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the gate equipment and appurtenances in accordance with the manufacturer's instructions and recommendations.
B. The gate and frame shall be installed after the concrete has been poured. Anchor bolts shall be set in the concrete and grout placed between gate frame and concrete. The gate frame shall not be distorted during installation.
C. Weir Calibration: Weir gate minimum and maximum elevations will be set as per plans and as indicated on the manufacturer’s approved drawings. Each weir crest shall be measured by laser level accurate to 0.01 feet. The position of the operator at the upper weir elevation level shall be marked on the operating stem and the lower stop collar (and electric actuator upper limit switch where applicable) set as per the manufacturer’s instructions. Repeat procedure for the lowest weir elevation setting the upper stop collar (and electric actuator lower limit switch where applicable). Level shall be measured at both sides of each weir for all dual stem operator gates to verify proper installation and operation.
D. Any self-contained gate must be completely factory assembled. No field assembly of the gate frame will be allowed. Any self-contained gate that is delivered to the job site not fully assembled will be rejected and returned to the manufacturer for assembly.
E. Final Tests Before Startup: Perform the following preventive maintenance operations and checks before startup:
    1. Verify proper lubrication of stem, operators, and/or actuators in accordance with manufacturer's recommendations.
    2. Check that handwheels or cranks are free to rotate by hand. Do not operate if operator force is higher than the 40 pound maximum effort specified, until the cause of the trouble is determined and corrected.

3. Test and adjust gate operations and tolerances. Replace damaged and malfunctioning equipment.

3.2 SHOP TESTING

A. Any slide gates having areas of 20 square feet or larger shall be shop tested for leakage. The gates must pass a shop test at the specified head rating in the unseating head condition (0.05 gpm/linear foot of seal) prior to shipment. A fully documented shop test shall be submitted for each gate to the Engineer for approval prior to shipment.

B. All gates imported into the United States must pass a shop test at the specified head rating in the unseating head condition (0.05 gpm/linear foot of seal) prior to shipment. A fully documented shop test shall be submitted for each imported gate to the Engineer for approval prior to shipment.

3.3 ADJUSTING AND CLEANING

A. Check hoist, stem guide, and gate attaching bolts for proper tightness.

B. Check gate groove and clean any foreign matter.

C. Contractor shall Lubricate threaded portion of stem and crank assembly with lubricant as specified by manufacturer of gate.

D. Clean contact surfaces on gate

E. Adjust stem stop collars and lock into place as per manufacturer's instructions. Install stem cover and indicator tapes on rising stem operators as per manufacturer's instructions. Stop collars should be set to the exact full open/close positions. Install stem cover.

3.4 FIELD TESTING

A. All gates shall be field tested.

B. Slide gates shall have a maximum permissible leakage rate of 0.05 gallons per linear foot of seat facing per minute.

C. At the discretion of the Engineer, tests shall either be certified or witnessed.

3.5 FIELD START-UP SUPERVISION

A. An authorized factory trained, direct employee of the gate manufacturer shall inspect and certify the installation of all the gates supplied.

B. A total of one trip and one, 8-hour workday shall be supplied. Part of the 8-hours shall be a training session for the plant personnel. .

END OF SECTION

SECTION 15400

PLUMBING – GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Perform the following items of work required to complete the work of this Section, as shown on the drawings, and specified herein:
   1. All labor, materials, equipment, and transportation shall be provided as required to completely furnish, install, and test the plumbing and water systems, with all connections as shown on the drawings and described in these specifications or as required by the Plumbing Code of the Project State. The accompanying drawings do not show every detail of pipe, valves, fittings, hangers, equipment, and fixtures which are necessary for the complete installation but are provided to show the general arrangement and extent of work to be performed. Provide all work as indicated on the drawings together with all items necessary for or incidental to the completion of the work.

B. Work Included: The plumbing work shall include, but not be limited to the following (when applicable), refer to requirements specified in Division 15:
   1. Building sanitary waste and vents and sanitary building drain systems to the point outside the building indicated on the drawings.
   2. Building domestic hot and cold-water supply system to the point outside the building indicated on the drawings.
   3. Plumbing fixtures and trim.
   4. Water heaters, backflow preventers and plumbing accessories.
   5. Water, waste, and vent connections to equipment when furnished by others.
   6. Sump pumps and associated piping and controls.
   7. Plumbing pipe identification and signage.
   8. All other plumbing items indicated on the drawings, specified herein, or needed for a complete and proper plumbing installation.

C. Drawings and Measurements:
   1. The Drawings show the general arrangement, direction, and sizes of pipes. They are not intended to show every offset, valve, and fitting, and every structural difficulty that may be encountered.
   2. Coordinate installation of plumbing systems with the work of other trades.
   3. Verify all measurements at the job site.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

B. Seismic Control: When applicable, refer to Section 13081 for general project and equipment specific seismic requirements.

1.3 QUALITY ASSURANCE

A. Materials and Workmanship: All materials and workmanship shall be suitable for the respective work and the type of service encountered.

B. Equipment: All equipment shall be constructed to operate safely without water hammer and undue wear.
C. Local Codes: Install plumbing systems in accordance with applicable state and local plumbing codes, except where requirements of the drawings and these specifications are more stringent.
D. Permits: Arrange for all permits, inspections, and tests required by codes at no additional cost to the Owner.
E. Standards: When standards are referred to, the latest issue shall apply.

1.4 JOB CONDITIONS

A. Scheduling Work: Install and test all plumbing to be cast into or buried under concrete floor slabs prior to the placement of concrete.

1.5 SUBMITTALS

A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340, and as specified herein. Shop drawings shall contain the following information at a minimum:
    1. Completed Submittal Certification Form. Shop drawing submittals will be returned unreviewed without this form.
    2. Manufacturer's literature and illustrations for all equipment and materials to be installed indicating all capacities, performance requirements, electrical characteristics, options, and accessories as shown on the drawings and as specified in each Section.
    3. Guarantees/Warranties as specified in each Section.
B. Submit to the Engineer: Operations and Maintenance Manual for all mechanical equipment as specified in the General Conditions. Refer to Operation and Maintenance section of specification 01340 for all other requirements for submissions to engineer. Operations and Maintenance Manual shall contain the following information at a minimum:
    1. Manufacturer's operation & maintenance manuals with all non-applicable content removed or crossed out.
    2. Table of Contents
    3. Contractor and Manufacturer Contact Information.
    4. Operator service requirements including Preventative Maintenance Schedule and Summary.
    5. Troubleshooting Information.
    6. Warranty Information.
    7. Shop Drawings corrected to As-Built Conditions.
    8. Wiring and Control Diagrams.
    9. Parts and Service Contact Information.
    10. List of All Component Part Numbers.
    11. Spare Parts and Supply Lists.
    12. Completed Operations and Maintenance Manual Certification Form at the start of each section for all equipment provided.
    13. Complete the following table for all equipment installed and include following the Table of Contents for all installed equipment or at the beginning of each section for the equipment in that section:

Equipment Name	Unit Tag	Serial Number	Model Number	Building / Location	Date Installed

1.6 DELIVERY, STORAGE & HANDLING

A. In accordance with Section 01600.
B. Exercise care during loading, transporting, unloading and handling to prevent damage of any nature to interior and exterior surfaces of equipment, fixtures, pipe and fittings.
C. Do not drop equipment and fixtures.
D. Store materials on the project site in enclosures or under protective coverings.
E. Assure that all materials are kept clean and dry.
F. Do not store materials directly on the ground.
G. Exercise care so as not to damage, crack, mar finish and to prevent damage of any nature to fixtures.
H. Remove damaged fixtures from project and replace at no additional cost to the Owner.
I. Protect fixtures after installation by wrapping or covering to prevent use and damage.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials that are new, suitable for intended use, and of type, style, and quality specified and as shown on the Drawings.
B. Provide pipe, fittings, and devices that meet requirements of local plumbing codes and be in accordance with applicable ASTM, ANSI, and Commercial Standard (CS) standards.

2.2 BOLTS, ANCHOR BOLTS, NUTS, HANGERS, AND SUPPORTS

A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.
B. All bolts, anchor bolts, nuts, washers, lock washers, plates, bolt sleeves, pipe hangers and supports shall be constructed of the following materials:
    1. Galvanized steel in accordance with Division 5 unless otherwise indicated below or specified elsewhere.
    2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
    3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all heavy moisture or submerged applications as well as in wetwells, headworks, dewatering rooms, chemical rooms; and enclosed clarifiers, aeration basins, or storage tanks, etc. For additional description and definition of submerged surfaces refer to Specification Section 09900.

2.3 EQUIPMENT AND VALVE TAGS

A. Identify all new plumbing equipment shall be identified with a color-coded equipment/valve tag. Submit a complete list of proposed Identification Tag information for review by the Engineer and Owner. Tag information shall match the information provided on the Drawings.

B. Tags shall conform to the following specifications:
   1. 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. 5/32" top hole for hanging tags.
   2. Tags shall be black or red unless otherwise specified.
   3. Tags shall have up to three lines engraved on the outward facing side, with eight characters per line of identification information.
   4. Valve tags shall be secured to valves with adjustable stainless steel bead chain.
   5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two stainless steel screws or stainless-steel pop rivets.
   6. Tags shall be rated to withstand temperatures from -40°F to 175°F
   7. Manufacturers:
      a. Seton Name Plate Corporation
      b. Brimar Industries
      c. Supreme Instrument & Electrical Services
      d. Equivalent Manufacturer

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment and piping systems in a neat workmanlike manner.

B. Lines and Grades:
   1. Unless otherwise shown on the drawings, install piping parallel to building walls wherever possible.
   2. Install piping level or pitched as indicated on the drawings or in accordance with the applicable plumbing code.

C. Supports: Support piping in accordance with the plumbing code. Hanger and support materials shall be as indicated in Paragraph 2.2.B of this section.

D. Expansion: Provide provisions for the expansion of pipelines.

E. Do not provide close nipples.

F. Do not install piping through, directly over, or in front of electrical switchgear and power panels.

G. Caulk the spaces between the pipe and walls, ceilings, and floors gas-tight where shown on the Drawings.

H. Fittings for Dismantling Piping: Provide a sufficient number of unions to allow the dismantling of all piping.

I. Pitch:
   1. Pitch sanitary waste and storm drainage piping in accordance with the plumbing code.
   2. Pitch water piping toward low points. Install hose end drain valves at low points.

J. Coordinate locations of piping, sleeves, inserts, hangers, equipment, and access provisions with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities.
K. Follow manufacturer's published recommendations for installation methods not otherwise specified.
L. Coordinate locations of structural systems necessary for pipe and equipment support to permit proper installation.
M. Coordinate locations of pipe sleeves, trenches and chases with equipment and piping locations.
N. Core holes through concrete and masonry using rotary core drill. Locate holes to avoid interference with structural members such as beams or grade beams. Lay out holes in advance and perform drilling only after approval by the Engineer. Obtain approval in advance by the Engineer for drilling holes through structural members.
O. Gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms.
P. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, work of other trades, and traffic areas.
Q. Perform all work incidental to the installation of the apparatus and materials including, but not limited to, cutting, patching, trenching, excavating, backfilling, trench covering, plastering and the constructing of chases, slots, furring, foundations, piers, and pads, when applicable. All work shall be performed in accordance with the applicable Divisions of this Specification by qualified workers regularly employed in the applicable trades.

3.2 TESTING

A. When the installation is complete, test pipelines in the presence of the Engineer and the Plumbing or Building Inspector in accordance with the requirements of the local and state plumbing codes. Provide necessary testing equipment and utilities.
B. Test underground piping prior to backfilling.
C. Test piping prior to application of paint and insulation.
D. Separately test portions of piping which will be concealed before completion.
E. Procedure:
    1. Piping Which Carries Water or Liquid Under Pressure: Fill pipes with water and subject them to l00 psig. or l-l/2 times the normal working pressure, whichever is greater, for two (2) hours with no loss in test pressure.
    2. Soil, Vent, Waste and Drain Piping:
        a. Plug all outlets and fill pipes with water to the top of the highest vent stack above the roof, or with not less than l0 feet of water at all points in section.
        b. The piping shall maintain this water level for a period of 30 minutes.
    3. Fuel Gas Piping: Test with compressed air, in accordance with NFPA 54 requirements prior to backfilling or covering of any pipe. Test pressure shall be 1-1/2 times working pressure or 15 psi (whichever is greater). Test duration shall be not less than 1/2 hour for each 500 cuft of pipe volume. Piping system shall withstand the test pressure without showing any evidence of leakage. Bubble test all fittings and joints with a soap/water solution.
    4. Isolate equipment that cannot withstand test pressures prior to any testing.
    5. Do not test plastic piping with compressed air or other gases.

F. Repairs:
   1. Should leaks be found, repair as required even to the extent of disassembling and remaking the joints or replacing sections of pipe.
   2. Do not repair leaks through the application of external caulking at joint surfaces or the use of chemical compounds.
   3. Replace defective pipe and fittings and repeat tests until the testing results are approved by the Engineer.

3.3 DISINFECTION

A. Disinfect piping installed to carry potable water. Perform the work in accordance with the procedure outlined in AWWA Designation 060l or the plumbing code, whichever is more stringent.
B. Disinfectant shall produce a concentration not less than 50 parts per million (ppm) available chlorine throughout the entire system and not less than l0.0 ppm chlorine residual after a contact period of not less than 24 hours. Repeat disinfection if chlorine residual is less than l0 ppm after a 24-hour contact period.
C. During the disinfection period, exercise care to prevent the contamination of water in the existing community, town, or city water main.
D. After the disinfection period, flush the piping with clean potable water until the chlorine residual does not exceed 0.2 ppm.

3.4 PAINTING AND IDENTIFICATION

A. All plumbing piping shall be identified by this Contractor through the use of vinyl pressure sensitive markers. Markers shall indicate system, using abbreviations supplied by Engineer. Each system shall use a different color marker.
B. Flow arrows shall indicate direction of fluid flow.
C. Labels and arrows shall be provided at twenty-foot intervals and in or above each room.
D. Paint plumbing piping, valves, pumps, and equipment in accordance with Specification Section 09900.
E. Apply signage and identification in accordance with specification section 10140.

END OF SECTION

SECTION 15401

PLUMBING, PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, and test a complete piping system including all required specialties and appurtenances as indicated on the drawings and as herein specified. Refer to additional requirements in specification Section 15400.

1.2 QUALITY ASSURANCE

A. Standards (General):
   1. NSF 61
   2. NSF 372
   3. ANSI/UL 263
   4. ANSI/UL 2846

B. Standards (Piping):
   1. Cast Iron Pipe, Hub and Spigot: ASTM A74.
   2. Cast Iron Pipe, No-hub: ASTM A888.
   3. Polyvinyl Chloride (PVC) Pipe: ASTM D1785, ASTM D2665, NSF 14.
   4. Copper Tubing (Water Applications): ASTM B88, NSF/ANSI 61 & 372.
   5. Crosslinked Polyethylene (PEX) Piping: ASTM F876, ASTM F877, NSF 14.
   6. Steel Pipe: ASTM A53.

C. Standards (Fittings & Couplings):
   1. Cast Iron, Hub and Spigot, Gasket: ASTM C564.
   2. Cast Iron, No-hub, Standard coupling: ASTM C1277.
   3. Cast Iron, No-hub, Heavy-duty coupling: ASTM C1540.
   4. Polyvinyl Chloride (PVC), Fittings: ASTM D2665, ASTM F1866.
   5. Polyvinyl Chloride (PVC), Primer: ASTM F656.
   6. Polyvinyl Chloride (PVC), Cement: ASTM D2564.
   7. Polypropylene Pipe, Fittings: ASTM F1412. D2657
   8. Polypropylene Pipe, Socket end fittings: ASTM F1412, ASTM D2657.
   9. Copper Solder fittings: ASTM B16.18, ASTM B16.22.
   10. Copper Press fittings: ASME B16.51 and IAPMO PS 117.
   11. Crosslinked Polyethylene (PEX) Fittings: ASTM F1960.
   12. Extruded Polyethylene Gas Fittings: ASTM D2513.
   13. Malleable Iron, Threaded fittings: ASME B16.3.
   14. Valves, fuel gas service: ASME B16.33.
   15. Forged Steel Fittings: ASTM A105, ASTM A182.

1.3 SUBMITTALS

A. General: Submittals shall be in accordance with specification Section 01340 and 15400.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pipe and Fittings:

1. Sanitary Waste and Vent:
   a. Below Floor Slabs:
      i. Service weight hub and spigot cast iron soil pipe and fittings with neoprene compression gaskets.
   b. Above ground building lines:
      i. Service weight no-hub cast iron soil pipe and fittings.
         (1) Less than 50 feet below roof level: Standard no-hub couplings consisting of neoprene gasket, corrugated stainless-steel shield, and stainless-steel clamps and screws (minimum two for pipe 4” and smaller, minimum four for pipe 5”-10”).
         (2) Greater than or equal to 50 feet below roof level: Heavy duty no-hub couplings consisting of neoprene gasket, corrugated 300 series stainless-steel shield, and 300 series stainless-steel clamps and screws (minimum four for pipe 4” and smaller, minimum six for pipe 5”-10”).
      ii. When permitted by local codes PVC may be provided in lieu of cast iron:
         (1) Piping: Schedule 40 PVC solid wall pipe.
         (2) Fittings: Socket type drain, waste, and vent fittings.
         (3) Joining method: Two-step process; primer and solvent cement.
2. Sump Pump Discharge
   a. Buried:
      i. Piping: Schedule 80 PVC solid wall pipe.
      ii. Fittings: Socket type drain, waste, and vent fittings.
      iii. Joining method: Two-step process; primer and solvent cement.
   b. Above ground building lines:
      i. Less than or equal to 3”:
         (1) Piping: Schedule 80 PVC solid wall pipe.
         (2) Fittings: Socket type drain, waste, and vent fittings.
         (3) Joining method: Two-step process; primer and solvent cement.
      ii. Greater than 3”:
         (1) Piping: Schedule 40 Galvanized Steel
         (2) Fittings: Threaded or Flanged
3. Domestic and Process Water:
   a. Building Water Service:
      i. Type “L” copper tube with solder or press fittings.
      ii. When permitted by local codes: pre-insulated, 160 psi, PEX-a piping with PEX-foam insulation with engineered polymer or lead-free brass cold-expansion fittings.
   b. Interior Building Lines

i. Type "L" copper tube with solder or press fittings.

B. Valves (Up to and including 2-1/2 inch):
1. Acceptable Manufacturers:
a. Nibco
b. Watts
c. Apollo
d. Stockham
e. Milwaukee
f. Or equivalent manufacturer.
2. For use in general service and all areas unless otherwise specified:
a. Gate Valves:
i. Screwed or solder end, bronze body, rising stem, solid bronze disc, 300 psi CWP
(1) Threaded: Nibco T-111-LF, Stockham LFB-103, Apollo 101T-LF, or equal.
(2) Solder: Nibco S-111-LF, Stockham LFB-104, Apollo 101S-LF, or equal.
b. Globe Valves:
i. Screwed or solder end, bronze body, PTFE disc, 300 psi CWP.
(1) Threaded: Watts LFGLV, Milwaukee UP502, Apollo 120T-LF, or equal.
(2) Solder: Watts LFGLVS, Milwaukee UP1502, Apollo 120S-LF, or equal.
c. Check Valves:
i. Screwed or solder end, bronze body, PTFE disc, 300 psi CWP.
(1) Threaded: Nibco T-413-Y-LF, Stockham LFB-319Y, Apollo 161T-LF, or equal.
(2) Solder: Nibco S-413-Y-LF, Stockham LFB-309Y, Apollo 161S-LF, or equal.
d. Ball Valves:
i. Acceptable in lieu of gate and globe valves for 2-inch and smaller.
ii. MSS SP-110, full port bronze ball, threaded or solder ends, 2-part bronze body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 600 psi CWP.
(1) Threaded: Watts LFFBV-3C, Stockham LF-T-255, Apollo 70LF-100, or equal.
(2) Solder: Watts LFFBVS-3C, Stockham LF-S-255, Apollo 70LF-200, or equal.
3. For use in designated areas with corrosive atmospheres as listed in paragraph 2.2:
a. Gate Valves:
i. Screwed end, 316 stainless steel body, non-rising stem, solid wedge disc, 200 WOG.
(1) New Line N10055-SS, Sharpe 30276TE, FNW 15B-200, or equal.
b. Globe Valves:

i. Screwed end, 316 stainless steel body, 316 stainless steel disc, 200 WOG.
(1) New Line N10220-SS, Sharpe 40276TE, FNW 17B-200, or equal.

c. Check Valve:
i. Screwed end, 316 stainless steel body, 316 stainless steel solid disc, 200 WOG.
(1) New Line N10070-SS, Sharpe 20276TE, FNW 16B-200, or equal.

d. Ball Valves:
i. Acceptable in lieu of gate and globe valves for 2 inch and smaller.
ii. MSS SP-110, full port stainless steel ball, threaded ends, 2-part 316 stainless steel body, reinforced PTFE or equal resilient seat, blowout-proof stem, lever handle, 1000 psi CWP.
(1) Watts S-FBV-1, Stockham T-2852-SS, Apollo 76F-100, or equal.

C. Valves (3-inch and larger):
1. Gate Valves:
a. Refer to Section 15101 - General Service OS&Y - 3 inches and larger.
2. Globe Valves:
a. Refer to Section 15102 - General Service 3 inches and larger.
3. Check Valves:
a. Refer to Section 15110 - Valves - 3 inches and larger.

D. Insulation: As specified in "Pipe and Equipment Insulation" Section in this Division.

E. Drainage and Pipe Specialties:
1. Acceptable Manufacturers:
a. Zurn.
b. Josam.
c. J.R. Smith.
d. Or approved equal.
2. Floor Drains:
a. Type "A" - cast iron body, drainage flange, flashing clamp, adjustable 7-inch diameter nickel-bronze strainer. Equal to Zurn Z-415 with Type "B" strainer.
b. Type "B" - cast iron body, extra heavy-duty drain, flashing clamp, 15" top, 8" outlet size. Equal to Zurn Z-503.
c. Type "C" - cast iron body, drainage flange, flashing clamp, extra heavy cast iron loose slotted grate, with suspended sediment bucket. Equal to Zurn Z-610, 4" outlet.
d. Type "D" - cast iron body, deep sump, bottom outlet, seepage pan and membrane flashing clamp, 9-inch diameter, heavy duty cast iron deep flange grate. Equal to Zurn Z-511, 3" outlet.
e. Type "E" - cast iron body, drainage flange, 12 inch x 12 inch heavy duty hinged cast iron grate, cast iron sediment bucket. Equal to Zurn Z-610H.

f. Type "F" - PVC body, low profile, large capacity drain, integral anchor flange, 8" diameter PVC grate, sediment bucket, 4” PVC DWV outlet. Equal to Zurn Z-FD2360-PVC-P.

3. Cleanouts:
   a. Floor Cleanouts:
      i. Cast iron body, anchor flange with clamp collar, cast iron cover, internal brass plug. Equal to Zurn Z-1400-KC-BP. (For use in concrete floor areas.)
      ii. Cast iron body, anchor flange with clamp collar, round scoriated Nickel Bronze top (adjustable), internal brass/bronze plug. Equal to Zurn ZN-1400-BP. (For use in finished floor areas, if floor is carpeted supply with carpet top and marker.)
   b. End Cleanouts: Cast iron body, ABS tapered thread plug. Equal to Zurn Z-1440.
   c. Wall Cleanouts: Cleanout tee fitting, brass countersunk plug, round stainless-steel access cover with securing screw. Equal to Zurn Z-1446.
4. Parapet Scuppers: Downspout nozzle with wall flange, plain bronze threaded inlet and decorative face of wall flange and outlet nozzle. Equal to Zurn Z-199. 6-inch x 7-inch top scupper drain/cast iron body. Plain bronze oblique strainer with 90° combination frame and membrane flashing clamp. Equal to Zurn Z-187.
5. Air Admittance Valve:
   a. ABS or PVC cap and body, synthetic rubber membrane, one way valve. Studor Mini-Vent or equivalent product by Oatey, ProFlo, or equal.

F. Water Distribution and Pipe Specialties
1. Hose Bibb:
   a. Single Temperature: 3/4” volume control valve, wall mounting bracket, outlet with pipe supports, vacuum breaker, 3/4” hose connection, chrome plated finish, stainless steel hose rack. Leonard model SW-75-1571-LF equivalent product by Armstrong, Strahman, or equal.
   b. Manual Blender: 3/4” hot and cold volume control valves, two stop check valves, wall mounting bracket, outlet with pipe supports, vacuum breaker, 3/4” hose connection outlet with dial thermometer, chrome plated finish, stainless steel hose rack. Leonard model SW-75-EVBD-LF equivalent product by Armstrong, Strahman, or equal.
2. Water Hammer Arrestor: PDI rated water hammer arrestors, stainless steel shell, gas charged expansion chamber, stainless steel or elastomer bellows. PDI size as indicated on the drawings (per manufacturer’s recommendations if not indicated). Zurn Z-1700 or equivalent product by Jay R Smith, Precision Plumbing Products, or equal.
3. Thermostatic Domestic Water Tempering Valve: Self-contained bronze body three-way mixing valve with liquid filled or bi-metal thermostatic element, adjustable discharge range 80 degrees F to 140 degrees F, flow capacity not less than as noted at 20 psi differential, "fail-safe" feature on failure of either hot or cold water supply or of thermostatic element. Provide with combination

strainer-check stops, union inlets and outlet pipe. Finish to be sprayed satin or rough brass. Leonard Type TM, Symmons 5-200 or approved equal.

4. Backflow Preventers:
   a. Double spring-loaded check valve assembly with automatically operating reduced pressure relief valve located in the pressure zone between the two check valves.
   b. Inlet and outlet gate valves and inlet strainer.
   c. Test cocks on inlet, relief, and outlet pressure zones.
   d. Size, flow capacity and pressure drop as shown on the drawings.
   e. N.S.F. and A.S.S.E. tested and approved.
   f. Air gap drain.
   g. For use in general service and all areas unless otherwise specified:
      i. All bronze construction with stainless steel internals, union or flanged connections.
      ii. 1/2 inch - 3/4 inch sizes: Watts #LF009, Febco #LF860, Wilkins #975XL, or equal.
      iii. 1 inch - larger: Watts #LF909, Febco #LF825Y, Wilkins #975XL, or equal.
   h. For use in designated areas with corrosive atmospheres as listed in paragraph 2.2:
      i. All 316 stainless steel construction with stainless steel internals, union or flanged connections.
      ii. 1/2 inch - 1 inch sizes: Watts #SS009, Apollo #40-200-T2S, Wilkins #375ST, or equal.
      iii. 1 inch – 2": Wilkins #375ST or equal.
5. Pressure Reducing Valve: Direct operating for dead end service, self-contained, 125 lb. lead free cast copper silicon alloy body, screwed ends, adjustable, spring loaded, EPDM diaphragm actuated, stainless steel seat, EPDM disc, integral strainer, thermal expansion by-pass. Size and pressure range as indicated on the Drawings. Watts #LFU5B, Wilkins 600XL, Cash-Acme EB-24U, or approved equal.
6. Vacuum Relief Valves: Bronze body, automatic venting, vacuum relief valve, 3/4-inch inlet. Equal to Watts LFN36, Wilkins VR10XL, Apollo 37LF20101, or equal.
7. Pressure and Temperature Relief Valves: ASME rated bronze body automatic reseating combined pressure and temperature relief valve, thermostat element operated, test lever, 125 psi pressure relief setting. Equal to Watts 40XL, Cash-Acme FVMX, Wilkins TP220, or equal.

2.2 DESIGNATED CORROSIVE AREAS

A. Designated Areas Requiring Corrosion Resistant Materials:
   1. Wet Well Entrance
   2. Wet Well

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide offsets in all piping to place in proper position and avoid work of other trades.
B. The supply lines or fittings for every plumbing fixture shall be so installed as to prevent backflow.
C. Install all valves with stems horizontally to upright. Do not install with stems down.
D. Adjust pressure reducing valve, and tempering valve as directed by the Engineer.
E. Where plastic piping joins metal piping, threaded adapters shall be installed only with plastic male into metal female.
F. Install piping free of sags, bends, and kinks.
G. Solder joints: solder joints shall be made in accordance with ASTM B 828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
H. Threaded joints: threaded joints shall have pipe joint compound or teflon tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.
I. Press connections: copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully inserted in the fitting. The joints shall be pressed using the tools approved by the manufacturer.
J. Install air gap drain on all reduced pressure zone backflow preventers that are designed to accommodate one. Pipe drain to nearest floor drain if available or to 6" above finish floor one pipe size larger than the backflow preventer drain.

3.2 TESTING

A. Perform pressure testing on all piping and equipment in accordance with Section 15400.

END OF SECTION

SECTION 15423

ELECTRIC WATER HEATER

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, and test electric water heater(s) and appurtenant work as shown on the Drawings and as specified herein. Refer to additional requirements in specification Section 15400.

B. Other Trades: Cooperate with other trades whose work is to be coordinated with water heaters.

1.2 QUALITY ASSURANCE

A. Standards

1. Standby loss requirements: USDOE, ASHRAE/IES90.1
2. ANSI/NFPA 70
3. UL certified to NSF Standard 5
4. Safe Drinking Water Act, Section 1417

1.3 SUBMITTALS

A. General: Submittals shall be in accordance with specification Section 01340 and 15400.

B. Submittals shall show physical dimensions, electrical data, control information, UL certification, and warranty information.

1.4 GUARANTEE

A. Tankless instantaneous water heater shall have a 5-year guarantee of tank against leakage and 1-year guarantee of all other component parts.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Tankless Instantaneous Water Heater:

1. ABS-UL 94Vo rated cover.
2. Element shall be iron free, nickel chrome, replaceable cartridge insert.
3. Unit shall have replaceable filter in the inlet connector.
4. Heater shall be fitted with 1/2" pipe compression nuts (5/8-inch OD).
5. Maximum operating pressure of 150 PSI
6. Adjustable thermostatic control with high temperature limit cutoff.
7. Furnish any contactor and controls required for operation
8. Size, capacity, and electrical characteristics as indicated on the Drawings.
9. Acceptable Manufacturers:
    a. Eemax
    b. Chronomite
    c. Hubbell
    d. Stiebel Eltron
    e. Equivalent manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the water heater(s) in strict accordance with the manufacturer's instructions and recommendations.

B. Install the water heater(s), piping, and wiring in accordance with all applicable local and State codes.

C. Coordinate electrical installation with Electrical Contractor.

END OF SECTION

SECTION 15450

PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, and test plumbing fixtures and trim as indicated on the Drawings and specified herein. Refer to additional requirements in specification Section 15400.

1.2 QUALITY ASSURANCE

A. Standards:
   1. ASME A112.
   2. ASSE 1016.
   3. NSF 61.
   4. NSF 372.
   5. Americans with Disabilities Act (ADA)
      a. ICC A117.1: Standard for Accessible and Usable Buildings and Facilities.

B. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years.

C. Items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.

1.3 SUBMITTALS

A. Submittals shall be in accordance with specification Sections 01340 and 15400.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Service Sink:
   1. Type F-1:
      a. 22-inch x 18-inch white, acid resisting enameled cast iron, roll-rim service sink, minimum 9-inch high faucet back, stainless steel rim guard, wall hanger.
         i. American Standard: “Lakewell” 7692.008
         ii. Kohler: "Bannon" K-6718
         iii. Zurn: Z5888
         iv. Or equivalent product.
      b. Service sink faucet with integral vacuum breaker, hose-end rigid spout, integral stops, rough chrome finish.
         i. American Standard: 8350.243
         ii. T&S Brass: B-0665-CR-BSTR
         iii. Chicago: 897-MPRCF
         iv. Or equivalent product.

c. 3-inch cast iron P-trap standard with sink strainer.
   i. American Standard: 7798.030
   ii. Kohler: K-6673
   iii. Zurn: Z5900-IP3
   iv. Or equivalent product.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely fasten and support all fixtures.
   1. Provide fixture hangers or carriers as specified for all wall hung fixtures.
   2. Firmly attach block feet of chair type fixture carriers to floor slab with ½ inch x 3-inch self-expanding concrete anchor bolts.
   3. Furnish hangers to General Trade for installation in cast-in-place concrete walls.

B. Set fixtures at heights to rim as specified. Where not specified set heights as required by code.

C. Provide shut-off valves or stops in water service lines to each fixture.

D. Where fixture comes in contact with wall or floor, the joint shall be watertight.

END OF SECTION

SECTION 15492

SUBMERSIBLE SUMP PUMP

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install submersible type sump pump and sewage ejector of type, capacity, and at location as shown on the Drawings and as specified herein. Refer to additional requirements in specification Section 15400.

PART 2 - MATERIALS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Liberty Pump Company
   2. Zoeller Pump Company
   3. Weil Pump Company
   4. Barnes Pumps
   5. Or equivalent manufacturer.

2.2 SUMP PUMPS

A. Simplex Sump Pump:
   1. Pump: Submersible solids handling type sump pump with cast iron casing, cast bronze impeller, stainless steel motor pump shaft, bronze fitted construction, and mechanical seals. 1-1/2” IPS discharge minimum, as shown on the Drawings. Capable of passing 3/4” spherical solids. Epoxy powder-coat finish.
   2. Motor:
      a. Ball bearing designed for operation while totally submerged in water.
      b. Built-in thermal overload protection.
      c. Stainless steel shaft and fittings.
   3. Control: Integral non-mercury float control, 10-foot-long waterproof grounding type electric cable.
   4. Size, capacity, and electrical characteristics as shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install where shown on drawings.
B. Provide a gate valve and a check valve in discharge pipe above sump pump.
C. Provide a union on the pump side of the gate valve to permit removal of pump unit.
D. Extend discharge as shown on the drawings.
E. Adjust controls for proper operation.
F. Verify electrical outlet provided for pump meets Division 16 requirements for location. Outlet provided must be GFCI rated.

3.2 TESTS

A. Test operation of pump and controls under actual working conditions in presence of the Engineer.

END OF SECTION

SECTION 15600

HVAC - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Perform the following items of work required to complete the work of this Section, as shown on the drawings and specified herein:
   1. All labor, materials, equipment, and transportation shall be provided as required to completely furnish, install, and test the Heating, Ventilating, and Air Conditioning systems, with all connections as shown on the drawings and described in these specifications or as required by the Mechanical Code of the Project State. The accompanying drawings do not show every detail of ductwork, dampers, pipe, valves, fittings, hangers, equipment, and fixtures which are necessary for the complete installation but are provided to show the general arrangement and extent of work to be performed. Provide all work as indicated on the drawings together with all items necessary for or incidental to the completion of the work.

B. Work included: The Heating, Ventilating, and Air Conditioning work shall include, but not be limited to the following, refer to requirements specified in Division 15:
   1. Heat generation and transfer equipment.
   2. Ductwork and devices.
   3. Air moving and air handling equipment.
   4. Automatic temperature control systems.
   5. Equipment insulation.
   6. Balancing air systems.
   7. Connections to equipment installed by other trades.
   8. Installation of components and devices furnished by other trades that are located in Heating and Ventilating piping, ducts, or equipment.

C. Drawings and Measurements:
   1. The Drawings show the general arrangement, direction, and sizes of pipes, ductwork, and equipment. They are not intended to show every offset, valve, and fitting, and every structural difficulty that may be encountered.
   2. Coordinate HVAC system installation with the work of other trades.
   3. Verify measurements at the job site.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

B. Seismic Control: When applicable, refer to Section 13081 for general project and equipment specific seismic requirements.

C. Electrical Work:
   1. The HVAC work shall include the installation of all motors, temperature controls, limit switches, etc., as herein specified. All 480-volt, 208-volt, and

120-volt wiring and connections, and all motor starters, not specified in this Section, will be provided under Division 16 - Electrical.

2. All 24-volt wiring and auxiliary devices required for the specified systems, equipment and operations indicated in this Section shall be provided under this Section, unless specifically indicated on the Drawings related to Division 16 - Electrical. This shall include, but is not necessarily limited to, all wiring for automatic temperature and damper modulation control.
3. The materials and methods for all electrical work provided under this Section shall comply with the requirements specified under Division 16 - Electrical. Coordinate equipment ratings, starter sizes, protective device sizes, wire and conduit sizes, holding coil voltages and control voltages with Division 16.

1.3 QUALITY ASSURANCE

A. Materials and Workmanship: All materials and workmanship shall be suitable for the respective work and the type of service encountered. The contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Division.
B. Equipment: All equipment shall be constructed to operate safely without undue wear.
C. Local Codes: Install all systems in accordance with applicable state and local codes; in the event of conflict between or among specified requirements and pertinent regulations and/or codes, the more stringent requirement will apply.
D. Permits: Arrange for all permits, inspections, and tests required by codes at no additional cost to the Owner.
E. Standards: When standards are referred to, the latest issue shall apply.

1.4 JOB CONDITIONS

A. Scheduling Work: Install and test all materials to be cast into or buried under concrete floor slabs prior to the placement of concrete.

1.5 SUBMITTALS

A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340, and as specified herein. Shop drawings shall contain the following information at a minimum:
    1. Completed Submittal Certification Form. Shop drawing submittals will be returned unreviewed without this form.
    2. Manufacturer's literature and illustrations for all equipment and materials to be installed indicating all capacities, performance requirements, electrical characteristics, options, and accessories as shown on the drawings and as specified in each Section.
    3. Guarantees/Warranties as specified in each Section.
B. Operations and Maintenance Manual: Provide Operations and Maintenance Manual for all mechanical equipment as specified in the General Conditions. Refer to Operation and Maintenance section of specification 01340 for all other requirements for submissions to engineer. Operations and Maintenance Manual shall contain the following information at a minimum:

1. Manufacturer's operation & maintenance manuals with all non-applicable content removed or crossed out.
2. Table of Contents
3. Contractor and Manufacturer Contact Information.
4. Operator service requirements including Preventative Maintenance Schedule and Summary.
5. Troubleshooting Information.
6. Warranty Information.
7. Shop Drawings corrected to As-Built Conditions.
8. Wiring and Control Diagrams.
9. Parts and Service Contact Information.
10. List of All Component Part Numbers.
11. Spare Parts and Supply Lists.
12. Completed Operations and Maintenance Manual Certification Form at the start of each section for all equipment provided.
13. Complete the following table for all equipment installed and include following the Table of Contents for all installed equipment or at the beginning of each section for the equipment in that section:

Equipment Name	Unit Tag	Serial Number	Model Number	Building / Location	Date Installed

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01600.
B. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of equipment and materials.
C. Store materials on the project site in enclosures or under protective coverings.
D. Assure that all materials are kept clean and dry.
E. Do not store materials directly on the ground.
F. The Contractor shall be responsible for the care and protection of all materials and mechanical work until the project is accepted by the Owner.
G. Immediately remove from the construction site all materials damaged and/or destroyed and replace with new materials to the complete satisfaction of the Engineer without additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide and install only new materials and equipment and of the latest design of the respective manufacturers.
B. All materials and equipment of the same classification shall be the product of the same manufacturer unless otherwise specified.
C. Provide all electrical specialties and accessories as specified with the equipment in accordance with requirements of Division l6. All specialties and accessories shall meet the NEMA Electrical Classification of the space in which they are installed.

See Drawing Sheet E-1 for the NEMA Schedule.

D. Furnish to the proper trades, all manufacturer's wiring diagrams for installation of mechanical equipment.

E. Provide tee fittings, elbows, reducers, sheet metal safing, and other required components to install equipment and control devices furnished by other trades.

F. Furnish and install all necessary supports and bases for all items furnished under HVAC as required for the specific item/equipment to provide alignment to adjacent inlet and outlet interconnecting piping and/or ductwork. In the absence of specific details within the Contract Documents for the supports and bases, submit proposal outlining supports/bases for the specific item/equipment being provided including materials of construction, size, components and other necessary details for review and acceptance by the Engineer. Materials of construction shall be suitable for the intended operating environment. Standard 4-inch concrete housekeeping pads are not included within this specification and are furnished by others.

2.2 BOLTS, ANCHOR BOLTS, NUTS, UNISTRUT, HANGERS, AND SUPPORTS

A. Furnish all necessary bolts, anchor bolts, nuts, washers, lock washers or locking nuts, plates and bolt sleeves in accordance herewith. Anchor bolts shall have suitable washers, lock washers and, where so required, their nuts shall be hexagonal.

B. All bolts, anchor bolts, nuts, washers, lock washers, plates, bolt sleeves, duct and pipe hangers and supports shall be constructed of the following materials:

1. Galvanized steel in accordance with Division 5 unless otherwise indicated below or specified elsewhere.
2. Stainless steel hardware (minimum of Type 304, unless otherwise indicated) is required in all corrosive atmospheres, exterior areas, and/or areas with NEMA 4X or NEMA 7 rating.
3. Stainless steel hardware (minimum of Type 316, unless otherwise indicated) is required in all heavy moisture or submerged applications as well as in wet wells, and others similar spaces. For additional description and definition of submerged surfaces refer to Specification Section 09900.

2.3 EQUIPMENT AND VALVE TAGS

A. Identify all new HVAC equipment shall be identified with a color-coded equipment/valve tag. Submit a complete list of proposed Identification Tag information for review by the Engineer and Owner. Tag information shall match the information provided on the Drawings.

B. Tags shall conform to the following specifications:

1. 2.5-inch diameter, 1/16" thick, rigid, multi-layered sandwich laminate with contrasting inner and outer colored acrylic plastic layers. 5/32" top hole for hanging tags.
2. Tags shall be black or red unless otherwise specified.
3. Tags shall have up to three lines engraved on the outward facing side, with eight characters per line of identification information.
4. Valve tags shall be secured to valves with adjustable stainless steel bead chain.
5. Tags secured to equipment shall be fastened to a flat visible surface by a minimum of two stainless steel screws or stainless-steel pop rivets.
6. Tags shall be rated to withstand temperatures from -40°F to 175°F

7. Manufacturers:
    a. Seton Name Plate Corporation
    b. Brimar Industries
    c. Supreme Instrument & Electrical Services
    d. Equivalent Manufacturer

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all work in a neat workmanlike manner.
B. Make all installations structurally sound throughout.
C. All equipment and appurtenant components shall be installed in strict accordance with the manufacturer's written instructions, recommendations and as shown on the drawings.
D. Supports: Support ductwork and piping in accordance with the mechanical code. Hanger and support materials shall be as indicated in paragraph 2.2.B of this section.
E. Expansion: Provide provision for expansion of pipelines.
F. Do not install piping through, directly over, or in front of electrical switchgear and power panels.
G. Caulk the spaces between the duct or pipe and walls, ceilings, and floors gas-tight where shown on the Drawings.
H. Coordinate locations of piping, sleeves, inserts, hangers, equipment, and access provisions with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities.
I. Follow manufacturer's published recommendations for installation methods not otherwise specified.
J. Coordinate locations of structural systems necessary for duct, pipe, and equipment support to permit proper installation.
K. Coordinate locations of duct and pipe sleeves, trenches and chases with duct, piping, and equipment locations.
L. Core holes through concrete and masonry using rotary core drill. Locate holes to avoid interference with structural members such as beams or grade beams. Lay out holes in advance and perform drilling only after approval by the Engineer. Obtain approval in advance by the Engineer for drilling holes through structural members.
M. Gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms.
N. Locate all installations to avoid interference with cranes and materials handling equipment, storage areas, work of other trades, and traffic areas.
O. Perform all work incidental to the installation of the apparatus and materials including, but not limited to, cutting, patching, trenching, excavating, backfilling, trench covering, plastering and the constructing of chases, slots, furring, foundations, piers, and pads, when applicable. All work shall be performed in accordance with the applicable Divisions of this Specification by qualified workers regularly employed in the applicable trades.

3.2 TESTING

A. When the installation is complete, test pipelines in the presence of the Engineer and the Plumbing or Building Inspector in accordance with the requirements of the local and state mechanical codes. Provide necessary testing equipment and utilities.
B. Test underground piping prior to backfilling.
C. Test piping prior to application of paint and insulation.
D. Separately test portions of piping which will be concealed before completion.
   1. Isolate equipment that cannot withstand test pressures prior to any testing.
   2. Do not test plastic piping with compressed air or other gases.
E. Repairs:
   1. Should leaks be found, repair as required even to the extent of disassembling and remaking the joints or replacing sections of pipe.
   2. Do not repair leaks through the application of external caulking at joint surfaces or the use of chemical compounds.
   3. Replace defective pipe and fittings and repeat tests until the testing results are approved by the Engineer.

3.3 CLEANING

A. Do not allow refuse and surplus materials to accumulate and obstruct the construction site.
B. Upon completion of the installation, remove refuse and surplus materials from the construction site and leave the building neat and clean.

3.4 PAINTING AND IDENTIFICATION

A. All HVAC piping shall be identified by this Contractor through the use of vinyl pressure sensitive markers. Markers shall indicate system, using abbreviations supplied by Engineer. Each system shall use a different color marker.
B. Flow arrows shall indicate direction of fluid flow.
C. Labels and arrows shall be provided at twenty-foot intervals and in or above each room.
D. Paint HVAC piping, valves, pumps, and equipment in accordance with Specification Section 09900.
E. Apply signage and identification in accordance with specification section 10140.

3.5 OPERATOR TRAINING

A. Operator Training shall be performed by a duly authorized representative of the HVAC contractor, who is fully trained in the installation, startup, and operation of the installed equipment.
B. Provide combined training and operational assistance for plant operators in the proper operations of the mechanical system equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
C. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance, and warranty conditions. Should the representative require time in addition to the minimums indicated herein to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner.

Under absolutely no circumstances shall warrantees become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described in Owner's representatives during these sessions.

D. At the Owner's discretion, the training sessions may be video recorded for Owner's future use.

E. The contractor’s representative shall fill out the Operator Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

3.6 BALANCING

A. Balancing of air and water system flows shall be in accordance with Section 15907.

OPERATOR TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment: _____

_____

Specification Numbers: _____

_____

I, the undersigned System Provider's Authorized Representative, have trained the Owner's personnel listed below in the proper operation and maintenance of the above listed equipment.

_____

_____

_____

_____

_____

_____
(System Provider's Authorized Representative/ Signature & Printed Name) (Date)

_____
(Owner's Representative/ Signature & Printed Name) (Date)

_____
(Witnessed by Engineer/ Signature & Printed Name) (Date)

END OF SECTION

SECTION 15604

AUTOMATIC TEMPERATURE CONTROL (ELECTRONIC)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish, install, and test a fully functional electronic automatic temperature control (ATC) system of the type and function as required on the drawings and herein specified.
   1. All 24-volt (low voltage) wiring systems included for automatic temperature controls systems as part of this specification shall be installed by the Automatic Temperature Controls contractor.

B. Coordination with Other Trades: The automatic temperature control trades shall coordinate and supervise other trades whose work affects the control systems, including but not limited to:
   1. Coordinate installation and wiring of air monitoring equipment furnished and installed under Division 13.
   2. Coordinate interconnections with SCADA system furnished and installed by Division 13 as shown on the drawings and described herein.

C. Work Performed by Other Trades: The following incidental work shall be furnished by the designated trade under the supervision of the automatic temperature control (ATC) trade:
   1. The heating/cooling trades shall:
      a. Install automatic valves and separable wells that are specified to be supplied as a portion of the control systems.
      b. Furnish and install all necessary: valved pressure taps, water, drain and overflow connections and piping.
   2. The sheet metal trades shall:
      a. Furnish and install all automatic dampers.
      b. Provide necessary blank-off plates required to install dampers that are smaller than duct size.
      c. Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
      d. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place only after stratification problem has been eliminated.
      e. Provide access doors or other approved means of access through ducts for service to control equipment.
   3. The electrical trades shall:
      a. Install line-voltage electrical wiring systems (120 volt single phase, 240 volt single phase, 208 volt 3-phase or 460 volt 3-phase) in accordance with Division 16 requirements.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
   1. Section 16075 – Conduit, Cable and Wiring Identification and Tagging
   2. Section 16160 – Cabinets and Enclosures
   3. Section 16900 – Controls

1.3 QUALITY ASSURANCE

A. The system shall be installed, tested, and balanced by competent technicians regularly employed by the temperature control manufacturer.

1.4 SUBMITTALS

A. Provide shop drawings in accordance with the requirements of the General Conditions, Section 01340, and as specified herein. Shop drawings shall contain the following information at a minimum:
   1. Manufacturer's literature for all equipment including maintenance and operating instructions and parts lists.
   2. Description of operation for all systems.
   3. Electric wiring diagrams showing all wiring, and equipment including all inter-connections on a terminal to terminal basis. Refer to ladder wiring diagrams shown on the Drawings. Note any discrepancies due to actual system submitted.
   4. Panel layout drawings for all local and central panels (to scale).
   5. Valve and damper operator schedule showing size, configuration, capacity and location of all equipment.

B. Operations and Maintenance Manual: Provide Operations and Maintenance Manual for all mechanical equipment as specified in the General Conditions. Refer to Operation and Maintenance section of specification 01340 for all other requirements for submissions to engineer. Operations and Maintenance Manual shall contain the following information at a minimum:
   1. Manufacturer's operation & maintenance manuals with all non-applicable content removed or crossed out.
   2. Table of Contents
   3. Contractor and Manufacturer Contact Information.
   4. Operator service requirements including Preventative Maintenance Schedule and Summary.
   5. Troubleshooting Information.
   6. Warranty Information.
   7. Shop Drawings corrected to As-Built Conditions.
   8. Wiring and Control Diagrams.
   9. Parts and Service Contact Information.
   10. List of All Component Part Numbers.
   11. Spare Parts and Supply Lists.
   12. Completed Operations and Maintenance Manual Certification Form.

1.5 GUARANTEE

A. The control system designated on drawings and plans and herein specified, shall be guaranteed to be free from original defects in both material and workmanship for a

period of one (1) year of normal use and service, excepting damages from other causes. This guarantee shall become effective starting the date the Owner begins to receive beneficial use of the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Honeywell
   2. Johnson Controls
   3. Schneider Electric
   4. Reliable Controls
   5. Automated Logic
   6. Siemens
   7. Or equivalent manufacturer.

2.2 MATERIALS

A. General: The control system shall consist of enclosures containing the necessary standalone programmable controllers; all required, terminal strips, interposing relays, selector switches, and other ancillary components; as well as all sensors, thermostats, temperature transmitters, controllers, automatic valves and dampers, damper operators, control panels, and other accessory equipment to meet the intent of the specification and provide for a complete and operable system. Refer to Drawings for electrical wiring and interlocks.

B. All panels and devices shall meet the NEMA electrical classification of the space in which they are installed. Refer to drawing Sheet E-01 for NEMA classification schedule.

C. Standalone Controller:
   1. Protocols
      a. BACnet
      b. Supports one B/IP subnetwork and B/VPN.
      c. Ethernet or MS/TP.
      d. DHCP: Dynamic Host Configuration Protocol.
      e. SMTP: Simple Mail Transfer Protocol:
      f. Provides standard email communications for broadcasting email alarms.
      g. Supports TLS/SSL security.
      h. SNTP: Simple Network Time Protocol.
      i. Wi-Fi on controllers with the -W option:
      j. Supports WPA-Personal and WPA2-Personal security.
   2. Touchscreen Display
      a. Display full-color graphics, runtime logs, trend logs, alarms, and schedules.
      b. Full-color screen, 4.3" wide-quarter VGA, thin film transistor, projective capacitive touch; Display area 2 1/4" x 3 3/4".
   3. Universal Inputs
      a. 12-bit A/D converter.
      b. Analog: 0–10 VDC 4–20 mA, thermistor.

c. Binary: Dry contact.
d. Impedance: MΩ for 0–10 VDC range, 250 Ω for 4–20 mA range, 20 kΩ pull-up for thermistor/dry contact range.
e. Pulse counting up to 150 Hz. Supports flow meters.
f. 24 VAC overvoltage protection.

4. Universal Outputs
   a. 12-bit D/A converter.
   b. Analog: 0–12 VDC.
   c. Binary: Software-configurable between 0–12 VDC.
   d. Maximum 75 mA each.
   e. 24 VAC overvoltage and short protection.
5. Spare I/O
   a. Controller shall be provided with spare inputs and outputs for connection of additional equipment and devices. Number of spare input and outputs will correspond to 20% of the total used, with a minimum of two inputs and two outputs.
6. Equivalent to:
   a. Reliable Controls MACH-Pro
   b. Automated Logic WebCTRL
   c. Siemens Desigo
   d. Or equal

D. Electric Line-Voltage Industrial Thermostat:
1. Industrial/heavy commercial grade, Line-Voltage type thermostats in NEMA 12, 3R, 4/4X process and production areas capable of directly activating heating or cooling equipment.
2. Thermostat shall be wall mounted in a heavy-duty metal enclosure. The enclosure shall meet the NEMA requirements of the area in which they are installed. Minimum rating shall be dust tight, NEMA 12.
3. Switching shall be SPST with a minimum rating of 16 Full Load Amps (FLA) and 80 Locked Rotor Amps (LRA) at 120 VAC or the full load rating of the device(s) to be activated, whichever is greater.
4. Differential shall be fixed 3-5 deg. F.
5. Bulbs shall be corrosion resistant, shielded and either locally or remote mounted as required.
6. Covers shall have temperature set point adjustment knob except when concealed or removable key adjustment is noted. Scale range shall be 40 to 100 °F unless described otherwise in the control description under paragraph 3.1.
7. In areas of a building that comply with the Americans with disabilities act, thermostats shall be mounted at a height of 48" above a finished floor.

E. Thermometers:
1. A thermometer shall be located adjacent to each rigid stem thermostat. A dual thermometer with liquid-filled remote system shall be mounted adjacent to each remote bulb thermostat. Averaging bulb thermometers shall be used where averaging bulb thermostats are required.

2. Provide duct-type thermometers in all fresh air intake, mixed air, return air, and all supply fan discharges and elsewhere where noted or shown. Thermometers shall have the proper range scales for the locations where installed.
3. Panel-mounted indicating thermometers shall be minimum two inches' diameter.

F. Differential Pressure Controllers:
1. Static pressure regulators shall be direct or reverse acting as required with adjustable setpoint and throttling range with field calibration capability.

G. Control Valves: Three-way, two-way, mixing, or diverting service as required. Operator shall be electric. Valve pressure drop shall not exceed 7 feet water column (w.c.). Control valves shall be sized by the ATC contractor.

H. Dampers:
1. All control dampers shall be furnished as part of Section 15862.
2. All dampers shall be installed by sheet metal trades.
3. All dampers installed for outside air applications shall be low leakage design and construction. Refer to Section 15862 for minimum construction details.

I. Damper Operators and Linkages:
1. Damper operators shall be electric open-close or fully proportioning as indicated or required.
2. Linkages shall be suitable to connect operator to damper leaves and transmit full torque of motor. All necessary hardware shall be included with the linkages.
3. Damper motors shall be quiet in operation and shall have ample power to overcome friction of damper linkage and air pressure acting on louvers to position dampers accurately and smoothly. The damper operator mounting arrangement shall be outside the airstream wherever possible.
4. The operators shall be capable of operating at varying rates of speed to correspond to the dictates of the controllers and variable load requirements. The operators shall be capable of operating in sequence when required by the sequence of the operation. The operators shall have external adjustable stops to limit the stroke in either direction. The operator linkage arrangement shall be such as to permit normally open or normally closed positions of the dampers as required.
5. Electric Operators:
   a. On-off, reversing, or proportional as required.
   b. Spring return to closed or open position as required.
6. Dampers associated with emergency generator cooling shall fail open on loss of electrical power.

J. Miscellaneous Devices:
1. Provide all the necessary relays, positioners, clocks, transformers, etc. to make a complete and operable system.
2. Locate these devices on local panel unless specified otherwise.

K. Miscellaneous Hand Switches and Indicator Lights:
1. Size: 30 mm
2. All indicator lights shall be 120V AC, LED with push to test option.
3. Reference Section 16900 for additional specifications.

4. Number of positions and nameplate legends shall be as indicated in Paragraph 3.1 of this specification.
5. Selector switches shall be configured in the order listed; for example, a three position Hand-Off-Auto switch shall be configured such that the left position is “Hand”, center position is “Off”, and right position is “Auto”.

L. Relays:
1. Pilot duty relays shall be Form C, UL listed, two (2) to four (4) pole relay with DIN rail mounted base rated a minimum of 5 amps at 120 VAC. Relay shall have indicator and mechanical test pushbutton.
2. Industrial relays or contactors shall be used to directly drive 120 VAC single phase equipment.
3. Refer to Division 13 and 16 for additional requirements.

M. Panels:
1. Panels shall be provided to enclose all relays, switches, and controllers as required.
2. Panels shall be front access with gasketed, hinged covers with keyed tee handles.
3. Required indicating and control devices shall be installed in the cover.
4. Terminal strips shall be provided for all electrical connections.
5. Enclosure shall be furnished with a corrosion resistant finish.
6. Panels shall be central and/or local as indicated or required.
7. Control Panels shall be provided in accordance with Division 13 and 16 .
8. All Control and Industrial Panels shall be constructed in accordance with UL 508A standard. Refer to Division 13 and 16.
9. Control panel shall be provided with spare mountings for additional relays. Number of spare mountings will correspond to 5% of the total number of relays within each panel, with a minimum of one spare mounting.
10. All wiring entering and leaving control panels shall be terminated on field terminal blocks and labeled.

N. Gauges:
1. Thermometers and pressure indicating gauges shall be provided as shown on the Drawings and other points throughout the system where the visual indication of temperature or pressure is required or will prove beneficial to operating personnel in the operation of the control system. Gauges will not be required on room type thermostats.

O. Duct-mounted Airflow Switch:
1. SPDT paddle-type or thermal dispersion proof- of- airflow switch, for mounting in ductwork of ventilation equipment serving Class 1/Division 2 rated areas and Unclassified rated areas in accordance with NFPA 820.
    a. Paddle type: Stainless steel paddle, range adjustment screw, 120 Volt, 16 FLS AC rated. Unit shall have NEMA 4X or NEMA 7 enclosure in areas requiring same. Furnish switch, for mounting in ductwork by mechanical contractor; provide wiring to ATC panel. Dwyer V4, or equivalent product by Johnson Controls, Omega, or equal.

b. Thermal dispersion: 316 Stainless steel sensor head, NEMA 4X and Class 1 Division 1&2 rated powder coated housing, 120VAC, 4W. Ameritrol FX, or equivalent product by Johnson Controls, Magnetrol, or equal.

PART 3 - EXECUTION

3.1 DESCRIPTION OF OPERATION

A. General
   1. Electric Unit Heater (EUH):
      a. Wall mounted thermostat provided with unit shall energize the heating coil and fan as necessary to maintain the space temperature setpoint.
         i. Space temperature setpoint - 55°F (adj.)

B. Dry Well Ventilation
   1. Ventilation Fan (EF-1)
      a. Controlled by the following associated with panel ATC-1:
         i. Hand/Off/Auto switch
         ii. Outside air temperature sensor
         iii. Light Status Relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans, refer to ATC riser diagram for additional information
      b. IF the lights in the Electrical Room or Pump room are energized, then the space shall be considered occupied; if the lights are de-energized, then the space shall be considered unoccupied
      c. IF the space is occupied OR the switch is in the “Hand” position OR the outside air temperature is greater than 50°F (adj.);
         i. Damper D-1: open
         ii. Damper D-2: open
         iii. Fan: energized, operating continuously at design airflow
      d. IF the space is unoccupied AND the switch is in the “Auto” position AND the outside air temperature is less than 50°F (adj.);
         i. Damper D-1: open
         ii. Damper D-2: open
         iii. Fan: energized, operating continuously at 50% design airflow
      e. IF the switch is in the “Off” position (for maintenance only)
         i. Damper D-1: closed
         ii. Damper D-2: closed
         iii. Fan: de-energized
      f. Duct-Mounted Flow Switch: If the proof-of-flow switch indicates a lack of air flow, the associated horn/strobes shall be activated, and an alarm and detailed notification shall be sent to the SCADA system alerting the operator to the condition. Flow switch activation and alarm signal generation is covered under Division 13. Proof of flow relay shall be SPDT and be configured as normally open, held closed.
         i. Maintenance Switch: Provide two position selector switch on door of ATC panel. Label switch “Ventilation Monitoring Alarm” and the positions “Maintenance” and “Active”. The switch shall

disengage the operation of the horns and strobes when in the "Maintenance" position.

g. Ventilation monitoring horn/strobe activation schedule

Panel	Flow Switch	Horn	Strobe	SCADA notification
ATC-1	FS-1	H/S-1 H/S-2	H/S-1 H/S-2	Yes

C. Wet Well Ventilation

1. Ventilation Fan (EF-2)

a. Controlled by the following associated with panel ATC-1:

i. Hand/Off/Auto switch

ii. Run cycle timer

iii. Outside air temperature sensor

iv. Combustible gas detector (by others)

v. Light Status Relays (provided by Division 16). Provide wiring to dry contacts; coordinate locations with electrical contractor and electrical plans, refer to ATC riser diagrams for additional information.

b. IF the lights in Wet Well Entrance or Wet Well are energized, then the space shall be considered occupied; if the lights are de-energized, then the space shall be considered unoccupied.

c. IF the space is occupied OR the switch is in the "Hand" position OR the outside air temperature is greater than 50°F (adj.) OR the combustible gas detector located within the space senses a lower explosive limit of 10% or greater;

i. Damper D-3: open.

ii. Fan: energized.

d. IF the outside air temperature is less than 50°F AND the space is unoccupied AND the switch is in "Auto" position, the fan shall be controlled by the run cycle timer on repeating schedule;

i. Active:

(1) Damper D-3: open.

(2) Fan: energized.

ii. Inactive:

(1) Damper D-3: closed.

(2) Fan: de-energized.

iii. Active – 5 minutes; Inactive – 55 minutes (adj.)

e. IF the switch is in the "Off" position (for maintenance only

i. Damper D-3: closed

ii. Fan: de-energized

3.2 INSTALLATION

A. Control wiring shall be neatly installed, parallel to building lines, and in locations not subject to damage. All wiring and conduit to be installed in accordance with the requirements of Division 16.

3.3 IDENTIFICATION

A. Provide all control equipment, panels and manual controls with black lamacoid nameplates engraved with white letters indicating the function, tag number, service or apparatus being served.
B. Properly number all wires and terminals where applicable.

3.4 TESTING AND COMPLETION

A. Initial equipment testing shall be performed in coordination with the work of other trades to confirm system functionality.
B. Coordinate with Testing and Balancing Contractor to adjust settings as necessary for speed-controlled equipment.
C. Start-up and operational testing shall be performed in the presence and to the satisfaction of the Engineer's designated representative to demonstrate the function of each system.
D. Upon completion of the project, the automatic temperature control system provider shall completely adjust, ready for use, all thermostats, controllers, valves, damper operators, relays, etc., provided under this Section.

3.5 OPERATOR TRAINING

A. Operator Training shall be performed by a duly authorized representative of the ATC system provider, who is fully trained in the installation, startup and operation of the equipment.
B. Provide combined training and operational assistance for plant operators in the proper operations of the ATC system equipment, and in the techniques, methods, schedules, etc. associated with maintenance.
C. The level of the training and operational assistance provided shall be as required to ensure proper understanding of the equipment's operations, maintenance and warranty conditions. Should the representative require time in addition to the minimums indicated herein to sufficiently detail the proper operations and maintenance of the equipment, it will be provided at no additional cost to Owner. Under absolutely no circumstances shall warrantees become void due to Owner's failure to follow operational and maintenance procedures which were not fully detailed and described in Owner's representatives during these sessions.
D. At the Owner's discretion, the training sessions may be video recorded for Owner's future use.
E. The system provider representative shall fill out the Equipment Training Certification form included within this Section. Training will not be considered complete until this form has been provided to the Engineer.

3.6 PROGRAMMED MAINTENANCE

A. Upon completion of the installation, the automatic temperature control contractor shall submit to the Owner for consideration, an agreement, to provide the necessary programmed maintenance to keep the various control systems in proper working condition.
B. This proposed programmed maintenance agreement shall fully describe the maintenance work to be performed and shall advise the cost of this work during the 1-year guarantee period provided as part of this Contract by the ATC Contractor as

well as for subsequent years thereafter.

3.7 ADJUSTMENTS

A. The automatic temperature control contractor shall make three (3) follow-up visits during the guarantee period to make adjustments to the system for seasonal variations.

ATC SYSTEM TRAINING CERTIFICATION

Owner: _____ Date: _____

Project: _____

Contractor: _____

ATC System Provider
Representative: _____

Equipment: _____

I, the undersigned System Provider's Authorized Representative, have trained the Owner's personnel listed below in the proper operation and maintenance of the above listed equipment.

_____

_____

_____

_____

_____

_____ _____
(System Provider's Authorized Representative/ Signature & Printed Name) (Date)

_____ _____
(Owner's Representative/ Signature & Printed Name) (Date)

_____ _____
(Witnessed by Engineer/ Signature & Printed Name) (Date)

END OF SECTION

SECTION 15766

ELECTRIC UNIT HEATERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, install, and test electric unit heaters as shown on the Drawings and as specified except electric wiring. Refer to additional requirements in specification Section 15600.

B. Other Trades: Cooperate with other trades whose work is to be coordinated with electric unit heaters.

1.2 SUBMITTALS

A. Submittals shall be in accordance with specification Section 01340 and 15600.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Indeeco.
   2. Markel.
   3. Chromalox.
   4. Equivalent manufacturer.

2.2 MATERIALS

A. Unit Heaters:
   1. Capacities as shown on the Drawings.
   2. Mounting accessories as shown on the Drawings.
   3. Heater to be forced fan type of the kW rating, voltage and phase specified in the schedule.
   4. Individually adjustable discharge louvers.
   5. Fin tube metal sheathed, steel or cast aluminum heating elements.
   6. Automatic reset thermal overheat protection.
   7. Totally enclosed continuous fan-duty type fan motor with built-in thermal overload protection.
   8. Aluminum, propeller-type fan.
   9. Galvanized steel cabinet with polyester powder coat finish.
   10. Magnetic contactor mounted and wired in cabinet.
   11. Fused control transformers when required for thermostat or fan operation.
   12. Provide with wall thermostat or integral thermostat as indicated on drawings.

B. Washdown / Corrosion Resistant Unit Heaters:
   1. Capacities as shown on the Drawings.
   2. Mounting accessories as shown on the Drawings.
   3. UL Listed for corrosive areas and NEMA 4X hose down requirements.
   4. Heater to be forced fan type of the kW rating, voltage and phase specified in the schedule.

5. Finned tubular heating elements, type 316 stainless steel sheath with mechanically wound stainless steel fins and mounting fittings.
6. Totally enclosed motor with permanently lubricated ball bearings, designed to resist moisture and corrosion, fitted with an epoxy-coated aluminum fan blade and factory wired to NEMA 4X enclosure.
7. Heating elements and motor enclosed in round, 16-gauge, stainless steel shroud with stainless steel louvered outlet grille and plated rear grille.
8. Single point, line voltage connection for incoming power.
9. NEMA 4X enclosure housing element terminals and the following standard built-in controls:
    a. Automatic reset overtemperature cutout
    b. 24V control transformer
    c. Fan delay relay
    d. Contactors and terminal block for field wiring
10. Factory mounted and wired disconnect switch.
11. "Heater On" pilot light indicating when heating elements are energized.
12. Thermostat shall be furnished with each heater for remote wall mounting. Thermostat shall be UL Listed with NEMA 4X enclosure suitable for wet and corrosive areas.

C. Explosion Proof Wet-Location / Corrosion Resistant Unit Heaters:
1. Capacities as shown on the Drawings.
2. Mounting accessories as shown on the Drawings.
3. Factory Mutual and CSA Approved for: Class I, Divisions 1 and 2, Group D.
4. Heater to be forced fan type of the kW rating, voltage and phase specified in the schedule.
5. The corrosion-resistant protective coated motor shall be totally enclosed with permanently lubricated ball bearings, designed to resist moisture and corrosion, fitted with an epoxy-coated aluminum fan blade and factory wired to NEMA 7, 9 enclosure.
6. Wet location construction:
    a. Washable per IP55
    b. IP55 motor
7. 316 stainless steel heat exchanger with aluminum fins
8. 316 stainless steel cabinet
9. Aluminum fan blades
10. Cast aluminum NEMA 4, 7, 9 control enclosure
11. Corrosion-resistant hardware
12. Single point, line voltage connection for incoming power.
13. Controls factory mounted on the unit: automatic and manual reset overtemperature cutouts, controlling magnetic contactor, and 24-volt control circuit transformer housed in a NEMA 7, 9 cast aluminum enclosure.
14. Thermostat shall be furnished with each heater for remote wall mounting. Thermostat shall be UL Listed with NEMA 7, 9 enclosure suitable for Class 1, Div. 1 areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All system components shall be installed in strict accordance with the manufacturer's written instructions, recommendations and as shown on the drawings.

3.2 ADJUSTING AND CLEANING

A. Adjust operation and clean to the satisfaction of the Engineer.

3.3 STARTUP, TESTING, AND TRAINING

A. Provide startup, testing and training in accordance with the requirements of Section 15600.

END OF SECTION

SECTION 15820

VENTILATION FANS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install ventilation fans of the types and arrangement as shown on the Drawings and as specified herein. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

A. Standards
   1. Air Movement and Control Association
      AMCA 210-85 Laboratory Methods of Testing Fans for Rating
      AMCA 300-85 Test Code for Sound Rating
   2. National Fire Protection Association
      NFPA 70-90 National Electrical Code
      NFPA 90A Installation of Air Conditioning and Ventilating Systems

B. Each fan shall be licensed by AMCA to bear the Certified Rating Seal. When this standard is not applicable, the manufacturer shall submit data to verify the fan capacity at the specified operating condition.

1.3 SUBMITTALS

A. General: Submittals shall be in accordance with specification Section 01340.

B. Submittals shall show physical dimensions, shaft sizes, drives, drive arrangement, motor data, electrical data and performance curves. Where there is a requirement for an explosion proof motor the shop drawing will verify that the motor and associated wiring devices meet Class I, Group D, Division I requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Refer to the Drawings for the following information (when applicable):
   1. Specific type and size of fan.
   2. Electrical characteristics - voltage and phase.
   3. Direct or belt drive.
   4. Requirement for explosion proof motors including wiring devices (Class I, Group D, Division 1).
   5. Requirements of explosion proof fan construction shall comply with AMCA Standards handbook Publication 99-86, construction type "B".
   6. Special corrosion resistant coatings.
   7. Additional accessories and specialties.

B. Motors:
   1. Totally enclosed fan cooled (TEFC) unless noted otherwise.
   2. Integral thermal overload protection on single phase fractional horsepower motors

3. Two speed motors shall be two winding style. Single winding two speed motors are not acceptable without specific approval of the Engineer.
4. Motors driven by Variable Frequency Drive units shall be rated for VFD operation.
5. ECM motors shall be DC electronic commutation type motor (ECM) specifically designed for fan applications. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.

C. Inline Centrifugal Fans:
1. Acceptable Manufacturers
   a. Greenheck Fan Corp.
   b. Loren Cook, Co.
   c. Pennbarry
   d. Equivalent manufacturer.
2. Duct mounted, belt or direct driven as scheduled.
3. Fan wheels, aluminum backward inclined.
4. Housing, all aluminum construction.
5. Mounting brackets and vibration isolations required for wall mounting or hanging from ceiling as shown.
6. AMCA certified for both air and sound performance.
7. Completely wired internally with leads brought to an external junction box.
8. Belt drive fans shall have variable pitch sheaves selected with scheduled operating point midrange of the selected sheave.

D. Centrifugal Inline Direct Drive Fan:
1. Acceptable Manufacturers:
   a. Greenheck Fan Corp
   b. Fantech
   c. Loren Cook, Co.
   d. Or approved equal
2. Housing: UV resistant ABS-PC blend plastic, integral external electrical terminal box with pre-wired terminal strip connections.
3. Motor:
   a. Motorized impeller shall be an external rotor type, Class B insulation, totally enclosed PSC type for maximum efficiency.
   b. Permanently sealed self-lubricating ball bearing type.
   c. Automatic reset thermal overload protection.
   d. Acceptable for continuous duty.
4. Wheel
   a. Backward inclined centrifugal type.
   b. Statically and dynamically balances to provide vibration free performance.
5. Code Approval:
   a. Fan shall be UL tested and approved.

2.2 SPARE PARTS

A. Provide one set of manufacturer’s recommended spare parts for future use by the Owner:
   1. Air filters.
   2. Fan belts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as required in strict accordance with the manufacturer's instructions and recommendations and as shown on the Drawings.
B. Provide flexible duct connections on inlet and outlet of fan when fans are ducted.
C. Install fans on roof or exterior wall with flashing to prevent water and weather from entering building.
D. Performance testing and balancing shall be in accordance with specification Section 15907-Testing and Balancing Heating and Ventilating Systems.

END OF SECTION

SECTION 15840

DUCTWORK AND DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install all required sheet metal and ductwork, setting of control dampers, louvers, flexible connections, and devices as shown on the drawings or required to make the installation complete in accordance with the intent of the drawings and specifications. Refer to additional requirements in specification Section 15600.

B. Design Criteria: The drawings do not show every detail of fittings, hangers and equipment which are necessary for the complete installation but are provided to show the general arrangement.

1.2 QUALITY ASSURANCE

A. Ductwork:

1. SMACNA "HVAC Duct Construction Standards - Metal & Flexible".
2. ASHRAE Duct Construction Recommendations (5 percent maximum leakage allowable).
3. SMACNA "Thermoplastic Duct (PVC) Construction Manual".
4. SMACNA "Round Industrial Duct Construction Standards".

1.3 SUBMITTALS TO THE ENGINEER

A. Submit manufacturer's certification for the type of material provided.

B. Submit all shop drawings to the Engineer as specified in the General Conditions of the Construction Contract and as specified in Section 01340.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver all ductwork and accessories as Work progress requires.

B. Store all material to prevent damage of any nature.

1.5 JOB CONDITIONS

A. Protection:

1. Protect all ductwork, and accessories from the accumulation of paint, concrete, mortar, etc.
2. Keep the interior of duct system free from dirt, rubbish, etc.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All ducts, devices and accessories except PVC ducts and other ducts noted on drawings shall be constructed to SMACNA 2-inch water gage (w.g.) classification for both vacuum and pressure applications.

B. Ducts, devices and accessories shall be constructed of materials as noted below and on the Drawings.

1. Aluminum 3003 alloy H14 temper per ASTM B209. Select ductwork and reinforcement to meet SMACNA standards in aluminum duct to achieve a (-) 4" w.c. pressure rating.
2. Occupied spaces such as offices, locker rooms, conference rooms, etc.: Galvanized steel in compliance with ASTM A653/A653M and SMACNA "HVAC Duct Construction Standards, Metal and Flexible" (SMACNA DCS), may be used.

C. All longitudinal and traverse joints, seams and connections of supply and return ducts operating at a static pressure less than or equal to 2 inches water gauge (w.g.) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic plus embedded fabric systems or tapes installed in accordance with the manufacturers installation instructions.

D. Sealant and Gaskets
1. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
2. Water-Based Joint and Seam Sealant:
   a. Application Method: Brush on.
   b. Solids Content: Minimum 65 percent.
   c. Shore A Hardness: Minimum 20.
   d. Water resistant.
   e. Mold and mildew resistant.
   f. VOC: Maximum 75 g/L (less water).
   g. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   h. Service: Indoor or outdoor.
   i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
   j. Color: White, to match supply ductwork.
3. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Insulation: Ducts requiring insulation shall use materials specified in Section 15891. Note that duct sizes shown are inside clear dimension, not necessarily sheet metal size.

F. Diffusers, grilles, and registers:
1. All air devices shall be supplied by a single manufacturer.
2. Acceptable manufacturers:
   a. Price.
   b. Nailor.
   c. Titus
   d. Anemostat.
   e. Manufacturers with equivalent diffusion pattern, air throw, velocity, and sound level.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, duct volume dampers, fire dampers, flexible connectors, and access doors shall conform to SMACNA Duct Construction Standards.

B. Install duct so that ductwork shall operate without chatter, vibration, and be airtight so that no dust marks from air leaks will show at connections or outlets.

C. Field Changes to Ductwork: Design changes such as those required to suit the size of factory fabricated equipment actually furnished to minimize losses in pressure and performance due to sudden expansion and contraction. Use transitions in field changes as well as modifications to connecting ducts.

D. Splitters and Dampers: Dampers shall have accessible operating mechanism, and where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitter dampers shall be operated by quadrant operators or 3/16-inch rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 8 inches. Manual volume-control dampers shall be operated by locking type quadrant operators. Dampers and splitters shall be two gages heavier than duct in which installed. Unless otherwise indicated, multi-leaf damper shall be opposed blade type with maximum blade width of 4 inches. Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, provide the locking type quadrant operators for dampers, when installed on ducts to be thermally insulated, with stand-off mounting brackets, bases or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Provide volume dampers where shown on the Drawings.

E. Air Deflectors: Provide air deflectors in all square elbows, duct- mounted supply outlets, takeoff or extension collars to supply outlets, and tap-in branch-takeoff connections. Air deflectors shall be factory-fabricated and factory- or field-assembled units consisting of curved turning vanes or louver blades for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide square elbows with curved vanes as shown on the Drawings. Devices shall be of the same material as ductwork.

F. Duct Access Doors: Provide hinged doors at all automatic dampers, fire dampers, coils, thermostats, temperature controllers, and other apparatus requiring service and inspection in the duct system. Doors shall be 12 by 12 inches unless otherwise shown on the Drawings. Where size of duct will not accommodate this size, make the doors as large as practical. Install doors not less than 24 by 24 inches on each side of each air-handling unit. Doors shall be rigid, and shall be provided with airtight felt gaskets. Provide doors with hinges, pins and two fasteners of the same material as the adjacent duct. Provide doors 24 by 24 inches or larger with fasteners operable from both sides. Doors in insulated ducts shall be of the insulated type. Unless otherwise shown on the Drawings, doors shall swing so that fan pressure or suction holds the door closed.

G. Duct Sleeves and Prepared Openings:
   1. Round ducts - 15 inches in diameter or less: Provide duct sleeves for all round ducts 15 inches diameter or less passing through floors, walls, ceiling, or roof. Install ducts larger than 15 inches diameter and all square and rectangular ducts passing through floors, walls, ceilings or roof. Sleeves shall conform to the requirements of Section 15092 except as noted below:
      a. Sleeve shall provide one-inch clearance between the duct and the sleeve, or one inch clearance between the insulation and the sleeve for insulated ducts, except at grilles, registers, and diffusers.
   2. Round ducts larger than 15 inches diameter and all rectangular ducts:
      a. Install ducts larger than 15 inches diameter and all square and rectangular ducts passing through floors, walls, ceilings or roof through prepared openings.
      b. Provide one-inch clearance between the duct and the prepared opening, or one-inch clearance between the insulation and the prepared opening for insulated ducts, except at grilles, registers, and diffusers.
      c. Space between the prepared opening and the duct or duct insulation shall be packed with commercial grade twisted fireproof yarn. Seal the annular space with polyurethane sealant, S-6, per Section 07900 for standard penetrations. Penetrations through fire rated walls and floors shall utilize Fyre-shield sealant, S-7, per Section 07900 in lieu of the polyurethane sealant.
   3. The contractor shall be responsible for the proper size and location of sleeves and prepared openings. The Drawings attempt to indicate approximate sleeve and prepared opening sizes. The actual size is to be carefully coordinated with concrete placement and other construction activities to ensure sufficient and properly sized sleeves and prepared openings are provided. Due consideration should be given to the need for increased opening sizes to accommodate devices such as fire dampers or contractor selected equipment.
   4. Provide duct sleeves and prepared openings for all duct mains and duct branches. Branch takeoff connections to grilles, registers, and diffusers shall be in accordance with SMACNA HVAC Duct Construction Standards - Metal & Flexible.

H. Duct Supports: Provide and install duct supports not less than two 1-inch by 1/16-inch thick spaced one on each side of duct in accordance with SMACNA HVAC Duct Construction Standards Metal & Flexible. Supports on the risers shall allow free vertical movement of the duct.

I. Support ducts and install to be completely free from vibration under all conditions of operation. Attach supports only to structural framing member and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, use retainer clips.

J. Access Panels: Provide access panels for all concealed valves, controls, dampers, duct access doors, and any item requiring inspection and maintenance. Provide access panels of sufficient size.

K. Air Filters: Install air filters so that access space for servicing the filters is provided. Install filters with suitable sealing to prevent bypassing of air.

L. Flexible Collars: Provide flexible collars in connections between fans and ducts or casings and where ducts are of dissimilar metals, as shown on the Drawings and were required. Make collars of neoprene coated glass fabric weighing approximately 30 ounces per square yard. Securely fasten flexible connections by stainless steel clinch type bands for round ducts. For rectangular ducts, install the flexible connections locked to metal collars using normal duct construction standards.

M. Flashings: Where ducts pass through exterior building walls and roofs, provide flashings and make waterproof. Flashing shall conform to Division 7.

N. Cleaning of Duct System: After completing installation of ductwork, clean the entire system of rubbish, plaster, dirt and any other debris. After installation of equipment and connections are made to fan, and before any grilles, outlets or registers are installed, blow out the entire system with dampers and outlets wide open.

3.2 QUALITY CONTROL

A. Tests: Upon completion and prior to acceptance of the installation, perform the following tests:

1. Low Pressure/Velocity Ductwork: Make all supply ducts, return ducts, exhaust ducts, plenums, and casings substantially airtight in compliance with SMACNA Duct Class C criteria. Inspect duct joints for completeness of seal under operation at the indicated system pressure before covering with insulation or concealing in masonry. Substantially airtight shall be construed to mean that no air leakage is noticeable through the senses of feeling or hearing at all duct joints.

B. Preliminary Tests: Give the air supply and distribution system and its components an operational test for a period of not less than 4 hours.

C. After preliminary test, adjust, test and balance the air supply and distribution system to obtain air volumes as shown on the Drawings. Record final balanced air quantities and submit to the Engineer for approval.

D. Provide necessary samples from installed ductwork as Engineer may require (not to exceed 10) for inspection purposes. Patch all openings due to the removal of the samples at no additional cost to the Owner.

3.3 SHEET METAL THICKNESS TABLES

A. Minimum Sheet Metal Gauges for Rectangular Duct for both galvanized steel and stainless-steel ducts shall be according to SMACNA HVAC Duct Construction Standards.

B. Wherever the tables allow for more than one choice of gage and reinforcement, the Contractor shall select the gage reinforcement and reinforcement spacing that will be used throughout the Contract and submit this information to the Engineer through the submittal process specified in the General Conditions.

3.4 MINIMUM PVC THICKNESS

A. PVC ducts shall all be 1/4" minimum wall thickness.

B. Reinforcement and rigidity class shall be as detailed in SMACNA Thermoplastic Duct (PVC) Construction Manual for the pressure classification noted on the Drawings. Submit selected method of reinforcement to the Engineer.

END OF SECTION

SECTION 15862

DAMPERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install dampers and accessories where shown on the Drawings. Refer to additional requirements in specification Section 15600.

1.2 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings in accordance with the General Conditions of the Construction Contract.

1.3 DELIVERY, STORAGE AND HANDLING

A. Deliver as Work progress requires.
B. Protect in a suitable weathertight enclosure to prevent damage of any nature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Air Balance, Inc.
   2. Airstream
   3. Louvers & Dampers, Inc.
   4. Ruskin.
   5. Or approved equal.

2.2 MATERIALS

A. Motor Operated Air Control Dampers:
   1. Control Dampers:
      a. Equal to Ruskin Model CD50 control damper.
      b. Multi-blade, parallel or opposed blade as indicated.
      c. Fully gasketed with a maximum allowable leakage of 4 cfm per square foot of face area at 1 inches W.C. differential pressure.
      d. Entire damper shall be constructed from aluminum 6063-T5 structural shapes and extrusions.
      e. Bearings and blade shafts shall be non-corrosive.
B. Damper Operators:
   1. Manual operators supplied by damper or louver manufacturer.
   2. Motor operators and linkage to connect motor to damper linkage will be furnished and installed by the Automatic Temperature Control (ATC) Contractor.
   3. Normal closed or open as noted, spring return, electric motor operated. Modulating type as indicated in Section 15604.
C. Miscellaneous Connecting Sheet Metal:
   1. Galvanized steel or stainless steel to match adjacent duct.

2. Thickness: Per SMACNA
3. Joints, seams, connections, cross bracing, flanges and supports as required for installation and recommended by SMACNA.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install dampers, operators and linkage in strict accordance with the manufacturer's instructions and recommendations.
B. Ensure all blades open, close, and seal properly.

END OF SECTION

SECTION 15869

LOUVERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Provide and install louvers and accessories where shown on the Drawings. Refer to additional requirements in specification Section 15600.

1.2 QUALITY ASSURANCE

A. All louvers shall be certified by AMCA for air pressure drop, free area, and water penetration.

B. Acceptable Manufacturers:
   1. Ruskin Mfr. Co.
   2. Air Balance, Inc.
   3. Louvers & Dampers, Inc.
   4. American Warming and Ventilating, Inc.
   5. Airstream Inc.
   6. Or equivalent.

1.3 SUBMITTALS TO THE ENGINEER

A. Submit shop drawings, manufacturer's literature, maintenance data and operating instructions as stated in the General Conditions of the Construction Contract.

B. Submit free area, pressure drop, and water penetration data for each louver for approval.

C. Submit AMCA certification for louver style.

D. Submit sample louver section with proposed finish for review and no exceptions taken by the Engineer.

E. Submit scale drawings of each louver showing sizes, construction details, and mullion locations.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver in manufacturer's unopened containers as job progress requires.

B. Store in unopened containers in weathertight building.

C. Exercise care in handling to avoid bending blades or frames, damaging finish and other damage of any nature.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Exterior Stationary Louvers:
   1. Equal to Ruskin Mfr. Co. Model ELF-375DX.
   2. Storm proof, .08l extruded aluminum 6063-T5 blades.
   3. Architectural style.
   4. 6063-T5 extruded structural aluminum frame, .100" wall thickness, mitered corners and caulking slots.

5. Rigid hidden architectural style mullions as required for span, but not greater than 48" on center. Provide mullions at each section of louver requiring duct or fan connection.
6. Blade stiffeners.
7. l/2-inch mesh replaceable aluminum bird screen on interior, insect screen where shown on the Drawings.
8. Kynar 500 finish - manufacturer's standard color selected by Engineer.
9. 4-inch width.
10. Provide extended sill.
11. Caulk slots and flange when installed in masonry construction. Provide nailing flange when installed in wood frame construction.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install as required using manufacturer's instructions and recommendations and as shown on the Drawings.
B. Caulk all openings as required in Division 7 and as shown on the Drawings.
C. Isolate metal to metal contact between aluminum louver frames and steel damper frames or ductwork with suitable paint.

3.2 CLEANING AND ADJUSTING

A. Clean all louvers and dampers of grease, tar and dirt to the satisfaction of the Engineer.
B. Adjust all louvers to the satisfaction of the Engineer.

END OF SECTION

SECTION 15907

TESTING AND BALANCING HEATING AND VENTILATING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: The testing and balancing Work includes the measurement and setting of air and water flow devices in accordance with the Contract Documents for the systems, recording data, making tests, and preparing reports, all as hereinafter specified. Perform the Work specified in this Section on, and after the completion of, Work on the HVAC systems. Refer to additional requirements in specification Section 15600.

B. Qualifications: Obtain the services of a qualified testing organization, approved by the Engineer, to perform the testing and balancing work as herein specified. The criteria for determining qualifications of the testing organization shall be certification by the Associated Air Balance Council (AABC), certification by the National Environmental Balancing Bureau (NEBB), or organization shall have submitted proof to satisfy the Engineer that the organization meets the technical standards for membership of the AABC as published in the AABC "National Standards for Field Measurements and Instrumentation - Total System Balance", Volume Two, No. 12173, except that affiliation with manufacturers, installing contractors, or engineering firms may not preclude their acceptance.

C. Procedures: Accomplish the Work in accordance with the agenda specified herein. Follow procedures described herein and, in general, if not specifically described herein, the Work shall be in accordance with the Associated Air Balance Council's "National Standards for Field Measurements and Instrumentation Total System Balance", Volume Two, No. 12173, and standards of NEBB.

D. Cooperate with the selected test and balance agency in the following manner:

1. Provide sufficient time before final completion date so that tests and balancing can be accomplished.
2. Provide immediate labor and tools to make corrections when required without undue delay. Install balancing dampers as required by test and balance agency.
3. Put all heating, ventilating and air conditioning systems and equipment into full operation and continue the operation of same during each working day of testing and balancing.
4. Keep the testing and balancing agency informed of any major changes made to the system during construction and provide with a complete set of as-built drawings.
5. Include the costs of dampers, pulley and belt changes and the costs of obtaining the test and balancing agency in the Contract price.

E. Installation shall not be considered complete until final reports by the testing agency have been submitted to the Engineer and approved.

1.2 SUBMITTALS TO THE ENGINEER

A. Submit the name of the proposed testing organization to the Engineer for approval within 90 days after Contract award.

B. Provide all results of all required tests for the Engineer's approval.

1.3 AGENDA

A. Preliminary Report: Review Drawings and Specifications prior to the installation of any of the affected systems and submit a written report to the Engineer indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.

B. Submit an agenda for approval by the Engineer prior to start of testing and balancing work. The agenda shall include the following:

1. A complete listing of all air and water flow and air terminal measurements to be performed.
2. Specific test procedures and parameters for determining specified quantities, e.g., flow, drafts, etc., from the actual field measurements to establish compliance with the Contract Documents.
3. Samples of forms showing applications of procedures and calculations to typical systems.

C. Advise the Engineer in advance when the testing will begin so that the testing procedure and techniques can be evaluated and approved or modified.

D. Procedure Reporting: Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch), and factors used.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Not applicable in this Section.

PART 3 - EXECUTION

3.1 PROCEDURES AND INSTRUMENTS - GENERAL

A. Requirements: Adjust all systems and components to perform as required by the Drawings and Specifications.

B. Test Duration: Perform operating tests of heating coils, fans and other equipment no less than a four-hour duration after stabilized operating conditions have been established. Base capacities on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Use methods of application of instrumentation in accordance with the approved agenda.

D. Use only instruments used for measurements that are accurate and calibrated within 6 months of the testing with calibration histories for each instrument available for examination. Have each test instrument calibrated by a laboratory approved by the Engineer or by the manufacturer. The Engineer has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

E. Apply all instruments in accordance with the manufacturer's instructions and recommendations.

F. Provide all labor, instruments and appliances required. Do not install instruments that are permanent installations used for the tests, e.g., gages, thermometers, etc., until just prior to the tests to avoid damage and changes in calibration.

G. Accuracy of all thermometers shall be plus or minus l graduation at the temperatures to be measured. Graduations shall conform to the following schedule.

Medium	Design Temperature Differential (°F)	Maximum Graduation (°F)
Air	10 or less	1/2
Air	over 10	1
Water	10 or less	1/10
Water	10-20	1/2
Water	over 20	1

3.2 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide the required design air quantity to, or through, each component. Conduct adjustment and balancing of all systems during the period of the year approximating maximum seasonal operation, unless otherwise directed or approved by the Engineer.

B. Equalizers: Adjust equalizing devices to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.

C. Balance: Use flow adjusting (volume control) devices to balance air quantities only, i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of normal limits.

D. Accomplish balancing between runs (submains, branch mains and branches) generally by flow regulating devices at, or in, the divided flow fitting.

E. Restriction imposed by flow regulating devices in or at terminals shall be minimal. Make final measurements of air quantity after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

F. Fan Adjustment: Generally, vary the total air system quantities, by adjusting fan speeds, or axial-flow fan wheel blade pitch. Use damper restriction of a system's total flow only for systems with direct connected fans (without adjustable pitch blades), provided system pressure is less than 1/2-inch w.g.

G. Except as specified herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE Handbook of Fundamentals.

H. Omit pitot tubes traverse when the duct serves only a single room of space and its design volume is less than 200 cfm. In lieu of Pitot tube traverse, determine air flow in the duct by totaling volume of individual terminals served, measured as specified herein.

I. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), determine air quantity by measurements at terminals served.

J. Test Holes: Provide test holes, in straight ducts, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.
K. Air Terminal Balancing.
L. Air Motion: Air motion and distribution shall be as specified and as shown on Drawings. In addition to air motion measurements, make smoke tests wherever requested by the Engineer, to demonstrate the air distribution from air terminals, at no additional cost to the Owner.
M. Changes in the specified agenda due to field conditions, will be considered for approval by the Engineer.

3.3 WATER SYSTEM PROCEDURES

A. Adjustment: Adjust all heating, bypass, and transfer systems to provide the required quantity to, or through each component.
B. Metering: Measure water quantities and pressures with calibrated meters.
C. Use venturi tubes, orifices, or other metering fittings installed in system and pressure gages to measure water flow rates and balance the systems.
D. Adjust the systems to provide the approved pressure drops through the heat transfer equipment (coils, converters, etc.) prior to the capacity testing.
E. Where flow metering fittings are not installed, determine flow balance by measuring temperature differential across the heater transfer equipment.
F. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.
G. Automatic Controls: Position automatic control valves for full flow through the heat transfer equipment of the system during tests.
H. Flow: Adjust the flow through bypass circuits at three-way valves to balance that through the supply circuit.
I. Distribution: Adjust distribution by balancing devices (cocks, valves, and fittings) and automatic flow control valves as provided. Do not use service valves.
J. Only record pressure differential where automatic flow control valves are utilized in lieu of venturi tubes, provided the pressure is at least the minimum applicable to the tag rating.
K. Special Procedures: Where available pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system; specific procedures shall be delineated in the agenda.

3.4 TEST RECORDS

A. Submittal: Submit three (3) copies of the reports described herein, covering air and water system performance, and air motion (fpm), to the Engineer prior to final tests and inspection.
B. Instrument Records: Include types, serial numbers, and dates of calibration of all instruments.
C. Reports: Identify conspicuous items not conforming to Contract requirements in the reports.

3.5 AIR SYSTEM DATA

A. Report: Include in the certified report, for each air-handling system, the following data (as applicable):

1. Equipment (fan or factory fabricated station unit):
    a. Installation Data:
        i. Manufacturer and Model.
        ii. Size.
        iii. Arrangement, Discharge, and Class.
        iv. Motor H.P., Voltage, Phase, Cycles and Full Load Amps.
        v. Location and Local Identification Data.
    b. Design Data: Data listed in schedules on the Drawings and in the Specifications.
    c. Fan Recorded (Test) Data:
        i. C.F.M.: Discharge CFM and % of OA under minimum conditions.
        ii. Static Pressure: S.P. total, S.P. suction and S.P. discharge.
        iii. R.P.M.: Fan and motor.
        iv. Motor Operating Amps.
        v. Motor Operating B.H.P.
        vi. Motor Sheave Size and Make.
        vii. Fan Sheave Size and Make.
        viii. Number of Belts Size and Make.
2. Duct Systems:
    a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-Air, and Exhaust:
        i. Duct size(s)
        ii. Number of Pitot tube (Pressure) Measurements.
        iii. Sum of Velocity Measurements (Note: Do not add pressure measurements).
        iv. Average Velocity.
        v. Recorded (Test) C.F.M.
        vi. Design C.F.M.
    b. Individual Air Terminals:
        i. Terminal Identification (Supply or Exhaust, Location and Number designation).
        ii. Type, Size, Manufacturer and Catalog Identification.
        iii. Applicable Factor for Application, Velocity, Area, etc., and Designated Area.
        iv. Design and Recorded Velocities - F.P.M. (State "core", "inlet", etc., as applicable). Record data for three readings and average.
        v. Design and Recorded Quantities - C.F.M. Record data for three readings and average.
        vi. Deflector Vane or Diffusion Cone Settings.

3.6 WATER SYSTEM DATA

A. Report: Include in the certified report, for each water system, the following data:

1. Pumps:
    a. Installation Data:

i. Manufacturer and Model.
ii. Size.
iii. Type Drive.
iv. Motor H.P., Voltage, Phase, and Full Load Amps.

b. Design Data:
i. G.P.M.
ii. Head.
iii. R.P.M.
iv. B.H.P and Amps.

c. Recorded Data:
i. Discharge Pressure (Full-Flow and No-Flow).
ii. Suction Pressures (Full-Flow and No-Flow).
iii. Operating Head.
iv. Operating G.P.M. (From pump curves if metering is not provided).
v. No-Load Amps. (where possible).
vi. Full-Flow Amps.
vii. No-Flow Amps.

2. Air Heating Equipment:

a. Design Data:
i. Load in BTUH or MBH.
ii. Entering and Leaving Water Temperature.
iii. C.F.M.
iv. Water Pressure Drop.

b. Recorded Data:
i. Type of Equipment and Identification (location or number designation).
ii. Entering and Leaving Air Conditions (D.B. and W.B).
iii. Entering and Leaving Water Temperatures.
iv. G.P.M. (if metered).
v. Temperature Rise or Drop.

3.7 FINAL TESTS, INSPECTION AND ACCEPTANCE

A. General: Make tests to demonstrate that the capacities and general performance of air and water systems comply with the Contract Documents.

B. At the time of final inspection, recheck, in the presence of the Engineer, random selections of data (water and air quantities and air motion) recorded in the Certified Report.

C. Points and areas for recheck will be selected by the Engineer.

D. Measurement and test procedures shall be the same as approved by the Engineer for the Work forming basis of report.

E. Selections for recheck (specific plus random), in general, will not exceed 15 percent of the total number tabulated in the report.

F. Retests: If random tests elicit a measured flow deviation of ten percent or more from that recorded in the Balance Report listings, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, readjust all systems and re-test. Submit new data recorded, new Balance Reports and make new inspection tests, all at no additional cost to the Owner.

G. Marking of Settings: Following final acceptance of Balance Reports by the Engineer, permanently mark the settings of all valves, splitters, dampers, and other adjustment devices so that adjustment can be restored if disturbed at any time. Do not mark devices until after final acceptance.

END OF SECTION

SECTION 16000

ELECTRICAL - PUMP STATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide all labor, materials, equipment, operations, methods and procedures as specifically noted herein these specifications and as indicated in the Contract Documents, together with all items necessary for or incidental to the completion of the work.

B. All systems or additions to existing systems indicated in the Contract Documents shall mean all necessary supervision, labor, equipment and materials required to provide complete, properly functioning systems.

C. All systems shall be adjusted, tested, inspected, and turned over to the Owner in working order.

D. The words "provide", "furnish" and "install" are defined in DIVISION 0.

E. References:

1. Refer to each individual drawing within the Contract Documents in order to coordinate material and equipment locations and electrical requirements.

F. Work Specified Herein:

1. Visit and examine the project site and become familiar with all existing conditions pertinent to the work to be performed thereon. No additional compensation will be allowed for failure to be so informed.
2. The following scope of work is a brief generalization of the type and extent of the work specified under DIVISION 16. Detailed requirements are indicated on the Drawings and in related sections of the Specifications. The work includes, but is not necessarily limited to the following:
    a. The work specified under Division 16 is inclusive of the electrical work for this project as indicated on the Drawings and in related sections of the Specifications.
    b. Provide Electrical Service and Distribution System as indicated on the "Single-Line Diagram", related drawings and schedules, and as specified herein.
    c. Short Circuit and Arc Flash Studies
    d. Demolition of existing lighting systems and distribution equipment
    e. Raceways and fittings.
    f. Wires and cables.
    g. Service distribution equipment.
    h. Miscellaneous electrical distribution equipment.
    i. Grounding system.
    j. Installation of a radio antenna
    k. Power and control wiring between standby generator and service distribution equipment.
    l. Metering and service disconnect equipment.
    m. Emergency standby power system equipment and installation.

n. Complete demolition of existing systems as shown on the drawings for all complete removals and disconnections, removals, relocations, and installations.
o. All required electrical work for the proposed pump station building as shown on the drawings.
p. Contractor shall be responsible for obtaining temporary power to conduct work as required. Temporary power may be obtained from the local power company or by a temporary generator as required in order to maintain continuous operation of the pump station during the schedule of the construction period. The generator and all required fuel are to be supplied by the Electrical Contractor.

G. Removals and Relocations:
1. Examine the existing site, structure(s) and installation(s) for the work of all trades which will influence the cost of the work under DIVISION 16. This work shall include removals and relocations relating to the work of all trades which may interfere with, disturb, or complicate the performance of the work under DIVISION 16; and relating to the work involving systems, equipment and related service lines which shall continue to be utilized as part of the finished project.
2. Provide all associated labor, material, and costs to include all removals, relocations, and reconnections herein specified, necessary or required to provide operation and coordination of the combined new and existing systems and equipment.
3. Demolition:
a. Disconnect and remove existing equipment, devices, boxes, conduit, and associated electrical equipment as shown on the contract drawings.
b. Any demolition or relocation work performed which results in unused openings in control panels, instrument panels, control stations, pull or junction boxes, etc., which are to remain, shall be plugged by appropriate means such that it maintains the integrity of the NEMA classification of the area, as defined on Drawing E-01.
c. Any demolition or relocation which results in unused openings shall be sealed.
d. The work of this Contract involves demolition work. Review all Contract Documents and coordinate with all disciplines for a complete understanding of this demolition work. Provide all new work required to modify these changes along with all requirements for installation of the new work, as shown on the Contract Drawings.
e. There are areas where the demolition shall require that existing equipment such as pullboxes, conduit, and wiring, and associated devices be disconnected, removed, or relocated in order for the new equipment to be constructed and installed. In most cases, the detail of these existing conditions has not been shown. This Contractor will be responsible for performing all work necessary to demolish all devices associated with equipment in their entirety for the noted and intended demolition. The Contractor shall visit the site locations and become familiar with the areas

where this work is to be performed. Any concerns or issues regarding this work need to be addressed and submitted to the Engineer for clarification prior to submission of the final bid price for the work of this Contract. All costs associated with this work are the responsibility of this Contractor and shall be included as part of the overall costs for the electrical work of this project. No additional costs shall be allowed by this Contractor for any demolition work.

f. Disconnect and remove all abandoned conduits, wiring, boxes, equipment, controls, hangers, etc., shown or not shown, which are located within the area of construction under this contract.

H. Request for Information:

1. When there is a conflict or coordination issue, or if additional information is necessary for the Contractor to proceed with the intended work, a Request for Information (RFI) form shall be submitted through the General Contractor to the Engineer. The specific issue shall be described in the RFI and shall be sent to the Engineer for review and a response. RFI form shall be available via the General Contractor through the Engineer as required for this contract.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.

1. Section 01010 – Summary of Work (construction sequencing requirements that affect number and duration of equipment startups and certifications)
2. Section 01340 – Submittals
3. Section 01600 – Delivery, Storage and Handling
4. Section 01800 – Equipment Startup, Testing and Operator Training

1.3 BID ALLOWANCE AND COST TO BE CARRIED UNDER THIS CONTRACT

A. A bid allowance has been established for estimated costs for electrical, cable, internet, telephone, and security monitoring company utility services for the work required by them under this contract. Refer to General Conditions and Bid Forms including Measurement and Payment for exact requirements and costs to be carried as part of the work required under this section. Actual amounts shall be invoiced and submitted by the respective utility company for payment. Any credits for this allowance will be returned to the Owner under this contract.

1.4 QUALITY ASSURANCE

A. In general, the workmanship of the electrical installation shall be as described in the N.E.C.A. Electrical Design Guidelines. All methods of construction, details of workmanship, etc., that are not specifically described therein or indicated in the Contract Documents, shall be subject to the control and no exceptions to the Engineer.

B. Equipment and materials shall be of the quality and manufacture indicated in their respective description within the specifications.

C. Work determined by the Engineer to be unsatisfactory according to industry standards shall be redone at the Contractor's expense, with no additional compensation.

D. Safety and care of equipment and electrical installations to remain the responsibility of the Electrical Contractor until final acceptance by owner. Any cost associated due to damages or loss prior to owner acceptance to be covered by Electrical Contractor.

1.5 SUBMITTALS TO THE ENGINEER

A. Submit Shop Drawings, O&M Documentation, and manufacturer certificates in accordance with Section 01340. The requirements below are in addition to the standards therein.

B. Submittals required under this section include, but are not limited to the following for each of the locations specified:

1. Conduit
2. Wiring and cables types
3. Wire and cable colors
4. Service distribution equipment
5. Main circuit breaker
6. Meter socket and Metering Cabinet
7. Lightning arrestor and line surge protection
8. Receptacles
9. Automatic transfer switch
10. Mounting hardware and materials
11. Lighting fixtures and switches
12. Electrical distribution equipment
13. Miscellaneous electrical equipment
14. Pullboxes
15. Control station push buttons and enclosures
16. Expansion fittings
17. Motor starting equipment as required for the installation
18. VFD parameter settings, VFD software and digital copy of parameters
19. Conduit seal fittings
20. Emergency Standby Systems and Equipment
21. Coordination, short circuit, and arc flash study of the power distribution system
22. Equipment test results
23. Megger test results for cables and equipment prior to putting equipment into service
24. Submit all other equipment as required by the Contract

C. Submittals:

1. Shop Drawings Shall Consist Of:
    a. Project name and location.
    b. Contractor's name.
    c. Index Sheet - Listing the equipment being submitted, utilizing equipment designations, or symbols, indicated on the Contract Documents together with the proposed manufacturer, style/ type and catalog number.
    d. Manufacturer's scale or dimensioned drawings along with standard catalog "cut" sheets.
    e. Equipment ratings, service clearances and configuration.
    f. Listing of accessories to be furnished.
    g. Single-line and schematic diagrams where applicable.

h. Refer to related sections of the specifications for special shop drawing requirements for individual equipment types.

2. Provide samples of such items as lighting fixtures and wiring devices upon request of the Engineer.

3. Standard manufacturer's catalog cut sheets are acceptable; however, they shall be modified to indicate equipment and options to be provided for this project. Any listed equipment, options, or features which are not to be provided shall be properly indicated in the submittal. Failure to properly indicate project-specific equipment, options, and features will result in the submittal being returned without being reviewed.

4. Submit test results as listed in Section 3.4

D. Operations and Maintenance Manual

1. Requirements

a. Provide a complete bill of material for each piece of equipment.

b. Provide a preventative maintenance section for all applicable equipment including recommended schedule and spare parts.

c. Panels which require customized schematics shall be updated with changes made in the field and submitted on 11" x 17" size drawings. Also, internal and front elevation drawings shall be included identifying all equipment.

d. All equipment shall include a troubleshooting section with common symptoms and recommended solutions.

e. All equipment shall include emergency operations instructions particularly to Emergency Generators and Automatic Transfer Switches on how to operate the equipment when the automatic function of the equipment fails.

E. Final As-Built Record Drawings

1. During the ongoing construction the Contractor shall maintain a clean set of full-size drawings for markup. The drawings shall be red lined and marked up with all appropriately noted changes noting the as-built condition. Upon completion of the project the set of as-built markups shall be provided to the Engineer for final AutoCAD revisions.

1.6 PRODUCT HANDLING

A. Refer to additional requirements of Section 01600.

B. All materials shall be shipped, stored, handled, and installed in such a manner as not to degrade quality, serviceability, or appearance.

C. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored out of doors. Electrical equipment shall be stored in dry permanent shelters. If any apparatus has been damaged, such damage shall be repaired at no additional cost. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such special tests as directed by the Engineer or shall be replaced at no additional cost to the Owner.

1.7 DESIGN CRITERIA

A. Service and Metering

1. The power company serving this project is Central Maine Power. The service representative this project is as follows:
   Contact Person: Sabrina Noble
   Work Order Number: 10301080603
2. Contact telephone number: (207) 592-2507
3. Service will be obtained at 480/277V, 60 Hertz, from new pole-mounted service transformers located at the site, as shown on the drawings. A new pole will also be installed.
4. Extend new secondary service conduit and wires from the existing service riser pole and service transformer to the building as shown on the drawings. Installation of conduits and supports per local utility requirements. Provide number and size of conduits per local utility requirements.
5. Furnish and install the meter socket and metering cabinet per power company requirements.
6. Coordinate all shutdowns and activations of the services with the power company as part of this work.
7. Make all arrangements with the power company for obtaining service and pay all charges and provide all labor and material for the service. An allowance has been established for this work. Refer to General Conditions for these specifications for specific bid allowance to be carried as part of the work of this contract.
8. Provide all demolition and removals of existing secondary electrical service conduit and cables at the existing service riser pole and at the existing pumping station and as shown in the Contract Drawings.
9. Provide all service disconnections and re-energizations required by the Power Company during the work of this contract and include these costs as part of the work of this contract as part of the allowance establish for this electrical service work.

B. Codes, Inspection and Fees

1. All material and installation shall be in accordance with the latest edition of the National Electrical Code and the codes and ordinances of the Town or City of which the work is being performed.
2. Pay all fees required for permits and inspections. All power utilization fees incurred prior to owner's acceptance to be paid by General Contractor.

C. Tests and Settings

1. Test all systems provided under DIVISION 16, ELECTRICAL and repair or replace all defective work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and equipment used shall be Underwriters Laboratories, Inc. listed.

B. Refer to Drawing E-01 for specific references to NEMA ratings for equipment specified unless otherwise noted.

2.2 RACEWAYS AND FITTINGS

A. Rigid steel conduit shall be hot dipped galvanized as manufactured by Republic Steel Corp., Allied Tube and Conduit Corp., Wheeling Pittsburg Steel Corp., or equal.

B. Conduit hubs shall be as manufactured by Myers Electric Products, Inc., Raco Div., Appleton Electric Co., or equal.

C. PVC coated rigid steel conduit as manufactured by Rob-Roy "Plasti-Bond", Ocal, or equal.

D. PVC Schedule 40 and PVC Schedule 80 shall be extra heavy wall and UL Listed for the use intended. Acceptable Manufacturers: Carlon, Rob-Roy, or equal.

E. Aluminum conduit shall be rigid, heavy wall aluminum. Acceptable Manufacturers: Anaconda, Kaiser, VAW, or equal.

F. Liquidtight Flexible Metal Conduit

1. Liquidtight Flexible Metal Conduit shall be constructed of one continuous length of U. L. Approved electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges.
2. Flexible metal conduit shall be "liquid-tight" with PVC jacket. Acceptable Manufacturers: Alflex - a division of Southwire, Electri-Flex, Thomas & Betts - a division of ABB, or equivalent.
3. Flexible metal conduit installed in hazardous, NEMA 7, Class I Div 1 areas shall be UL Listed, and shall have a stainless-steel braid covering over a flexible stainless steel inner core. Packing shall be woven cotton braid impregnated with asphalt. Acceptable Manufacturer: Crouse-Hinds - a division of Eaton, Killark, Thomas & Betts - a division of ABB -XP Series, or equal.

2.3 WIRES AND CABLE

A. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper. All conductors installed below grade shall be XHHW stranded.

B. Outdoor power wiring shall be 600V, Type XHHW. Type XHHW shall be cross linked polyethylene, as manufactured by Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company, or equal.

C. Indoor power wiring shall be 600V, Type THWN. Type THWN shall be cross linked polyethylene, as manufactured by the Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company or equal.

D. Control wiring shall be 600V, Type THHW/THHN No. 14 AWG stranded. Type THHW/THWN shall be cross linked polyethylene, as manufactured by the Pirelli Cable Corp., Collyer Insulated Wire Company, The Okonite Company or equal.

E. Signal wiring shall be 600V, individually shielded twisted 2C or 3C, No. 16 AWG stranded with polyethylene jacket. Cable shall be rated for indoor use, outdoor use, below grade and ductbanks. Provide Houston Wire & Cable HW106 or equal.

F. Ground wires shall be THW and color-coded green.

G. Variable frequency drive (VFD) motor supply cables shall be provided where indicated on Drawings. VFD cables shall be four (4) conductor tinned stranded copper, with cross-linked polyethylene insulation, overall foil (100% coverage) / tinned copper braid (85% coverage) shields, No. 12 AWG tinned copper drain wire, and outer PVC jacket. Cables shall conform to UL specification for 1000 Volt flexible motor supply cable. Acceptable Manufacturers: Belden, Olflex, or equal.

H. Ethernet wiring
   1. Indoor locations shall be Category 6, 4-pair 24 AWG solid bare copper conductor, unshielded, FEP insulated, plenum rated.
   2. Outdoor ethernet wiring shall be category 6, 4-pair 24 AWG solid bare copper conductor, shielded, UL listed for wet locations, Belden Outside Plant Dry Core.
   3. Acceptable Manufacturers shall be Belden, Omni, or equal.

I. All wires and cables specified and installed underground shall be U.L. Listed and Labeled for underground use for all installations.

J. Power conductors shall be continuously polarized and color coded throughout using the following scheme:
   1. White - All neutral conductors, 208/120V systems and 240/120V.
   2. Gray - All neutral conductors, 480/277 volt systems.
   3. Green - All ground conductors
   4. Phase Conductors

208/120V Systems	**240/120V Systems**	**480/277V Systems**
Phase A - Black	Phase A - Black/(Red)	Phase A - Brown
Phase B - Red	Phase B - Red/(Blue)	Phase B - Orange
Phase C - Blue		Phase C - Yellow

   5. Regardless of conductor size, conductor insulation color shall correspond to the color coding required in this section.

K. Control Conductors shall be continuously polarized and color coded throughout using the following scheme:
   1. 120 Volts – Red
   2. DC Controls – Dark Blue
   3. Intrinsically Safe – Light Blue
   4. Outside Power Source - Yellow

2.4 METERING SOCKET AND METERING CABINET

A. Meter socket shall be of the type as recommended by the power company.
B. Metering cabinet shall be of the type as recommended by the power company.
C. Acceptable manufacturers are Milbank, Square D, or equal.

2.5 AUTOMATIC TRANSFER SWITCH

A. GENERAL
   1. The automatic transfer switch shall be designed for an emergency and normal source with ratings as indicated on the drawings. The automatic transfer switch shall be manufactured by Cummins, Caterpillar, or equal and shall be provided by the generator Manufacturer under Specification Section 16620.
   2. The transfer switch Manufacturer shall have been regularly engaged in the production of UL (Underwriters Laboratory) Standard 1008 Listed transfer switches. The transfer switches shall be documented and have been offered for sale on the open market for a minimum of five (5) years. The Manufacturer shall provide factory trained parts and service support through a factory authorized distributor that is regularly doing business in area of the installation.

3. The Manufacturer shall furnish literature containing diagrams, parts lists, and descriptions sufficient for the owner's personnel, or subcontract supplier to install, operate and perform normal maintenance on the equipment.
4. Testing: To provide proven reliability of the system, transfer switches shall be completely tested as follows:
   a. Representative production samples of the transfer switches supplied, shall be demonstrable, through tests, the ability to withstand at least 10,000 mechanical operating cycles. An operating cycle shall consist of one (1) electrically operated transfer from normal to emergency and back to normal.
   b. During the development of the original transfer switching mechanism for this family of transfer switches, a prototype of the transfer switching mechanism shall have passed the environmental tests listed in Military Standard, Mil-Std-202E. These tests shall include Method 101D-Condition B, Salt Spray-Corrosion; Method 103B-Condition B, Humidity; Method 107D-Condition A, Thermal Shock; Method 110A Sand and Dust.
   c. Transfer switches shall be UL Listed per Standard 1008. The minimum WCR (Withstand and Closing Current Ratings) shall meet the requirements of UL Standard 1008 and shall be obtained without contact welding. Where the line side overcurrent protection is provided by circuit breakers at 480 volts AC or less, the short circuit WCR shall be as follows:

TRANSFER SWITCH CONTINUOUS CURRENT RATINGS	K & J/L FUSES	WITHSTAND AND CLOSING RATINGS
40A, 70A, 100A	125A/200A*	14,000A RMS
150A, 260A	400A/600A*	30,000A RMS
400A, 600A	1200A/1200A*	65,000A RMS
800A, 1000A	2000A/2000A*	65,000A RMS

* Class J and L Fuses WCR = 200,000A RMS

      i. The RMS (root Mean Square) symmetrical fault current ratings shall be verified by UL witnessed tests on representative test samples. All WCR tests shall be performed with the overcurrent protective devices located external to the transfer switch. Tests conducted with overcurrent protective devices internal to the transfer switch, in such a manner that the transfer switch interrupts the current rather than withstanding the current, are not acceptable under this definition of withstand.
      ii. Where the line side overcurrent protection is provided by current-limiting fuses, the fuses shall be UL Class RK1, RK5, J, or L (with the fuse sizes being no larger than the UL. listed maximum ratings or component recognition procedures for the transfer switches supplied). The transfer switch closing rating shall be suitable for 200,000A available fault current, as verified by UL witnessed tests on representative test samples.
   d. Provide testing as specified herein.

5. Ratings: All transfer switches shall be UL Listed per Standard 1008. All transfer switches shall be suitable for use on emergency and legally required standby systems in accordance with ANSI-C1 and NFPA-99, rated for total system load. These loads shall include motors, electric discharge lamps, resistive loads, and tungsten lamps as described in Section 1 of UL 1008 Standard.
6. Transfer switches shall be 60 HZ. Refer to drawings for the number and locations of transfer switches, number of phases, number of poles, voltage, and ampere ratings.
7. Transfer switches shall be rated to carry 100 percent of their rated current continuously when in an enclosure. Refer to enclosure requirements as shown on the Drawings for each specific project location. Transfer switches which must be derated when installed in an enclosure (due to integral overcurrent devices or any other reasons) do not meet this specification. Transfer switches shall be rated for continuous operation in ambient temperatures of -40° C (-40°F) to 67°C (142°F).
8. Construction: Transfer switches shall be over center operation, double-throw construction, center neutral position type positively electrically and mechanically interlocked by a simple mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal and emergency positions.
    a. Enclosure shall be wall mounted and rated NEMA 12, painted steel.
    b. Transfer switches shall be quick-break, quick-make operation so that the speed of opening and closing is not controlled by an operator during manual operation. Transfer switches shall be a center neutral position type switch and shall provide a center "Programmed Transition" position for manual switching.
    c. Transfer switches shall be approved for manual operation under full load by integral mounted, permanently attached, high dielectric, manual operating handles. Manual operating handles, which are normally stored and must be installed for manual operation, do not meet this specification.
    d. The electrical operating means shall be a direct-acting, center neutral position, constant force in both directions, bi-directional linear induction motor to provide minimum friction, straight-line switch action. Motor shall be attached directly to the switching mechanism without the use of gears, cams, or other complex mechanical linkage methods.
    e. Transfer switches shall not contain any integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
    f. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching.
    g. Manual operating handles and controls (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches located on the outside of the cabinet do not meet this specification.
    h. Unless noted or specified otherwise, each transfer switch shall be mounted in separate cabinet enclosures with key-locking front doors and no

mechanical clips or fasteners located around the outside of the enclosure door as specified herein.

i. Maximum transfer time in either direction shall be six (6) cycles, except where the "Programmed Transition" feature is provided.

j. All transfer switches shall have transparent protective covers to protect operating personnel during manual operation, and to allow an operator to visually determine that the main contacts are "Open" or "Closed".

k. The main switch contacts shall be of the no maintenance type and high-pressure silver cadmium oxide to resist burning and pitting for long life operation. All switches shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs quickly and effectively; arc chutes shall have insulating covers to prevent interphase flashover.

l. Transfer switches shall have one (1) S.P.D.T. (Single Pole Double Throw), auxiliary dry switch contacts on both the normal and emergency-sides, operated by the transfer switch. These auxiliary switch contacts shall be factory wired to an easy access terminal block and may be used to monitor transfer switch position for controlling indicator lamps or other peripheral equipment. Contacts shall be rated 1200 VA.

m. Complete AL-CU (Aluminum-Copper) lugs, UL listed and CSA certified, shall be provided for both normal and emergency load positions. Provide all required lugs/phase for each switch based on cable sizes shown on the Contract Drawings. For 150A and larger transfer switches, top or bottom feed for load connections shall be provided for slimmer design, requiring less wall space. Load connections shall be field changeable either from top-to-bottom or bottom-to-top. Wiring space at normal, emergency, and load lugs inside the transfer switch cabinet shall comply with the latest edition of NEC. Full rated neutral bar with lugs for normal, emergency, and load neutral conductors shall be provided inside the cabinet.

n. Relay, with 2 N.O. and 2 N.C. contacts, which is energized whenever the normal source is available regardless of switch position.

o. Relay with 2 N.O. and 2 N.C. contacts, which is energized whenever the emergency source is available regardless of switch position.

9. Controls: Control accessories, either electronic or relay, shall be mounted in a separate smaller cabinet mounted on the inside of the main cabinet door. This is to allow for ease of service when the main cabinet lockable door is opened, but to prevent access by unauthorized personnel. Controls shall be microprocessor based type with operator interface panel for monitoring, viewing, and setting of system parameters.

   a. Control circuit disconnect plugs shall be provided to reenergize control circuits to avoid the hazards of electrical shock to personnel while adjusting.

   b. The Power Sentry electronic control, undervoltage and time delay modules, shall be a printed circuit board for ease of service. The solid-state undervoltage sensors shall simultaneously monitor all phases of the normal and emergency power sources to provide field adjustable range sensors for specific applications.

i. Voltage pickup settings shall be adjustable from a minimum of 85% to a maximum of 100% of nominal voltage. Voltage dropout settings shall be adjustable from a minimum of 74% to a maximum of 98% of the pickup setting with a fixed dropout time delay of 0.5 second.
ii. Voltage sensors shall be of the temperature compensated type, for maximum deviation over the temperature range of -32°C (-25°F) to 79°C (175°F). Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase of the normal or emergency power source, even where motor feedback voltages exist.
iii. Provide phase failure (loss of any phase) phase unbalance and phase rotation type sensing for protection of all phases of the system.

c. The Overvoltage and Frequency Sensing control, overvoltage and frequency sensing module, shall be a printed circuit board for ease of service. The solid-state overvoltage sensor(s) shall simultaneously monitor all phases of the source(s) to provide field adjustable ranges of voltage pickup and dropout and time delays. Frequency sensor(s) shall simultaneously monitor all phases of the source(s) to provide field adjustable ranges of frequency pickup and dropout and time delays.
i. Under/over frequency and over voltage sensing for the emergency source.

d. Controls shall signal the emergency power system to start upon signal from normal source voltage sensors. Solid-state adjustable time delay (0-90 sec) start shall avoid nuisance engine¬-generator set start-ups on momentary voltage dips or interruptions. Initial setting shall be 5 seconds.

e. The transfer switch shall transfer the load to the emergency power system after the engine-generator set reaches proper voltage and frequency and has stabilized.

f. The transfer switch shall control the engine-generator set to allow the set to start and transfer the load within 10 seconds (adjustable from 2 to 120 sec) after a normal source power failure. It shall be the responsibility of the transfer switch supplier to meet this requirement.

g. The transfer switch shall retransfer the load to the normal source after normal source power is restored, allowing normal source to stabilize before retransfer and shall allow staggered retransfer of loads in multiple transfer switch systems. Retransfer time delay shall be adjustable from 0-30 min. Initial setting shall be 3 minutes.

h. The controls shall signal the engine-generator set(s) to stop after load retransfer to the normal source but shall maintain the availability of the emergency source if the normal source fails shortly after retransfer. The controls shall allow the engine-generator set(s) to run unloaded for a cooldown period prior to shut down (adjustable from 0 to 10 min). Initial setting shall be 5 minutes.

i. The controls shall provide an automatic retransfer of the load from the emergency source to the normal source if the emergency source fails when the normal source is available.

j. The transfer switch operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred.

k. Controls shall provide built-in "Control Mode Status" indicators, mounted on the interior of the enclosure, consisting of L.E.D.s (Light Emitting Diodes) to indicate a sequence of functions such as the following:
   i. Source 1 OK
   ii. 2-Wire Run
   iii. Source 2 Ok
   iv. Timing for Transfer
   v. Transfer Command
   vi. Timing for Retransfer
   vii. Retransfer Command
   viii. Timing for Stop

l. The indicators shall allow the operator to determine that the controls are properly sequencing and shall assist in determining the sequence of any malfunctions that might occur.

m. Main cabinet front door mounted controls and indicator lamps shall consist of oil-tight, neon position indicator lamps (NORMAL - White and EMERGENCY - Amber) and key-operated Test and Selector switches to provide the following functions:
   i. TEST - Simulated normal source power loss to control unit for testing engine-generator set capability. Provide selector switch inside cabinet to allow for choice of load transfer or test without transfer.
   ii. NORMAL - Normal operating position and also restores the system to stand by operation; and if load was transferred, retransfers load from emergency to normal source after test and time delays.
   iii. RETRANSFER - Spring-loaded momentary position of switch, that overrides retransfer time delay to cause the immediate return to the normal source after a test or actual power outage.

n. Transfer switch shall be provided as a delayed transition, center neutral position switch. This feature shall be provided to allow for delay residual voltage of connected load. The time delay shall occur during switching in both directions, during which time the load is isolated from both normal and emergency sources. This will allow residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle.

o. The center neutral, delayed transition shall be connected in a manner that will not cause the time delay in switching, where the time delay has already been established by the loss of voltage to the load during normal source power interruptions.

10. Switches shall be equipped with the following items:
   a. Provide microprocessor based controller and Exerciser clock to set day-of-week (one week dial minimum), time-of-day, and duration-of-time of engine-generator set(s) exercise. A period with/without load selector switch.
   b. Provide Manual-Automatic retransfer selector switch. After normal source is restored, this switch provides either manual or automatic retransfer after the retransfer time delay has expired in the automatic position, or manual retransfer at a time selected by an operator.

c. Frequency reading of 45-65 HZ.
d. Generator running time meter reading in hours.
e. Multi-position AC readings and phase selection to read line current and line-to-line and line-to-neutral voltages in each phase with off position.
f. Meter(s) shall read whichever source is connected to the load.

2.6 MAIN CIRCUIT BREAKER

A. Circuit breaker shall be molded case, 600 Volts, sized as indicated on the Drawings with not less than 35KAIC Amperes, RMS interrupting capacity. Circuit breaker shall be installed within an enclosure with neutral and ground lug kit factory installed and provided in the enclosure. The operating handle shall be side mounted and pad lockable in the "On" and "Off" position. The breaker should still provide overload and short circuit protection when locked in the "ON" position. Breaker shall be service entrance rated.
B. Circuit breaker shall be UL listed and labeled as being suitable for use as service entrance equipment.
C. Acceptable Manufacturers are Square D, Cutler Hammer, ABB(GE) or equal.

2.7 GROUND ROD

A. 10 foot long by 3/4 inch diameter copper clad steel ground rods shall be provided, arranged and installed as shown on the drawings. Provide all required Cadwelds, grounding clamps and hardware as required for a complete installation per NEC and as shown on the drawings.
B. Acceptable Manufacturers are Erico, AB Chance Co., or equal.

2.8 EXOTHERMIC CONNECTION

A. The contractor shall be responsible to furnish and install exothermic connections as required and shown on the contract drawings.
B. The mold shall be new and clean and shall provide all required connection molds for different required types.
C. All connections shall be industry standards in a complete, continuous, and properly installed connection. Any connections not properly installed as inspected shall be removed and re-formed at the Contractor's expense.

2.9 SURGE PROTECTIVE DEVICES

A. Lightning Surge Protective Devices
1. Lightning and surge protection units shall be Square D Model Number SDSA 3650, three phase for 600 VAC phase-to-ground voltage. Provide a separate unit at all locations shown on the drawings. Provide a spare lightning and surge protection unit to the Owner for spare parts.
2. Lightning and surge protection units shall be Square D Model Number SDSA 1175, single phase for 250 VAC phase-to-ground voltage. Provide a separate unit at all locations shown on the drawings. Provide a spare lightning and surge protection unit to the Owner for spare parts.
B. Surge Protective Device
1. Devices shall be Listed and Component Recognized in accordance with UL 1449 to include Section 37.3 highest short circuit current rating (SCCR) of 200kA. Devices shall be UL 1283 listed.

2. Visible indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the equipment as well as on the module. A push-to-test button shall be provided to test each phase indicator.
3. The display panel shall clearly indicate in English or appropriate pictograms/icons each component on the display. Markings on the display shall contrast with the background color so as to be easily read.
4. The display shall have LED's to indicate the surge suppression status of each phase: Green = Full protection to that phase, Red = No protection to that phase.
5. The unit shall be equipped with an audible alarm which shall activate when any one of the surge current modules has failed. An alarm on/off button shall be provided to silence the alarm. A button shall be mounted on the display to test the audible alarm. The buttons and alarm shall be located on the front cover of the MCC. The alarm shall emit a minimum sound level of 50dB at one (1) meter from the front of the unit.
6. A surge counter shall provide a means to record the total number of transient line to ground, line to neutral, and line to line voltage surges since the counter was last reset.
7. Device shall be integral mounted within the equipment as shown on the drawings.
8. Acceptable manufactures are Eaton, Square D, or equal.

2.10 WIRING DEVICES

A. Receptacles shall be duplex, 20 Ampere, industrial grade and shall be ground fault type. Outdoor rated receptacles shall be provided with weatherproof, while in use type covers.
B. Light switches shall be rated 20 Ampere, single pole type, and industrial grade type.
C. Duplex receptacles shall be duplex, 20 ampere, industrial grade type.
D. Covers shall be stainless steel gasketed for exposed or concealed inside locations and weatherproof while in use covers for outdoor locations.
E. Provide 20A, 125V ENR Series dead front interlocked circuit breaking receptacles as shown on drawings. Refer to contract drawings for additional information. Crouse-Hinds Cat# ENR21201.
F. Acceptable Manufacturers are Cooper, Hubbell, or equal.

2.11 POWER DISTRIBUTION PANEL PDP

A. Provide power distribution panelboard with bolt-on breakers and copper busses. Panelboard shall be rated as shown on the drawings, but not less than 22,000 Amperes RMS Symmetrical. Panelboard shall be provided as shown and noted on the contract drawings. Acceptable manufacturers are Square D, Cutler Hammer, or General Electric, or equal.
B. Provide surge protective device as shown on drawings.
C. Power meter shall be a Allen Bradley Power meter 500. Provide all necessary hardware for current transformer and display. Acceptable manufacturers are Allen Bradley, Eaton, or equal.

2.12 LIGHT FIXTURES

A. Refer to lighting fixture schedule on the Drawings for specific requirements.
B. Acceptable manufacturers are Cooper Lighting, Holophane, or equal.

2.13 EXPANSION FITTINGS

A. Expansion fittings shall be watertight expansion type, designed to compensate for conduit movement. Expansion fittings shall be provided to allow movement of 4 inches in both directions for a total of 8 inches. Fittings shall have flexible copper braid bonding jumpers, neoprene sleeve and stainless-steel bands. Acceptable Manufacturer: O.Z./Gedney Type EX, Thomas & Betts, or equal.

2.14 DEVICE BOXES

A. Device boxes shall be cast malleable iron or aluminum type and gasketed type FS/FD series with hubs.

2.15 PULL BOXES AND JUNCTION BOXES

A. Box ratings shall be based on area of installation per the contract drawings. Boxes installed outdoors and NEMA 4X areas shall be 316 stainless steel NEMA 4X rated.
.
B. Boxes other than explosion proof shall be seamless weld type, with flush type screw-on covers and no hinges or side clamps all around. Use Myers hubs for conduit termination and entry into boxes. Acceptable manufacturers are Rittal, Hoffman, or equal.
C. Boxes with pre-punched hole provisions shall not be used.
D. Explosion-proof boxes shall be NEMA 4/7, Class I, Division 1, Group C & D or NEMA 4/7, Class I, Division 2, Group C and D for hazardous rated areas. Provide conduit sealing fittings inside and outside of explosion proof areas for all conduits per NEC. Acceptable manufacturers are Appleton, Crouse Hinds, or equal.
E. Boxes for concealed work shall be used only for concealed installations.

2.16 MOUNTING SUPPORTS AND HARDWARE

A. Provide 316 stainless steel uni-strut and 4" channel angle supports and stainless-steel mounting plates as shown and required for equipment mounting. All legs for stanchion mounting structures shall be channel angle support, no exceptions.

B. All bolts, washers and mounting hardware shall also be 316 stainless steel for the entire installation.
C. All metal channel ends shall be provided with pvc end caps.
D. Acceptable manufacturers are B-Line Systems, Inc., Thomas & Betts-Super Strut, Unistrut, or equal.

2.17 LINK SEAL

A. Furnish and install link seal fittings at all areas of buildings and structures both above and below grade for conduit entry. Refer to the contract drawings for additional requirements.
B. Acceptable manufacturers are Innerlynx, Crouse Hinds, or equal.

2.18 DISCONNECT SWITCHES

A. Furnish and install heavy duty type lockable disconnect switches as shown on the drawings. Switch NEMA ratings shall be as required and noted on the drawings. Ampacity shall be noted on the drawings and as required by NEC. Switches mounted outdoors or in NEMA 4X areas shall be 316 Stainless Steel NEMA 4X rated.
B. Acceptable manufacturers are Square D, Cutler Hammer, ABB(GE) or equal.
C. Disconnect switches shall have side mounted handle operators that are lockable in both the on and off position.
D. Acceptable manufacturers are Square D, Cutler Hammer, ABB(GE) or equal.

2.19 MOTOR CONNECTIONS

A. Provide all required flexible conduit liquid tight or explosion proof to meet the NEMA rating as noted on the drawings. Limit lengths to 24" or less. Moved to cable section.

2.20 RELAYS

A. Industrial Control Relays - Relays provided with 10 Ampere contact rating shall be Square D, Class 8501 type X, Cutler Hammer, ABB(GE) or equal. Relays with 30 Ampere contact rating shall be Square D, Class 8501, type C or equal.
B. Pilot Duty Relays - General purpose relays shall be IDEC RH Series, 10A contact rating, 4 Form "C" contacts or equal, provided with internal indicating light. Pilot duty control isolating relays for PLC inputs and outputs shall be suitable for the application and shall be submitted with no exceptions by Engineer.
C. Relays shall be electrically operated with 120 Volt coils except as noted otherwise on the Drawings. Contacts shall be rated 600 Volt, 10 Ampere.
D. Interposing relays used for telemetry inputs or other low current inputs shall be Potter and Brumfield type KHAU-17A16 - 120 Volt, Schneider or equal.
E. Timing Relays - Delay timing relays shall be general purpose, solid state type rated for use at 120 Volts. Contacts shall be rated 5 Amperes (minimum). Minimum time range shall be adjustable from 1 second to 1 minute. Time delay relays shall be IDEC RTE or equal.
F. Current Monitoring - Provide Hawkeye 721LC solid-core current transducer, 4-20mA output. The current sensor shall be coordinated with electrical equipment where sensor is to be installed. The sensor installation shall not void the UL listing of the electrical equipment. Acceptable manufactures are Hawkeye, Schneider Electric, or equal.

2.21 TERMINAL STRIPS

A. Terminal strips shall be supplied to make all power and control connections. All terminals shall be numbered and clearly marked for easy identification. Acceptable Manufacturers are Allen Bradley, Phoenix Contact, or Equal.

2.22 WIRE IDENTIFICATION

A. All individual conductors shall be identified using unique numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams for all terminations. This includes all process- and non-process-related wiring done as part of the work, such as fire alarm panels. Conductors shall

be clearly identified at each terminal block, equipment connection and junction. Markings shall utilize the equipment designation and terminal block number in the device higher upstream in the system hierarchy.

2.23 CONTROL POWER TRANSFORMERS

A. Provide all control power transformers necessary to make panel functional. All transformers shall have both primary legs and all "hot" secondary legs fused. One secondary leg shall be grounded.
B. Acceptable Manufacturers are Square D, Siemens, or equal.

2.24 CONTROL CIRCUIT FUSES

A. Fuses shall be rated for at least 125 Volts at the current ratings shown on the Drawings.
B. Fuses shall be Littlefuse, Bussmann, or equal.

2.25 MOTOR STARTERS

A. Fractional Horsepower Single-Phase Manual Motor Starter shall be provided with thermal overload(s) and red running indicating light. Starters shall be rated for 120 Volt operation.
B. Provide a fractional horsepower manual motor starter with thermal overloads, reset, and lockout provisions.

2.26 CONDUIT SEALS

A. Provide Class I, Div. 1, Groups C & D conduit seals as required by the N.E.C. and as shown on the Drawings or required by the NEC.
B. Provide Class I, Div. 2, Groups C & D conduit seals as required by the N.E.C. and as shown on the Drawings or required by the NEC.
C. Acceptable Manufacturers: Appleton, Killark, O-Z/Gedney, or equal.

2.27 MINI POWER CENTER

A. Mini Power Center
    1. General
        a. Nema 12 enclosure
        b. Aluminum-wound transformer and panelboard
    2. Ratings
        a. 480:120/240 Single phase 15 KVA transformer
        b. 24 circuit panelboard with bolt on circuit breakers with secondary main circuit breaker sized as shown on the drawings.
B. Transformers shall be of the energy efficient type.
C. Acceptable manufacturers: Eaton, Square D, Siemens, or equal.

2.28 LIGHTING PANELBOARD

A. Provide panelboard with main circuit breakers center mounted separate from the feeder breakers sized as shown on the drawings. Panelboard shall have bolt on breakers and copper busses rated as shown on the drawings but shall not be less than 10,000 ampere RMS symmetrical. Provide circuit breakers as noted on the drawings.
B. Acceptable manufacturers are Square D, Cutler Hammer, General Electric, equal.

2.29 VARIABLE FREQUENCY DRIVE

Furnish and install a variable frequency drive (VFD) for the pumps. VFD control panel shall be installed in a NEMA 12/3R or IP55 factory enclosure rated constant torque sized as follows: 2-125 HP and 1-75 HP drive. Maximum dimensions ae 37" H x 12" W x 13"D . Acceptable manufacturers are Toshiba model AS3, Eaton, or equal.

1. The application shall provide for a 480 volt three phase input under normal electrical service to the VFD control panel and a 480 volt three phase input during emergency standby electrical service to the VFD control panel. The sewage pumps are rated as the following:
   a. Duty Pump is rated 125 HP at 460 volt 3 phase with the following parameters:
      i. Full Load Current = 139 Ampere
      ii. Maximum Full Load Current at Service Factor = 160 Ampere
      iii. Locked Rotor Current = 905 Ampere
   b. Jockey Pump is rated 75 HP at 460 volt 3 phase with the following parameters:
      i. Full Load Current = 87 Ampere
      ii. Maximum Full Load Current at Service Factor = 100 Ampere
      iii. Locked Rotor Current = 558 Ampere
2. The final sizing of the VFD equipment shall be based on the following criteria:
   a. 100% Continuous Output Current
   b. 150% Overload Current for 1 Minutes
3. Refer to contract drawings for specific requirements and number of VFD units required.

B. Provide a complete and operational VFD control panel for the pump motor.

C. Provide a total of one (1) day of startup for the VFD equipment after confirmation of pre-startup has been completed. Reference Section 01800 for coordination of startup requirements.

D. Provide 1 day of separate training.

E. Refer to drawings for wiring requirements.

F. System Analysis
1. The VFD supplier shall perform a computer simulated power system study to verify compliance with the parameters as stated herein. The results of this study shall be submitted to the engineer. At a minimum the submitted results of this study shall include:
   a. A brief summary of the equations and calculation procedures used in the study.
   b. A results summary sheet which briefly describes the power system configuration analyzed and which states the calculated values of total harmonic distortion, notch depth and notch area.
   c. Computer generated graphs which illustrate the voltage and current waveforms of the power system with the VFD's operating. These waveform graphs shall directly illustrate the results of the power system computer model study.
   d. Detailed list of the amplitude of harmonic currents and voltages to the 50th harmonic.

2. The Contractor shall furnish the VFD supplier with all power system data required to perform the above-described study. These data may include but are not limited to:
   a. A complete one-line diagram of the subject electrical distribution system. The diagram must show the lengths of all bus and cable runs, impedance values of all types of bus and cable used, and number of conductors per phase.
   b. Complete electrical data on all equipment shown on the one line diagram is required. At a minimum this data shall consist of: Transformers - kVA, Primary voltage, Secondary voltage, Short circuit capacity or impedance. Motors - Stator resistance, No load RMS current, No load kVA, No load kW, Locked rotor RMS current, Locked rotor kVA, Locked rotor kW, Horsepower, Base speed, Number of poles, Efficiency at relevant speeds, Power factor at relevant speeds, Full load RMS current. Generators - Short circuit capacity or Subtransient reactance (Xd), Power factor, kW, X/R Ratio.
   c. If the distribution system can function in more than one configuration, the configuration(s) to be analyzed shall be clearly defined. Any other information which may affect the behavior of the distribution system shall also be provided.

2.30 ACTIVE HARMONIC FILTER

A. An active harmonic filter is to be provided to meet the requirements of IEEE 519-1992. The active filter shall be designed to electronically supply high frequency current of equal magnitude, opposite direction as being drawn off the power distribution system by the non-linear loads. The excess capacity of the active filter shall be used to provide reactive power to the circuit or bus to improve system power factor.

B. The supplier is responsible for determining the final size of the filter based off of the following operations: base load: 15 KVA, Heating load 22.5 KW, 2- 125 HP (operating at 100 HP).

C. Filter shall be provide with a wall mounted enclosure rated NEMA 1, painted steel. Wall mount units weighing more than 80 pounds shall have lifting lugs.

D. Active filter shall be provided with a main circuit breaker.

E. All active filters shall be defined as a power electronic device consisting of power semiconductors that switch into the AC line modulated current that will cancel detrimental harmonic currents. A DC bus shall store power for power semiconductor switching. A microprocessor shall control the operation of the power converter.

F. Each unit shall be designed with a current limiting function to protect the semiconductors. Operation shall continue indefinitely at this level without trip off or destruction of the active line filter.

G. Two distinct levels of faults shall be employed. Non-critical level faults will provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action.
   1. Faults such as AC line over voltage, AC line under-voltage, AC line power loss, and AC line phase imbalance shall be automatically restarted. Upon removal of these fault conditions, the active line filter shall restart without user action.

2. All other types of faults shall be considered critical and stop the active line filter. The run relay shall be disabled and the fault relay enabled. User shall be required to initiate a power reset (turn power off and on) to restart the active line filter.

H. The logic of the active line filter shall monitor the load current by utilizing two (2) current transformers (CTs) mounted on phases A and C to direct the function of the power electronic converter. The output of the current transformers shall be 5 Amperes.

I. Multiple active line filters may be installed in parallel to inject current. The units will function independently. If one unit is stopped or faulted, the remaining units will adjust accordingly to maintain optimum harmonic cancellation levels up to the capacity of the remaining units. The unit supplied shall not require field programming.

J. A 65kA rated molded case circuit breaker shall be used for short circuit protection. Fuses shall not be used.

K. The unit shall be supplied with a touch screen display for easy user control and monitoring.

L. Contacts shall be provided for operator information for run and fault. Each contact shall be rated for 1 Ampere at 120/240 volts. One form C contact shall be provided for each relay.

M. Modbus communications capability shall be supplied as a minimum. Additional communication protocols shall be available including Ethernet/IP if required.

2.31 CABLE SEALS

A. Conduit sealing bushings to seal the ends of conduits entering enclosures from below grade shall be OZ Gedney Co., Type CSB Series or equal.

2.32 DUCT SEALANT

A. Sealant to protect enclosures from flood water intrusion shall be FST-250 duct sealant or equal.

2.33 LOCAL CONTROL STATIONS

A. Provide a 316 stainless-steel enclosure with NEMA rating as shown on drawings. The number of devices the enclosure shall be able to hold shall be as shown on drawings. Enclosure shall have sufficient depth to accommodate mounting four Class 9001 KA-1 contact blocks side by side.

B. Provide heavy duty oil tight/watertight operators as indicated on drawings and as described below:

1. Selector switches shall be removable from the front of the control station without disturbing the wiring or mounting of the control unit. Selector switch shall be bat wing type, 30mm in size.
2. Emergency stop pushbuttons shall be large operator head type, red mushroom-head, maintained type switch. The operation shall be push to open and pull to re-engage. Provide multiple output contacts as shown on the drawings without disturbing the wiring or mounting of the control unit.
3. Indicator lights shall be 30 mm, Push-to-Test, heavy duty, oiltight with LED lamps and designed to operate at 120 Volts, 60 Hz AC. Indicator lights shall

be provided with mounting rings, engraved as indicated on the Drawings. Lens color shall be as indicated.

4. Speed potentiometers shall be 30 mm, compatible with the VFD supplied for the project.
5. Contact blocks used in heavy duty oil-tight control stations shall be Square D Type K single-pole, single-throw (SPST) or single-pole, double-throw (SPDT) and shall be suitable for mounting side by side and/or in tandem to the base of the operator. Contact block mounting screws shall be captive with a drilled and tapped head to permit easy tandem mounting of contact blocks. Terminals shall be pressure wire type with a self-lifting pressure clamp that will compensate for wire of different size ranging from #12-#18 solid or stranded. Contacts shall be double break. Contact tips shall be silver.

C. All equipment and devices shall be rated for space where being installed.
D. Acceptable manufacturers are Allen Bradley, Square D, or Cutler Hammer, equal.

2.34 COMPLETE ELECTRICAL DISTRIBUTION EQUIPMENT SUPPLIER

A. All electrical distribution equipment submitted for this project shall be by a single equipment Manufacturer. Multiple suppliers of this equipment shall not be acceptable. The following manufacturers shall be acceptable:
   1. Square D Company
   2. Cutler-Hammer
   3. Siemens
   4. GE(ABB)

2.35 TEMPORARY POWER REQUIREMENT USING PORTABLE GENERATOR

A. The Contractor shall maintain the pump stations operational at all times for the duration of the project. This shall be served via a portable generator during times of the replacement of the electrical service upgrade as shown and specified.
B. The use of a portable generator for temporary power must meet the dBA requirements of the respective city or town where the work is to be performed when in use during all periods of operation.
C. All permits required for this application shall be the complete responsibility of the Contractor.

PART 3 - INSTALLATION

3.1 RACEWAYS AND FITTINGS

A. Unless otherwise indicated on the Drawings, install all wiring in the following applicable raceway as shown on the Conduit Installation Schedule on E-1:
   1. Wiring 600 volts or less in indoor dry locations (NEMA 12): Heavy wall aluminum conduit. Cable tray (indoor only) and Galvanized heavy duty rigid steel conduit with no exceptions by the Engineer.
   2. Wiring 600 volts or less in dry concealed locations (NEMA 12): Galvanized electrical metallic tubing (for raceway sizes up to and including 2" trade size) or galvanized rigid heavy wall steel conduit. EMT only to be used in above ceiling spaces or within block walls or stud walls.

3. Wiring 600 volts or less in outdoor, above grade locations (NEMA 4X): Ridged heavy wall aluminum conduit with no exceptions by the Engineer.
4. Wiring 600 volts or less in indoor wet locations (NEMA 4X): Rigid heavy wall aluminum conduit. Galvanized rigid heavy wall steel conduit with no exceptions by the Engineer.
5. Wiring 600 volts or less in indoor or outdoor corrosive chemical areas use PVC-coated rigid steel conduit.
6. Wiring 600 volts or less in hazardous locations (NEMA 7 or 9): PVC galvanized rigid steel conduit, or rigid heavy wall aluminum conduit based on requirements listed previously in this section.
7. Underground Raceways
    a. All underground raceways shall be Schedule 80 extra heavy wall PVC conduit except for signal conduit raceways which shall be galvanized rigid steel conduit.
    b. Refer to drawings for specific concrete encasement duct bank details and requirements. All underground duct banks shall be completely concrete encased. Schedule 40 PVC allowed for concrete encased conduit runs other than Signal conduits.
    c. All PVC conduits shall transition to galvanized ridges steel conduit within 15’ of structure or building.

B. Where conduit extends out from underground or enters a structure/building or utility pole, it shall be installed as PVC coated rigid steel conduit. This shall remain PVC coated rigid steel to its final destination.
C. Where conduits are installed concealed within or below concrete slab and extend up through the slab, PVC coated rigid steel conduit sweeps shall be installed at all locations and shall remain PVC coated rigid steel conduit for all exposed areas.
D. Armored metal clad cable (MC) shall be allowed to be used for receptacles and switches, installed within concealed studded walls. EMT shall also be allowed to be used in this application.
E. MC cable whips limited in length to3 feet, can be used for drop feeds to light fixtures up in concealed areas.
F. No wire shall be pulled until the raceway system is complete in all details.
G. The ends of all raceways shall be tightly capped to exclude dust and moisture during the construction period. Caps shall be of a UL Listed type specifically used for this purpose. Rags, papers, etc. shall not be used.
H. Raceways terminating in gasketed enclosures shall be terminated with conduit hubs.
I. Raceways installed underground shall be encased in concrete and laid on trenches on mats of bank gravel or sand not less than six inches thick and well graded.
J. Provide long radius rigid steel conduit sweeps at entrances to equipment from underground.
K. Provide conduit expansion fittings as required. Install per Manufacturers recommendation.
L. Under no circumstances shall conduits penetrate containment walls and floor.
M. Conduits that originate from slab or from below slab shall have no breaks in conduit for a minimum of 4” above finished floor.

N. All conduit which enter an enclosure from below the protected flood elevation, shall have the conduit filled with FST compound within the enclosure to protect the enclosure from the egress of water.

3.2 WIRES AND CABLES

A. All conductors shall be carefully handled to avoid kinks or damage to insulation.
B. All feeder circuit wiring is to be installed within conduit and continuous from point to point without any splicing.
C. Alarm wires shall be uniquely identified at each end with wire markers. A typed list of the numbers used and their function (alarm served) shall be submitted to the Engineer by the Contractor for approval prior to installation.
D. All 600 Volt wire insulation shall be tested with a megohm meter after installation. Tests shall be made at not less than 500 Volts. A written test report of the results shall be submitted to the Engineer by the Contractor prior to putting the equipment into service. Provide certification of calibration within the past 12 months for test equipment.
E. After installation of conductors, seal conduits with Polywater FST Sealant or equal.
F. Grouping of Conductors
    1. Contractor may group certain wiring with the approval of the Engineer, as follows.
        a. Power 120V may be grouped with power 120V
        b. Control 120V may be grouped with control 120V
        c. Control 24V may be grouped with control 24V
        d. Instrumentation may be grouped with instrumentation
        e. Specialty wiring may be grouped with like systems
        f. Power wiring at 480V shall not be grouped
        g. Fire alarm system wiring shall not be grouped with other systems
    2. The installation shall be installed in accordance with all requirements of the NEC (including wire ampacity derating factors), Manufacturer's requirements, and the Engineer. Excessive grouping which interferes with functionality and reliability will not be allowed. The wiring configuration as shown on the Drawings is the baseline requirement for the work.

3.3 GROUNDING

A. Provide grounding conductors from ground electrodes to equipment as shown on the Drawings.
B. Do not use conduit as the ground and/or bonding conductor.
C. Bond ground terminal of receptacles to outlet boxes with #l2 AWG green insulated wire.
D. Ground conduit system and neutral conductor of wiring system with a connection at the main electrical service breaker.
E. The grounding network shall be connected to metallic water piping system, at two or more locations, with stranded copper, AWG, Green Insulated Conductor of the same size as grounding electrode conductor shown on the drawings or required by the National Electrical Code (NEC).
F. Make connections to ground rods with an exothermic welding process. Mechanical connections may be made at equipment only.

G. Ensure that a ground loop is not formed between equipment ground in electrical conduit and grounding electrode conductors directly connected to ground electrodes.
H. Group and bond ground wires to panel boxes, light fixtures, receptacles, etc., not to system neutral.
I. Make connection to water pipe with a suitable ground clamp or lug connection. If flanged pipes are encountered, make connection with lug bolted to flange connections.
J. Bond and ground all conduit systems.

3.4 INSTALLATION OF GROUNDING BUSHINGS

A. Provide grounding type insulated bushings on all power conduits regardless of size.
B. Provide grounding type insulated bushings on all control conduit and signal conduit regardless of size.
C. Install Polywater Sealant FST, or equal, in conduits for all outdoor locations and NEMA 4X locations to prevent moisture from entering enclosures and equipment.
D. Install Polywater Sealant FST in all conduits where there is a change in temperature such as transitioning from a room to the attic.
E. Provide a bushing at each conduit termination unless fitting at box where conduit terminates has hubs designed in such a manner to afford equivalent protection to conductors.
F. Any installations not provided with these requirements shall be removed and reinstalled at no additional cost to the Owner.

3.5 MYERS HUBS

A. Myers Hubs shall be of grounding type and installed on junction boxes and enclosures which do not have cast hubs in non-classified areas. All Myers Hubs shall be capable of receiving a wire bonding jumper regardless of conduit size.

3.6 EQUIPMENT

A. The inside of all equipment and enclosures shall be checked for tools and vacuumed cleaned of any debris.
B. The Contractor shall be responsible to ensure that all connections to motors, distribution equipment, and control panels are tightened to manufacturer’s recommendations.

3.7 TESTS

A. The entire grounding network resistance to be meggered and certified results recorded and submitted with no exceptions to the Engineer. Resistance shall not exceed 25 Ohms.
B. Branch circuits shall be tested during installation for continuity and identification and shall pass operational tests to determine that all circuits perform the function for which they are designed.
C. Adjust all settings on protective equipment and verify, check and establish with the power company that the secondary voltage is within 2% of rated voltage.
D. Test and set all motor circuit protectors, motor overload heaters to the nameplate horsepower of the equipment; and all circuit breaker settings in all electrical equipment shall be tested and verified operational.

E. Three phase panelboard's line currents shall be balanced to within 10% of each other.

F. For all feeder wiring rated 600 volts or less, provide 1,000 volt "Megger" insulation test prior to energizing feeders. Use a motor-driven megger for all tests. Test voltage shall be applied until readings reach a constant value, and until three (3) equal readings, each one (1) minute apart, are obtained. For new cable, a minimum megger reading shall be 45 megohms for feeder conductors. For existing cables, provide Polarization Index readings to the engineer for review. Document test results and submit to engineer. Provide certification of calibration within the past 12 months for test equipment. There shall be no exceptions taken by the Engineer before conductors are to be energized. See attached table at end of this section for recording data and submission to the Engineer.

G. Perform megger testing on all feeder conductors that will be de-energized for more than 10 days at time of conductor de-energization and provide test report to Engineer.

H. Three phase motors shall be checked for rotation and, if necessary, reverse the connections at the starter. Single phase and DC motors at motor connection box.

I. VFD START UP, TESTING AND VERIFICATION

1. Responsibility and Coordination: The VFD Manufacture, Supplier and Electrical Contractor are responsible for adjusting all of the VFD parameters for a fully functional system integrated with the instrumentation and control systems for this project. The VFD Supplier and Electrical Contractor are responsible for coordinating with the Instrumentation Contractor and the instrumentation programmer so the control systems function as intended as described in the instrumentation control descriptions.
2. VFD Parameter Setup: Complete the VFD Parameter Setup Checklist and Verification below in the presence of the specifying engineer.
3. The Electrical Contractor shall be responsible to coordinate an onsite meeting with the VFD Manufacturers technician and the specifying engineer. This meeting shall take place prior to the initial startup of the equipment.

VFD PARAMETER SETUP CHECKLIST

[ENTER NAME OF FACILITY]

- ☐ 1. Ramp up speed _____
- ☐ 2. Ramp down speed _____
- ☐ 3. Min speed (Hz) _____
- ☐ 4. Max speed (Hz) _____
- ☐ 5. 4-20mA setting at min speed (mA) _____
- ☐ 6. 4-20mA setting at max speed (mA) _____
- ☐ 7. Output scale calibration _____
- ☐ 8. Auto restart after power failure (yes/no) _____
- ☐ 9. Auto restart after overcurrent fault (yes/no) _____
- ☐ 10. Speed reference (internal/external) _____
- ☐ 11. If external - signal source _____
- ☐ 12. If external - signal type _____
- ☐ 13. Restart after E-Stop (yes/no) _____
- ☐ 14. Discrete outputs - Run (yes/no) _____
- ☐ 15. Discrete outputs - Fault (yes/no) _____
- ☐ 16. Analog outputs - Amps (absolute units) _____
- ☐ 17. Analog outputs - KW (absolute units) _____
- ☐ 18. Analog outputs - Speed (Hz) _____
- ☐ 19. Analog outputs - Speed (RPM) _____
- ☐ 20. Analog inputs - 4mA set to 0Hz (yes/no) _____
- ☐ 21. Analog inputs - 20mA set to 60Hz (yes/no) _____
- ☐ 22. Analog inputs - min speed limit set (yes/no) _____
- ☐ 23. Analog inputs - max speed limit set (yes/no) _____
- ☐ 24. Voltage boost (%) _____
- ☐ 25. Starting frequency (Hz) _____
- ☐ 26. PMW carrier frequency (Hz) _____
- ☐ 27. Acceleration time (sec) _____
- ☐ 28. Deceleration time (sec) _____
- ☐ 29. Forward run (yes/no) _____
- ☐ 30. Reverse run (yes/no) _____
- ☐ 31. Overload (60%-100%) _____

VFD PARAMETER SETUP VERIFICATION

[ENTER NAME OF FACILITY]

Date: _____

General Contractor: _____

Electrical Subcontractor: _____

VFD Supplier: _____

This certifies that the VFD parameters have been coordinated per the specifications and the requirements of this section.

_____ _____
(Authorized Representative of the General Contractor) Date

_____ _____
(Authorized Representative of the Electrical Subcontractor) Date

_____ _____
(Authorized Representative of the VFD Supplier) Date

PUMP STATION "NAME"
MEGGER TEST RESULTS

Project: _____ **Temperature:** _____
Date: _____ **Weather:** _____
Location: _____ **Test Equipment:** _____

Equipment / Feeder Under Test: _____ **Start Time:** _____ **End Time:** _____

Test Equipment: Make: _____ **Serial No.:** _____ **Test Voltage:** _____

	0.5 min	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min	P.I.
ΦA-Gnd.												
ΦB-Gnd.												
ΦC-Gnd.												
ΦA-ΦB												
ΦA-ΦC												
ΦB-ΦC.												

Equipment / Feeder Under Test: _____ **Start Time:** _____ **End Time:** _____

	0.5 min	1 min	2 min	3 min	4 min	5 min	6 min	7 min	8 min	9 min	10 min	P.I.
ΦA-Gnd.												
ΦB-Gnd.												
ΦC-Gnd.												
NEUT -Gnd.												
ΦA-ΦB												
ΦA-ΦC												
ΦB-ΦC.												

Notes: *Megger test only should record 5 minute value*
Polarization Index (P.I.) is 10 min reading divided by 1 min reading

END OF SECTION

SECTION 16073

SHORT-CIRCUIT/COORDINATION/ARC FLASH STUDY

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish short-circuit and protective device coordination studies which shall be prepared by the equipment manufacturer.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
   1. Section 16000 – Electrical – Pump Stations

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
   1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
   2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
   3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
   4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
   5. IEEE 1015 – Recommended Practice for Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems

B. American National Standards Institute (ANSI):
   1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
   2. ANSI C37.13 – Standard for Low Voltage ac Power Circuit Breakers Used in Enclosures
   3. ANSI C37.010 – Standard Application Guide for ac High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
   4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
   5. ANSI C37.5 – Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents

C. The National Fire Protection Association 70, National Electrical Code, latest edition.

1.4 SUBMITTALS TO THE ENGINEER

A. Submittals shall be provided in accordance with Sections 01340, 16000 and as specified in this section.

B. The short-circuit, protective device coordination, and arc flash studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

C. The results of the short-circuit, coordination, and arc flash studies shall be combined and summarized in a final report. Submit five (5) bound copies of the final report. Additional copies, where required, shall be provided on CD in PDF format.

D. The report shall include the following sections:
   1. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations
   2. Descriptions, purpose, basis and scope of the study
   3. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward adjusted for X/R ratios that are above the device design ratings
   4. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings
   5. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout
   6. Comments and recommendations for system improvements, where needed
   7. Executive summary

1.5 QUALIFICATIONS

A. The Short-Circuit, Coordination, and Arc Flash studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting power system studies. The Registered Professional Electrical Engineer shall be a full-time employee of the Engineering Services Organization.

B. The Registered Professional Electrical Engineer shall have a minimum of five (5) years' experience in performing power system studies for similar sized facilities.

C. The engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year. The engineer shall have 10 or more years of experience in completing Arc Flash Hazard Analysis Studies.

D. Studies shall be performed by a registered engineer in the state that the project is being completed.

1.6 WARRANTY

A. Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

PART 2 - PRODUCT

2.1 STUDIES

A. Contractor to furnish Short-circuit, Protective Device Coordination, and Arc Flash studies as prepared by equipment manufacturers.

B. Data collection

1. The Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit and coordination studies shall furnish the Contractor with a listing of required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and ensure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
2. Source contribution may include present and future utility supply, motors, and generators.
3. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
4. Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

C. Short-circuit Evaluation Study

1. Provide short-circuit evaluation study to include the following:
   a. Calculation methods and assumptions
   b. Selected base per unit quantities
   c. One-line diagram of the system being evaluated
   d. Source impedance data, including electric utility system and motor fault contribution characteristics
   e. Typical calculations
   f. Tabulations of calculated quantities
   g. Tables and listings of all equipment and results of short circuit results summarized for review.
   h. Furnish available fault current lamacoid nameplates at all main service distribution equipment including switchboards and all motor control centers and all other locations within the facility as required by the National Electric Code article 110.24(A) and as determined by the results of the study.
   i. Provide conclusions and recommendations
   j. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
   k. Electric utility’s supply termination point
   l. Incoming switchgear
   m. Unit substation primary and secondary terminals
   n. Low voltage switchgear
   o. Motor control centers
   p. Standby generators and automatic transfer switches
   q. Branch circuit panelboards
   r. Other significant locations throughout the system

s. Use typical conductor impedances based on IEEE Standard 141, latest edition.

2. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
3. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

D. Protective Device Coordination Study
1. Provide the protective device coordination study for the entire project location including all new and existing electrical systems and equipment and a summary of findings. The study is to include the entire electrical system for both utility normal power and for the emergency standby power system. These shall be broken out and included separately for a complete and detailed system study.
2. Description of the study and overview of system and how the study was performed.
3. All single line diagrams, devices shown, identification tags, bus tags for a complete description.
4. Circuit breaker and relay settings table summarizing the final recommendations for breaker coordination settings.
5. Identifying any discrepancies with the system devices and overall short circuit and coordination settings for the system with recommendations for revisions to the equipment.
6. Field testing and setting all equipment with final field walk-through with the Engineer that these settings have been properly performed. A system check-out and off and sign off must be performed for final acceptance that the actual installed equipment is coordinated with the final study requirements and settings.
7. A complete and acceptable system shall be provided for this portion of the work.
8. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
9. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
10. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
11. Identify devices associated with each curve by manufacturer type, function, and, if applicable, tap, time delay and instantaneous settings recommended.
12. Plot the following characteristics on the curve sheets, where applicable:
    a. Electric utility’s protective device
    b. Medium voltage equipment relays
    c. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance and damage bands
    d. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands
    e. Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

f. Conductor damage curves
g. Ground fault protective devices, as applicable
h. Pertinent motor starting characteristics and motor damage points
i. Pertinent generators short-circuit decrement curve and generator damage point
j. Other systems load protective devices for the largest branch circuit and the largest feeder circuit breaker in each motor control center
k. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

E. Arc Flash Study
1. Furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.
2. Provide available fault current lamacoid nameplates at all service equipment including switchboards and all motor control centers within the facility as required by the National Electric Code article 110.24(A).
3. Arc Flash Hazard Methodology Analysis Results and Recommendations shall include the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
4. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images. Labeling and Arc Flash results shall be provided for each electrical distribution system equipment both existing and new for this facility.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
B. Make minor modifications to equipment as required to accomplish conformance with short-circuit and protective device coordination studies.
C. Notify Owner in writing of any required major equipment modifications.

3.2 INSTALL ARC FLASH LABELS

A. All Arc Flash labels shall be submitted with a compiled listing which shall be confirmed, installed and checked in the field for final installation.

END OF SECTION

SECTION 16075

CONDUIT, CABLE, AND WIRING IDENTIFICATION AND TAGGING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide labels and tags to identify all conductors, conduits, and equipment in accordance with designations specified in this Section and in the contract documents.

B. Identification:

1. All distribution equipment (switchboards, motor control centers, distribution panelboards, transformers, transfer switches, disconnects, starters, control panels, control stations, etc.) shall have an engraved lamacoid tag, permanently mounted adjacent to the Manufacturer's nameplate, indicating the equipment's designation (as called out on the Drawings) and identification number per the Contract Documents.
2. All switchboard and distribution panel overcurrent devices, motor control center devices, individually mounted motor controllers, disconnect switches, control devices, etc., shall be provided with permanently attached engraved lamacoid tags indicating the equipment which they serve or control per the equipment designation and identification number indicated in the Contract Documents, and in accordance with OSHA requirements.
3. All branch circuit panelboards shall have, on the inner side of the door, a permanently attached, engraved lamacoid tag with the identification number of that panelboard. Provide and mount under plastic, in the directory frame of each panelboard, a neatly typewritten directory identifying the branch circuit overcurrent devices and the circuits, devices and areas which they serve.
4. All individually mounted panelboards, disconnects, motor controllers, control stations, etc. shall have a second engraved lamacoid tag below the first one which identifies from where the equipment is receiving power. This second label shall be smaller in height.
5. Label and identify with branch circuit and source panel all light switches, manual motor starters, and receptacles
6. Nomenclature on these nametags shall be project specific and wherever possible shall be full and complete. Excess abbreviations will not be allowed.
7. Power conductors shall be continuously polarized and color coded throughout using the following scheme:
   a. White - All neutral conductors, 208/120V systems
   b. Gray - All neutral conductors, 480/277 volt systems.
   c. Green - All ground conductors
   d. Phase Conductors

208/120V Systems	**240/120V Systems**	**480/277V Systems**
Phase A - Black	Phase A - Black/(Red)	Phase A - Brown
Phase B - Red	Phase B - Red/(Blue)	Phase B - Orange
Phase C - Blue		Phase C - Yellow

e. Regardless of conductor size, conductor insulation color shall correspond to the color coding required in this section.

8. Control Conductors shall be continuously polarized and color coded throughout using the following scheme:
   a. 120 Volts – Red
   b. DC Controls – Dark Blue
   c. Intrinsically Safe – Light Blue
9. Ethernet cables shall be color coded and labeled as shown on the instrumentation drawings.
10. All individual conductors shall be identified using unique numerical tags corresponding to conductor designations indicated on approved shop drawings of schematic diagrams for all terminations. This includes all process- and non-process-related wiring done as part of the work, such as fire alarm panels. Conductors shall be clearly identified at each terminal block, equipment connection and junction. Markings shall utilize the equipment designation and terminal block number in the device higher upstream in the system hierarchy. Markings shall follow the format "Device Tag-Equipment Served Tag-Device Terminal Block No." Refer to Division 13 for communication and Manufacturer instrument cable labeling requirements.
    a. System hierarchy shall be defined as follows:
        i. Master Terminal Unit
        ii. Remote Terminal Unit
        iii. Motor Control Center
        iv. Transmitters, Local Control Stations
        v. Elements
    b. Refer to attached figure showing sample wire labeling convention.
11. Conductor colors for power and control wiring shall be submitted for review.
12. All feeder cables shall be marked indicating load for each feeder for all junction boxes, handholes, and manholes.
13. Conduits shall be marked at both ends utilizing a stamped tag manufactured from 316 stainless steel with designations corresponding to the conduit schedule on approved drawings. Attach tags to conduits with 316 stainless steel wire. Such marking shall include the designation of the conduit, the destination of the conduit, and the type of conductors in the conduit, being power (P), control (C), or signal (S). The format for the marking shall be "Conduit Designation-Equipment Designation."
    a. For example, conduit P79 provides a power connection from Control Panel CP-CF to LIT-172. The marking at CP-CF shall therefore read "P79-LIT712." The corresponding marking at LIT-712 shall read "P79-CPCF."
    b. Conduit C90 provides a control connection from Motor Control Center MCC-1 to Control Panel CP-M. The marking at MCC-1 shall therefore read "C90-CPM." The corresponding marking at CP-M shall read "C90-MCC1."

c. Conduit S37 provides a signal connection from Control Panel CP-CF to CFP-800. The marking at CP_CF shall therefore read “S37-CFP800.” The corresponding marking at CFP-800 shall read “S37-CPCF.”
d. Refer to Table 1 – Cable Identification and Tagging Schedule. A copy of this schedule will be supplied to the Contractor. The attached Table 1 located at the end of this specification section has been provided as an example of the requirements to be provided as an example of the requirements to be provided for the project. They shall be provided for all cables which are power, control, and signal to be supplied for the entire project.

14. The following safety signage shall be provided for the following equipment. Signage shall be lamacoid plastic (Large Letters) yellow background with red engraved letters:
    a. All switchboards, motor control centers, VFD equipment, automatic transfer switches, solid-state, reduced-voltage starters, enclosed circuit breakers, etc., shall be provided with signage to read "DANGER - HIGH VOLTAGE". Each section (vertical component of multi-section enclosure) shall be furnished with an individual signage. Final requirements shall be determined at the discretion of the Engineer.
    b. All motor control center motors starters, individual motor starters and/or control panels shall be provided with signage to read "CAUTION - This Enclosure Contains Voltage Sources from Outside of This Enclosure".
    c. All switchboards, motor control centers, panel boards, transformers control panels, etc., shall have Arc Flash labels as provided and determined by the Arc Flash Study.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
    1. 16010 Electrical General (and as referenced)

1.3 QUALITY ASSURANCE

A. Supply all new materials, devices and equipment in conformance with:
    1. Underwriter's Laboratory, Inc.
    2. National Electrical Manufacturers Association.
    3. American National Standards Institute.
    4. National Electrical Code (NEC).
    5. Local Power Company.
    6. Local Telephone Company
    7. Local Internet Provider
    8. OSHA

1.4 SUBMITTALS TO THE ENGINEER

A. Shop Drawings are required for all items provided under this section. Submittals shall be provided in accordance with Sections 01340, 16010 and as specified in this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wire Markers:
   1. Provide Perma Sleeve Heat Shrink Tubing by Brady or equal. All markers to be type written.
B. Labels and tags shall be typewritten and pre-manufactured for the intended purpose. Labels and tags with “tails” will not be accepted. All labels and tags must be installed prior to site acceptance.
C. Lamacoid tags shall be nominal 1" x 4" with 3/8" white lettering on black background, unless specified otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Labels and tags shall be installed per Manufacturer guidelines to maximize the life of the label.

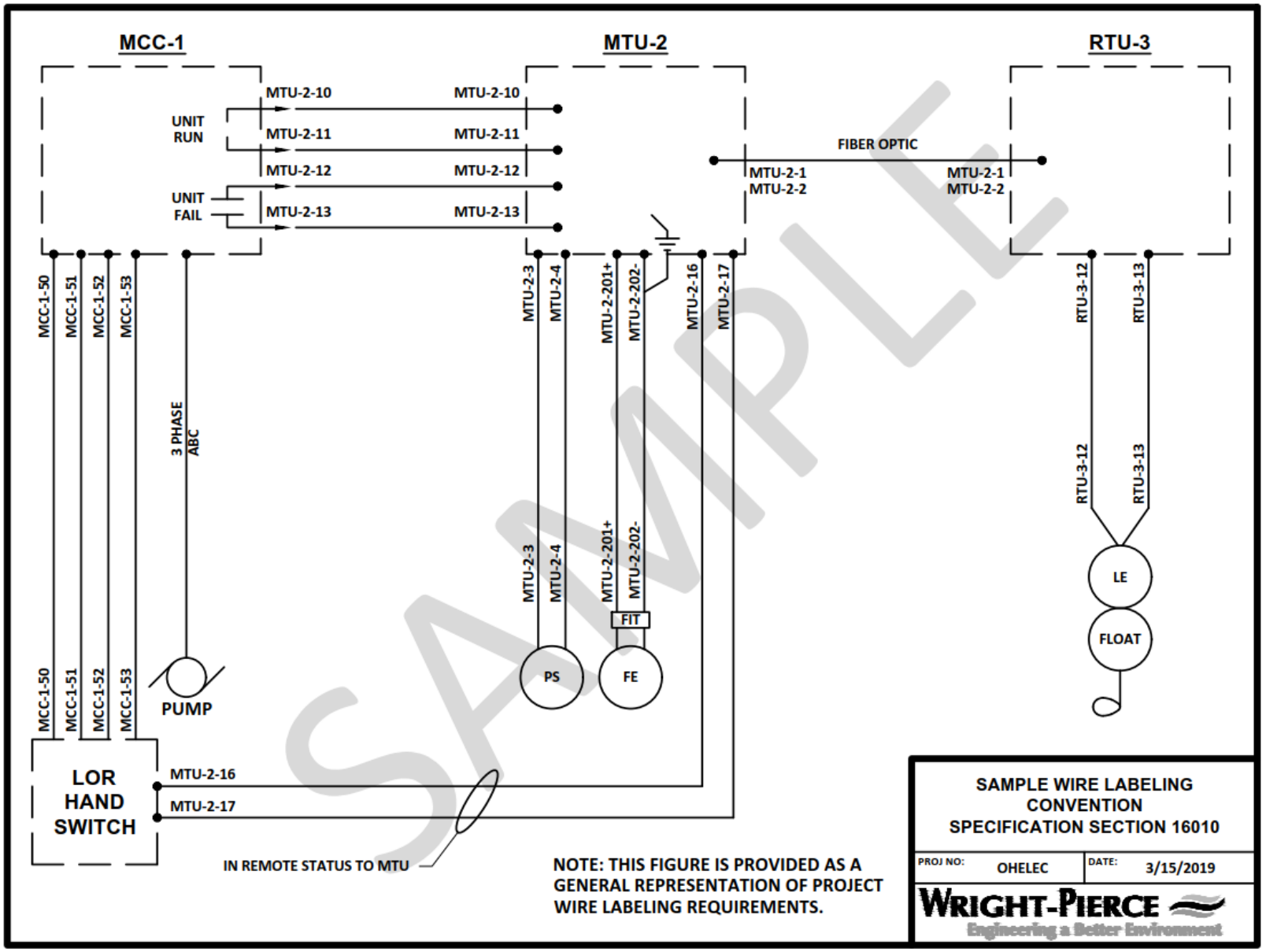

MCC-1
MTU-2
RTU-3
MTU-2-10
MTU-2-10
UNIT RUN
MTU-2-11
MTU-2-11
MTU-2-12
MTU-2-12
UNIT FAIL
MTU-2-13
MTU-2-13
FIBER OPTIC
MTU-2-1
MTU-2-2
MTU-2-1
MTU-2-2
MCC-1-50
MCC-1-51
MCC-1-52
MCC-1-53
3 PHASE ABC
MTU-2-3
MTU-2-4
MTU-2-201+
MTU-2-202-
MTU-2-16
MTU-2-17
RTU-3-12
RTU-3-13
RTU-3-12
RTU-3-13
LE
FLOAT
FIT
PS
FE
PUMP
MCC-1-50
MCC-1-51
MCC-1-52
MCC-1-53
LOR HAND SWITCH
MTU-2-16
MTU-2-17
IN REMOTE STATUS TO MTU
NOTE: THIS FIGURE IS PROVIDED AS A GENERAL REPRESENTATION OF PROJECT WIRE LABELING REQUIREMENTS.
SAMPLE WIRE LABELING CONVENTION SPECIFICATION SECTION 16010
PROJ NO: OHELEC
DATE: 3/15/2019
WRIGHT-PIERCE
Engineering a Better Environment

TABLE 1 – CABLE IDENTIFICATION AND TAGGING SCHEDULE

Internal Recycle Pump - 1	*IRP-6010*

	PLC-1		MCC-6A		VFD-IRP-6010		LCS-6010		Disconnect IRP-1				LOOP √	PURPOSE
	Term #	Wire #	Term #	Wire #	Term #	Wire #	Term #	Wire #	Term #	Wire #	Term #	Wire #		
DISCRETE	**6010-1**	1			**11**	1								Run Status
	6010-2	2			**12**	2								Rub Status
	6010-3	3			**13**	3								VFD Fault
	6010-4	4			**14**	4								VFD Fault
	6010-5	5							**NC**	5				Disconnect Off
	6010-6	6							**NC**	6				Disconnect Off
	6010-7	7			**17**	7								Seal Leak
	6010-8	8			**18**	8								Seal Leak
	6010-9	9			**19**	9								Overtemp
	6010-10	10			**20**	10								Overtemp
CONTROL	**6010-11**	11			**21**	11								Run Command
	6010-12	12			**22**	12								Run Command
	6010-13	13			**23**	13	**LOR**	13						Local
	6010-14	14			**24**	14	**LOR**	14						Remote
	6010-15	15					**NC**	15						In Remote
	6010-16	16					**NC**	16						In Remote
ANALOG	**6010-AI-1**	Cable 1			**25**	Cable 1								Speed
	6010-AI-1	Cable 1			**26**	Cable 1								Speed
	6010-AO-1	Cable 2			**27**	Cable 2								Speed Reference
	6010-AO-1	Cable 2			**28**	Cable 2								Speed Reference

PROJECT NAME: _____

CHECKED BY: _____ **DATE:** _____

END OF SECTION

SAMPLE

SECTION 16620D

STANDBY POWER SYSTEM - DIESEL

PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide a complete standby power system as indicated in the Contract Documents. The system shall be a factory built, prototype tested, production tested, field tested, complete and operable emergency / standby electric generating system, including all devices and equipment specified herein, shown on the Drawings, and/or as required for the service. Materials and equipment shall be new and current, delivered to the site completely wired, tested, and ready for installation. Coordination, Short Circuit and Arc Flash studies are required for this generator, refer to Section 16073 for requirements. This system shall include the following:

1. An outdoor diesel engine driven electric plant with an integrated fuel tank to provide standby electric power.
2. Engine-generator control console resiliently mounted on each generating set shall include complete engine start-stop control and monitoring system.
3. Starting batteries with battery charger for each engine-generator set.
4. Automatic load transfer controls are to be provided by the generator equipment supplier. Refer to section 16000 for additional information.
5. Mount any and all loose accessories, control devices, and other equipment as specified herein and/or as shown on Drawings.
6. All other components, accessories, parts, tests, documents, and services, as needed, to meet the performance requirements of this specification.
7. All necessary interconnecting wiring and connections to provide proper system operation.
8. Field testing, start up, and automatic transfer switch parameter set up as specified in Section 3 of this section. Refer to requirements of Section 01800 and 16000 for startup, testing and operator training.

B. This equipment, including engine-generator sets shall be manufactured by a single Manufacturer who has been regularly engaged in the production of engine-generator sets for a minimum of ten years.

1. The electric generating system described herein, including these components shall be factory built, factory tested, and shipped by this single Manufacturer, so there is one source of supply and responsibility for warranty, parts, and service. This Manufacturer shall have a representative based within 150 miles who can provide factory trained servicemen on a 24-hour per day basis, required stock of replacement parts, and technical assistance.
2. Different Manufacturers for the engine-generator set and the automatic load transfer controls will be acceptable providing that the equipment is completely coordinated, reviewed, integrated and written verification is provided that this system equipment is completely compatible before shipment and the engine-generator set Manufacturer is the source of responsibility for a complete and operational system interface between this equipment.

3. The responsibility for performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the supplier of the system. The Manufacturer shall furnish schematic and wiring diagrams for the engine-generator set(s).
4. All controls shall be the standard of the Manufacturer, who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part numbers of this Manufacturer and shall have second source listing where applicable. Control systems that are supplied by a Sub-vendor or Subcontractor of the vendor and not incorporated within the documentation drawings of the generator Manufacturer are not acceptable.
5. Complete load bank, building load testing, sound level testing and system equipment checkout will be required to be performed as part of the overall acceptance of this equipment.

C. The work of this section shall also include the overall supervision, start-up and testing of an owner-furnished, existing, diesel-fueled, emergency standby generator. The responsibility of the generator Manufacturer is to provide services and oversight for re-connection of the existing generator for the intended application as outlined within the guidelines of the contract documents. Refer to specific requirements noted under this section of the work.

1.2 REQUIREMENTS SPECIFIED ELSEWHERE

A. Additional Requirements are specified elsewhere including, but not necessarily limited to, General Conditions, Supplementary Conditions, and Division 1.
1. Section 16000 – Electrical – Pump Stations
2. Section 16000 – Automatic Transfer Switch

1.3 QUALITY ASSURANCE

A. The electric generating system must meet all requirements of NFPA 110 (Level 2) including design specifications, prototype tests, one-step full-load pickup, and installation acceptance.
B. The performance of the electric plant shall be certified by the Manufacturer verifying the electric plant's full power rating, stability and voltage and frequency regulation.
C. The complete standby power system installation, start-up and operating instructions shall be performed under the supervision of a factory-trained engineer/representative of the system Manufacturer.
D. Provide sound attenuation to meet local ordinances.
E. Acceptable Manufacturers:
1. Electric Plant:
   a. Cummins Power Generation
   b. Caterpillar
   c. Or equal
2. Automatic Load Transfer Controls:
   a. Specified under Section 16000. Refer to this related section for additional requirements.
3. Equipment as described herein is that as manufactured by Cummins, and all equipment furnished shall be equal in every way to that specified herein, including quality, operation, and function.

4. The equipment spacing, mounts, electrical wiring, ventilation equipment, fuel and exhaust components have all been sized and designed around the Manufacturers listed. If alternate equipment is substituted, the Contractor shall be responsible for changes in the facilities work, made necessary from installation of equipment other than Cummins, without additional cost to the Owner, and shall verify all work with the equipment Manufacturer.
    a. Any bidder wishing to use substitute equipment shall submit detailed data to the Engineer. Complete shop drawings, diagrams, and details shall be prepared specifically for this project. Standard and typical drawings will not be acceptable. Data for substitute equipment shall include complete information for the following:
        i. Plan drawing to verify that substitute equipment will fit into space allocated and allow for removal and service.
        ii. Allowance for proper cooling and combustion air.
        iii. To verify that all interconnecting wiring and piping is accounted for, provide complete interconnecting wiring diagrams and piping diagrams.
        iv. Provide the results of engineering to show compliance with the requirements for "prototype testing".
        v. Complete load study and load profile to show that engine-generator set(s) will not be overloaded during any phase of operation, including motor starting and steady-state load conditions.
        vi. Specification information, factory literature, catalog sheets, etc., to show compliance with specifications.
        vii. Deductions or additions to contract price for use of proposed substitute equipment.
        viii. Complete list of deviations from these specifications.
        ix. Short circuit study of the load circuits to verify that selective coordination and thermal and magnetic stresses on components will be equal to that specified.
        x. List of projects using similar equipment for the last 5 years.
        xi. Subtransient reactance listed.

F. Service:
    1. Replacement parts and competent service shall be available within state where the generator is located.

1.4 SUBMITTALS TO THE ENGINEER

A. Submittals shall be provided in accordance with Sections 01340, 16000 and as specified in this section:
    1. Complete typewritten description of system operation(s), and ratings, including a listing of all auxiliary devices.
    2. Manufacturer's data sheets and detailed dimensioned drawings for all pieces of equipment and auxiliary devices.
        a. Dimensioned drawings of the fuel tank as applicable shall include interior and exterior dimensions. The fuel shut-off and alarm levels shall be called out graphically or as a note.

b. Cutsheets for fuel tank appurtenances, including level sensors, alarm floats, fill valve, tank gauge, etc.
c. Generator Access Platforms: Plans, elevations, and details, along with a statement that stairs, platforms, and guards are OSHA-compliant as specified in Part 2 of this section, including stamp by Professional Engineer registered in the Project state.

3. Complete interconnecting wiring diagrams, cross referenced with equipment designations indicated in the Contract Documents, indicating all required wiring between the electric plant control panel, the automatic load transfer controls and all auxiliary devices.
4. Independent testing laboratory reports indicating the performance test results of the electric plants including power rating, stability and voltage and frequency regulation.
5. Unless specified otherwise herein, all performance data and other information shall be as on the Manufacturer's printed literature. Performance data shall be the result of test procedures in accordance with nationally recognized standards, plus such other procedures that are judged necessary by the Manufacturer to ensure maximum service reliability for emergency systems, and shall be available for inspection by the Engineer upon request.
6. Equipment supplier shall submit complete detailed step load program and calculations as part of the shop drawing submittal to demonstrate compliance with the motor starting and performance criteria as specified elsewhere in this Section.
7. All testing data sheets for load bank testing results, building load testing and sound level testing shall be submitted for final acceptance.
8. The supplier shall submit an engineered product for the specific application noted herein. Therefore, if the load equipment consists of a non-linear type application the supplier is required to perform a harmonic analysis of the generator determining both current and voltage distortion levels along with total harmonic distortion (THD) for the system based on the step loads assigned under this Section.
9. Layout plans and wiring diagrams of day tank and components of fuel transfer pumping system.
10. Qualifications of the ICC certified installer.
11. The system Manufacturer’s authorized local dealer shall furnish copies each of the manuals for each generator (total of 4 complete sets) and books listed below to be kept inside the enclosure and one set for the Owner's files for each unit under this contract. The Manufacturer shall also provide four CD's with each of the manuals, instructions, lists, procedures, charts, wire diagrams, and schematics on them.
    a. OPERATING INSTRUCTIONS - with description and illustration of all switchgear controls and indicators; and engine and generator controls and indicators.
    b. PARTS CD - that illustrates and lists all assemblies, subassemblies and components, except standard fastening hardware (nuts, bolts, washers, etc.).

c. PREVENTATIVE MAINTENANCE INSTRUCTIONS - on the complete system that cover daily, weekly, monthly, biannual, and annual maintenance requirements and include a complete lubrication chart.
d. ROUTINE TEST PROCEDURES - for all electronic and electrical circuits and for the main AC generator.
e. TROUBLESHOOTING CHART - covering the complete Genset showing description of trouble, probable cause, and suggested remedy.
f. RECOMMENDED SPARE PARTS LIST - showing all consumables anticipated to be required during routine maintenance and test.
g. WIRING DIAGRAMS AND SCHEMATICS - showing function of all electrical components, corrected as required showing as-built conditions.

1.5 TESTING

A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed: Factory Prototype Model Tests, Factory Production Model Tests, and Field Tests.

1. Factory Prototype Model Tests: The electric generating system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by NFPA 110. The tests, being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110, paragraph 3-2.1 thru 3-2.1.2 and their accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall have included:
   a. Maximum power level (maximum kW).
   b. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
   c. Structural soundness (Short-Circuit and Endurance Tests).
   d. Torsiograph Analysis: The Manufacturer of the engine-generator set shall verify that the engine-generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer output within the critical speed range of the engine-generator set. Results of this analysis shall be made available to the specifier on request. Calculations based on engine and generator separately are not acceptable.
   e. Engine-generator cooling and combustion air requirements.
   f. Transient response and steady-state speed control and voltage regulation.
   g. Generator temperature rise per NEMA MG1-22.40.
   h. Harmonic analysis and voltage waveform deviation per MIL-STD-705B, method 601.4 and as specified and required under this section. Refer to previously noted requirements.
   i. Three-phase short-circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for a duration of thirty seconds. Engine-generator set must build up and perform normally without manual interventions of any kind such as

resetting of circuit breakers or other tripping devices when the short circuit is removed.

j. Failure mode test for voltage regulator. With engine-generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operative after the test, and without evidence of damage.

k. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.

2. Factory Production Model Tests: Before shipment of the equipment, the engine-generator set(s) shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Testing at unity power factor only (resistance banks only) is not acceptable, since kW output is affected by the higher generator efficiency at unity power factor, and the KVAR for motor starting and regulation loads varies with power factor. Tests shall include:

a. Single step load pickup per NFPA 110, paragraph 5-13.2.6.

b. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

A summary of these test results shall be submitted a minimum of one month before the date of substantial completion.

1.6 LOADS AND REQUIREMENTS

A. The specific loads and requirements have been provided for the generator starting, running and shutdown requirements. Therefore, all responsibility for proper operation and regulation shall be provided by the supplier of this equipment. If this is not completely understood or included for the performance of this equipment then it shall be grounds for rejection of this equipment. The submittal requirements have been specifically noted in order to avoid any possible issues regarding improper operation of the standby power system. It shall be clearly understood and noted that the supplier will be responsible to provide all documentation and requirements set forth under this section for review and approval.

1.7 WARRANTY

A. The complete standby electric power system, including 1800 r/min engine-generator set shall be warranted for a period of five (5) years or fifteen hundred (1,500) operating hours, whichever occurs first, from the date of Substantial Completion. Multiple warranties for individual components (engine, generator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. This warranty shall be detailed in available written documents. In the judgment of the specifying authority, the Manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

B. Service Calls: Equipment supplier shall provide a 6-month Level I and 1year Level II service calls on the automatic transfer switch and generator. The Level II Service call shall include a full maintenance check and a change of all fluids and filters. Refer to Section 01800 for additional information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General:

1. This system shall include an engine-generator set at each site meeting or exceeding the minimum ratings as tabulated below, on a continuous standby basis. The sizing and selection of the specified generator has been based upon the specific Manufacturer based upon the software design of this product.

Maximum Allowable Starting Voltage Dip	Maximum Allowable Peak Voltage Dip	Maximum Allowable Freq. Dip	Maximum Surge kW Capability	Maximum Surge kVA Capability
20%	20%	10%	Per Manufacturer	Per Manufacturer

KW	KVA	Power Factor	Hz	Volts	Phase/Wire
200	250	0.8	60	480/277	3 Phase, 4 Wire

2. The engine generator set shall be capable of reliably starting the connected loads in the order listed in the table below. This shall be accomplished without exceeding the voltage and frequency dip specifications, and without causing unacceptable operation of electrical equipment. These load steps shall be coordinated with the Division 13 Integrator for proper staging of loads upon a power loss.

Load Name:	Load Rating (HP / kVA)	Starting Method
Step 1:		
Base Load	10 KVA	
Unit Heaters	20 KW	
Step 2:		
Pump No.1	50 HP*	VFD PWM
Step 3:		
Pump No.2 or Pump No.3	100 HP*	VFD PWM

*The horsepower listed is based on the pump curves that the motor will be operating at and not the motor nameplate to size the generator based on the operating load.

FVR & FVNR = Across the Line
VFD PWM = Variable Frequency Drive, Pulse-Width-Modulated
RVSS = Reduced Voltage Solid State Starters

3. The Standby Power System supplier shall have a complete understanding of the loads to be started and operated on emergency power, and the generator shall be properly sized and configured to perform the intended function.
4. Each engine-generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components, and each set shall incorporate vibration isolators of the type and quantity as specified by the set Manufacturer, whether mounted internally or externally to the set.
5. The total loading on the standby generator shall not exceed 90%. Any submitted generator program submitted which does not meet this criteria are terms for automatic rejection based on discretion of the Engineer

B. Engine:
1. Each engine shall be certified to U.S. EPA Emergency Only Use Emission regulations at the time of installation/commissioning in the state where being installed.
2. Engine shall be liquid-cooled, diesel for use with ultra-low sulfur diesel fuel. Design shall be turbocharged and intercooled where required by engine Manufacturer.
3. Engine shall be certified by the engine manufacturer as capable of driving a generator yielding a kW rating as specified herein. Engine shall be capable of driving the generator of this rating on a continuous standby basis for the duration of normal utility source interruptions per SAE J1349 conditions.
4. Fuel injection and valves shall not require adjustment while in service.
5. Maximum ambient air temperature 122°C.
6. Engine equipment shall include the following:
    a. An electric starter(s) as required by the Manufacturer.
    b. Positive displacement, mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements and dipstick oil level indicator.
    c. Fuel filter with replaceable element, and an engine driven, mechanical positive displacement fuel pump, all mounted on the engine. Replaceable dry element air cleaner.
    d. Engine speed isochronous electronic governing system to control generator frequency within ±0.25% of rated frequency under steady state load conditions, and capable of parallel operation with load sharing controls.
    e. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:
        i. Low coolant temperature alarm
        ii. Low lubrication oil pressure alarm
        iii. High coolant temperature alarm
        iv. Low lubrication oil pressure shutdown
        v. High coolant temperature shutdown
        vi. Overspeed shutdown
        vii. Overcrank lockout
        viii. Low coolant level shutdown

f. Engine starter battery charging alternator with solid-state voltage regulator.
g. Engine mounted thermostatically controlled water jacket heater(s) for engine to aid in quick starting. Heater(s) shall be rated 1500 W, 240V**]**, single, 60 HZ for the proper sizing and requirements of this unit or as determined by the manufacturer.

7. Cooling System:
   a. Engine shall be radiator cooled by engine mounted radiator system including belt-driven pusher fan, coolant pump, coolant level sensor, and thermostat temperature control. Performance of components shall be as required by set Manufacturer.
   b. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall.
   c. The cooling system shall be sized to operate at full load conditions and 120ºF ambient air entering the room.
8. Engine Exhaust System:
   a. Exhaust muffler shall be provided for each engine of size as recommended by the set Manufacturer. Muffler shall be of the side inlet, end outlet type and critical grade type. Provide support for the muffler so its weight is not supported by the engine.
   b. Stainless steel flexible exhaust connection shall be provided as required for connection between engine exhaust manifold and exhaust line, in compliance with applicable codes and regulations.
   c. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings.
   d. Provide guards or insulation as required by UL2200 at all "hot" locations of the generator including exhaust manifolds, flexible connections, etc., for a complete installation. Where not recommended or required for this application, the supplier is required to meet all safety and protective requirements of this section for alternative methods.
9. Diesel Fuel System: Provide a sub-base fuel tank with level gauge. The tank shall be new, unused, and shall not be galvanized. Tank shall be UL listed for secondary containment, dual wall, with rupture basin switch. The Manufacturer shall size the tank to provide a minimum of 48 hours of operation based on 75% loading or actual loading of the generator, whichever is larger.
   a. For exterior installations, fuel tank shall include tanks markings on all approachable sides indicating tank number, product type, NFPA 704 diamond, safe fill height. Labels shall have 2-inch high letters.
   b. For interior installations, also include NFPA 704 diamond at all room entry points.
   c. For interior installations, provide a remote level gauge, overfill valve, and fill point secondary containment at fill station.
   d. A low fuel supply sensing device shall be installed on the fuel tank for monitoring a low fuel level and for sending a low level alarm.
   e. Provide a high level fuel alarm for 90% and 95% full.

f. Provide a secondary containment leak detection device.
g. Provide an overfull protection valve and spill box at fill station.
h. The fuel tank shall be provided with a 2-inch exterior fill line with lockable cap (“tight fill type”), a 2-inchexterior vent line with approved vent cap, and a 2-inch emergency vent line with approved vent cap. The fill line, vent line, emergency vent line, etc. shall be located outside the generator to meet local code requirements and approval. Piping shall be sloped 1/8-inch/ft minimum. Provide complete details along with fuel tank drawings and assembly.

C. Generator

1. Generator shall be single-bearing, 2/3rd pitch, self-aligning, four-pole, synchronous type, revolving field, with amortisseur windings, with direct drive centrifugal blower for proper cooling and minimum noise, with temperature compensated solid-state voltage regulator, with brushless PMG exciter system. No brushes will be allowed. Telephone influence factor less than 50 per NEMA MG1-22.43.
2. Generator shall be directly connected to engine flywheel housing and driven through a flexible coupling to ensure permanent alignment; gear driven generators are not acceptable under this specification.
3. Gear reducers are not acceptable. Maximum speed of generator shall be 1800 RPM.
4. Insulation shall meet NEMA standards for Class H.
5. The maximum alternator temperature rise shall not exceed 105 °C above ambient. Generator design shall prevent potentially damaging shaft currents.
6. The three-phase, broad range, reconnectable generator shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
7. Voltage regulator shall be solid-state design and shall function by controlling the exciter magnetic field between stator and rotor to provide no load to full load regulation of rated voltage within ± 1% during steady-state conditions.
   a. The engine-generator set and regulator must sustain at least 90% of no load voltage for ten (10) seconds with 250% of rated load at near zero power factor connected to its terminals.
   b. The voltage regulator shall be insensitive to severe load induced waveshape distortion from SCR or thyristor circuits such as those used in battery charging (UPS), solid state reduced voltage starting, surge control applications, variable frequency drives (VFD's), and motor speed control equipment.
   c. A rheostat shall provide a minimum of ±5% voltage adjustment from rated value.
   d. Provide subtransient reactance to levels which allow for IEEE 519 harmonic mitigation. The subtransient reactance of this generator shall be set based upon the largest and most efficient alternator which will fit this generator at the maximum alternator temperature riser specified herein. Minimum subtransient reactance shall not exceed 0.0122 per unit.

8. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine-generator set Manufacturer so that the characteristics shall be matched to the torque curve of the prime mover. This design allows the prime mover to use its fullest power producing capacity (without exceeding it or overcompensating) at speeds lower than rated, to provide the fastest possible system recovery from transient speed dips. A system that routinely selects a linear-type (straight line) constant volts/hertz characteristic, without regard for the engine power and torque characteristics, will not meet this specification.
9. PMG Exciter shall be three-phase, full-wave, rectified, with heavy-duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads.
10. Generator design shall be of the self-protecting type, as demonstrated by the prototype short-circuit test as described under "Testing" herein. All other generator performance criteria shall be equal to that of the specified equipment.

D. Engine-Generator Set Control:

1. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The generator set mounted control shall include the following features and functions. **The control panel shall be mounted at an accessible height with all controls and screens viewable at eye level.**
2. Control Switches
    a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
    b. EMERGENCY STOP switch. External emergency stop station, for mounting outside room housing the prime mover. Provide a pad-lockable NEMA 4X cast box with larger red mushroom push off and pull on type device. Lockable in off position. Depressing the emergency E-Stop shall cause the generator set to immediately shut down and be locked out from restarting. Generator main breaker shall be shunt trip type and shall trip upon activation of emergency stop button.
    c. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

d. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

3. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:
   a. Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red. Analog meter can also be incorporated as part of the microprocessor based generator set control.
   b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
   c. Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.
4. Generator Set Alarm and Status Display
   a. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
      - low oil pressure (alarm)
      - low oil pressure (shutdown)
      - oil pressure sender failure (alarm)
      - low coolant temperature (alarm)
      - high coolant temperature (alarm)
      - high coolant temperature (shutdown)
      - engine temperature sender failure (alarm)
      - low coolant level (alarm or shutdown—selectable)
      - fail to crank (shutdown)
      - fail to start/overcrank (shutdown)
      - overspeed (shutdown)
      - low DC voltage (alarm)
      - high DC voltage (alarm)
      - weak battery (alarm)
      - low fuel day tank (alarm)
      - high AC voltage (shutdown)

- low AC voltage (shutdown)
- over frequency
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- ground fault (alarm) (optional—when required by code or specified)
- overload (alarm)
- emergency stop (shutdown)
- generator reverse power (shutdown)
- loss of excitation (shutdown)
- instantaneous over excitation (shutdown)
- time over excitation (shutdown)
- loss of sensing (shutdown)
- loss of PMG (alarm)

b. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

5. Engine Status Monitoring
   a. The following information shall be available from a digital status panel on the generator set control:
      i. engine oil pressure (psi or kPA)
      ii. engine coolant temperature (degrees F or C)
      iii. engine oil temperature (degrees F or C)
      iv. engine speed (rpm)
      v. number of hours of operation (hours)
      vi. number of start attempts
      vii. battery voltage (DC volts)
   b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
   c. Provide auxiliary dry contacts for remote indication for the following:
      i. Generator Run Status
      ii. Generator Failure Alarm
      iii. Generator Warning Alarm
      iv. Low Fuel Alarm
      v. Fuel Rupture Alarm
      vi. Low Battery Alarm

6. Engine Control Functions
   a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
   b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
   c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
   d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
   e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components and actual failure conditions.
7. Alternator Control Functions
   a. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine Manufacturer with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
   b. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
   c. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the

thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.

d. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

e. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

f. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 12VDC or more than 16 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 8 volts for more than two seconds a “weak battery” alarm shall be initiated.

g. When required by National Electrical Code or indicated on project drawings, the Control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set and provide relay that will function correctly in system as installed.

E. Auxiliary Equipment:

1. Starting Battery: Batteries shall be supplied for each engine and shall be mounted in a battery rack within the engine-generator set skid base. Batteries shall be 12 volt, heavy duty, diesel starting lead-acid type. Provide number of batteries based on starting requirements of generator.
2. Battery Charger(s): A voltage regulated battery charger shall be provided for each engine-generator set. Chargers shall be equipped with float, taper, and equalize charge settings. The battery charger shall provide dry contact alarms for loss of AC power, weak battery, and high battery.
3. External emergency stop station, Provide a pad-lockable NEMA 4X cast box with larger red mushroom push off and pull on type device. Depressing the emergency E-Stop shall cause the generator set to immediately shut down and be locked out from restarting. Generator main breaker shall be shunt trip type and shall trip upon activation of emergency stop button.
4. Distribution Panelboard, sized to accommodate all circuits on the generator skid.

F. Access Platforms:

1. Access platforms will be provided by others as shown on the drawings.

G. Outdoor Weather-Protective Enclosure

1. The Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified.
2. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable.
3. All sheet metal shall be primed for corrosion protection and finish painted with the Manufacturers standard color using a two-step electro-coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:
   a. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
   b. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
   c. Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
   d. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
   e. Salt Spray, per ASTM B117-90, 1000+hours
   f. Humidity, per ASTM D2247-92, 1000+ hours
   g. Water Soak, per ASTM D2247-92, 1000+ hours
4. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
5. Sound-attenuation enclosure shall reduce sound levels as follows and meet the requirements of the sound level enclosure tier as specified within.

Sound Level Requirements

Manufacturer	Sound Pressure Levels dBA at Full Load		
	1M	7M	15M
Cummins	89.9	72.0	66.38
Caterpillar			

6. Provide a complete and assembled Level 2, sound attenuated outdoor weather-protective engine generator unit for mounting on a concrete pad as shown on the contract drawings. Provide concrete pad installation requirements to General Contractor.
7. All equipment located and supplied within the enclosure shall be pre-wired by the generator Manufacturer except for the battery charger and block heater which shall be wired in the field by the Contractor.
8. The enclosure shall have all vibration isolation and shall be bolted to an outside concrete pad.
9. Refer to drawings for additional information.
10. Provide final field testing of sound levels as specified and as required by each city or town sound level requirements.

11. Enclosures shall be provided with motorized dampers for the exhaust and intake louvers to prevent the infiltration of ambient air when not in operation.
    a. Provide motor operated dampers for intake and out-take dampers to operate powered closed and fail open.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be made in complete accordance with Manufacturer's recommendations.
B. Install unit on concrete base to provide for servicing access and oil pan removal.
C. Flexible connections shall be used on all connections to unit.
D. Fill the engine cooling system with a solution of 50 percent ethylene glycol and water.
E. Support muffler so that its weight is not supported by the engine. Exhaust pipe sizing shall be as required to maintain exhaust backpressure within the limits established by the generator set Manufacturer.
F. Bond steel base, generator and engine frames and all equipment enclosures to main ground electrodes.
G. Provide a minimum of 4 - 3/4" stainless steel epoxy anchors to fasten the generator to the concrete foundation.
H. The external emergency E-Stop switch shall be installed as shown on Drawings.

3.2 FIELD TESTS AFTER INSTALLATION

A. Testing requirements are in addition to those in Section 01800 and 16950.
B. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative(s) of the engine-generator set(s) Manufacturer. The engine lubrication oil, as recommended by the Manufacturer for operation under environmental conditions specified, shall be provided by the engine-generator set(s) supplier.
C. Upon completion of initial start-up and system checkout, the supplier of the system shall perform a field test in the presence of the Contractor, Engineer and Owner's operating personnel to demonstrate load carrying capability and voltage and frequency stability.
D. The Contractor shall provide all fuel required for start-up and testing. Contractor shall make the necessary arrangements to have the fuel available when needed for start-up and testing. Upon completion of testing, Contractor shall top off the fuel tank.
E. The Contractor shall supply a complete electrical system operating and functional in order to verify that generator will start the connected loads in the order specified and load bank testing.
F. 100% Load shall consist of resistive load bank. Unity power factor is suitable for on-site testing, provided that rated load tests at power factor have been performed by the Manufacturer prior to shipment.

G. Record Keeping for resistive load bank and building load tests.
   1. Records shall be maintained throughout the resistive load bank and building load tests consisting of:
      a. Time-of-day
      b. Coolant temperature
      c. Cranking time until prime mover starts and runs
      d. Time required to come up to operating speed, voltage and frequency overshoot
      e. Time required to achieve steady-state condition with all switches transferred to the emergency position
      f. Voltage
      g. Frequency
      h. Current
      i. Oil pressure
      j. Ambient air temperature
      k. Kilowatts
      l. Power factor
      m. Battery charger rate at 5-minute intervals for the first 15 minutes
   2. Data shall be recorded at 15-minute intervals throughout the test.
   3. Continue this load test for 2 hours per NFPA 110, observing and recording load changes and the resultant effect on voltage and frequency.
   4. Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cooldown period and shutdown.
   5. Upon completion of the above test, allow the prime mover to cool for 5 minutes. Then apply available building load via Automatic Transfer Switch. A power failure shall be initiated by opening all switches or breakers supplying the normal power to the building or facility. This load pickup shall be in one step immediately upon reaching rated RPM.

H. During or after the tests, the Owner's operating personnel shall be fully instructed by the factory-trained representative in the operation and maintenance of this equipment.

I. Perform a building load test with the actual conditions of the load. This must be coordinated as a separate site visit for each station. Coordinate with Owner and Engineer to setup time and conditions of testing.

J. The Manufacturer's representative shall test and verify all protective functions of the generator control by accessing the control system through the use of a laptop computer and simulating failure modes or fault conditions.

K. Perform and test sound level values for each of the sites based on conditions set forth in the specifications.

STANDBY POWER SYSTEM - RESISTIVE LOAD BANK TEST

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

This certifies that the entire equipment/system has met the RESISTIVE LOAD BANK TESTING requirements of Section 16620, 16950 and all other applicable requirements of the contract documents.

(Authorized Representative of the Manufacturer)	(Date)
(Contractor)	(Date)
(Engineer) Wright-Pierce	(Date)

STANDBY POWER SYSTEM - BUILDING LOAD TESTS

Owner: _____ Date: _____

Project: _____

Contractor: _____

Equipment Manufacturer: _____

Equipment: _____

TEST #1 ☐ TEST #2 ☐ TEST #3 ☐

This certifies that the entire equipment/system has met the BUILDING LOAD TESTING requirements of Section 16620, 16950 and all other applicable requirements of the contract documents.

_____ _____
(Authorized Representative of the Manufacturer) (Date)

_____ _____
(Contractor) (Date)

_____ _____
(Engineer) Wright-Pierce (Date)

END OF SECTION

APPENDIX A
Geotechnical Explorations Findings - Northern Test Borings

Geotechnical Investigations Findings

Location: **Bath, ME**

Driller: **Northern Test Boring, Inc**

Project: **Bath Sewer Project**

Description **Geotechnical Probe Results**

Date of Explorations: **11/30/2023**

Probe Number	Location	Depth to Refusal (ft)
2	Near 1421 Washington	8.9
3	Near 1408 Washington	10.1
9	Office Dr	20

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 7.5'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	18	5-7	17	11	5	5	5'	
S2	24	20	10-12	5	5	4	5	10'	Brown Silty Clay
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
S4	24	24	20-22	1	1	1	15	20'	Bottom of Exploration 22'

Boring #: B-1
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 6.3'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	16	5-7	4	4	5	5	5'	Gray Silty Clay
S2	24	24	10-12	3	3	3	2	10'	
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
S4	24	24	20-22	1	1	1	15	20'	Bottom of Exploration 22'

Boring #: B-4
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 7.1'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	17	5-7	4	4	3	4	5'	
									Brown Silty Sand and Gravel
S2	24	16	10-12	4	3	4	3	10'	
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
								20'	Bottom of Exploration 17.1' Auger Refusal

Boring #: B-5
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 6.5'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	16	5-7	3	3	2	2	5'	Gray Silty Clay
S2	24	24	10-12	1	1	1	1	10'	
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
S4	24	24	20-22	1	1	1	15	20'	Glacial Till at 21'
									Bottom of Exploration 22'

Boring #: B-7
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 6.5'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	17	5-7	4	3	2	2	5'	Gray Silty Clay
S2	24	23	10-12	1	1	1	1	10'	
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
S4	24	24	20-22	1	1	1	12	20'	Glacial Till at 21'
									Bottom of Exploration 22'

Boring #: B-8
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 6.4'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	17	5-7	4	4	5	5	5'	Gray Silt and Clay
S2	24	23	10-12	3	3	2	2	10'	
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
S4	24	24	20-22	1	1	1	1	20'	Rod Probe 22'-37'. Probe refusal @ 37'

Boring #: B-10
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 6.9'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Medium-Coarse Sand Trace Silt
S1	24	17	5-7	5	5	6	7	5'	Gray Silt and Clay
S2	24	23	10-12	2	2	2	2	10'	
S3	24	24	15-17	1	1	1	1	15'	Gray Silty Clay
S4	24	24	20-22	1	1	1	1	20'	Rod Probe 22'-36'. Probe refusal @ 36'

Boring #: B-11
Sheet: 1 of 1

Northern Test Boring, Inc. Boring Log

Client: Wright Pierce	Project Name: Bath Sewer Project
Location: Bath, Me	Driller: Mike Nadeau

				Ground Water Observation 14.1'
Type	HSA	SS		
Size	2	1		Start Date: 12/17/24 Finish Date: 12/17/24
Hammer Wt.		140		
Hammer Fall		30"		

No	Pe	Re	Sampl Depth	Sample Blow Counts				Depth	Stratum Description
									Brown Silty Sand and Gravel (Fill)
S1	24	19	5-7	5	4	5	7	5'	
S2	24	24	10-12	4	5	5	7	10'	Gray Silt
S3	24	24	15-17	2	2	2	2	15'	Gray Silty Clay
S4	24	17	20-22	10	12	10	11	20'	Gray Silty Sand and Gravel (Glacial Till)

Boring #: B-12
Sheet: 1 of 1

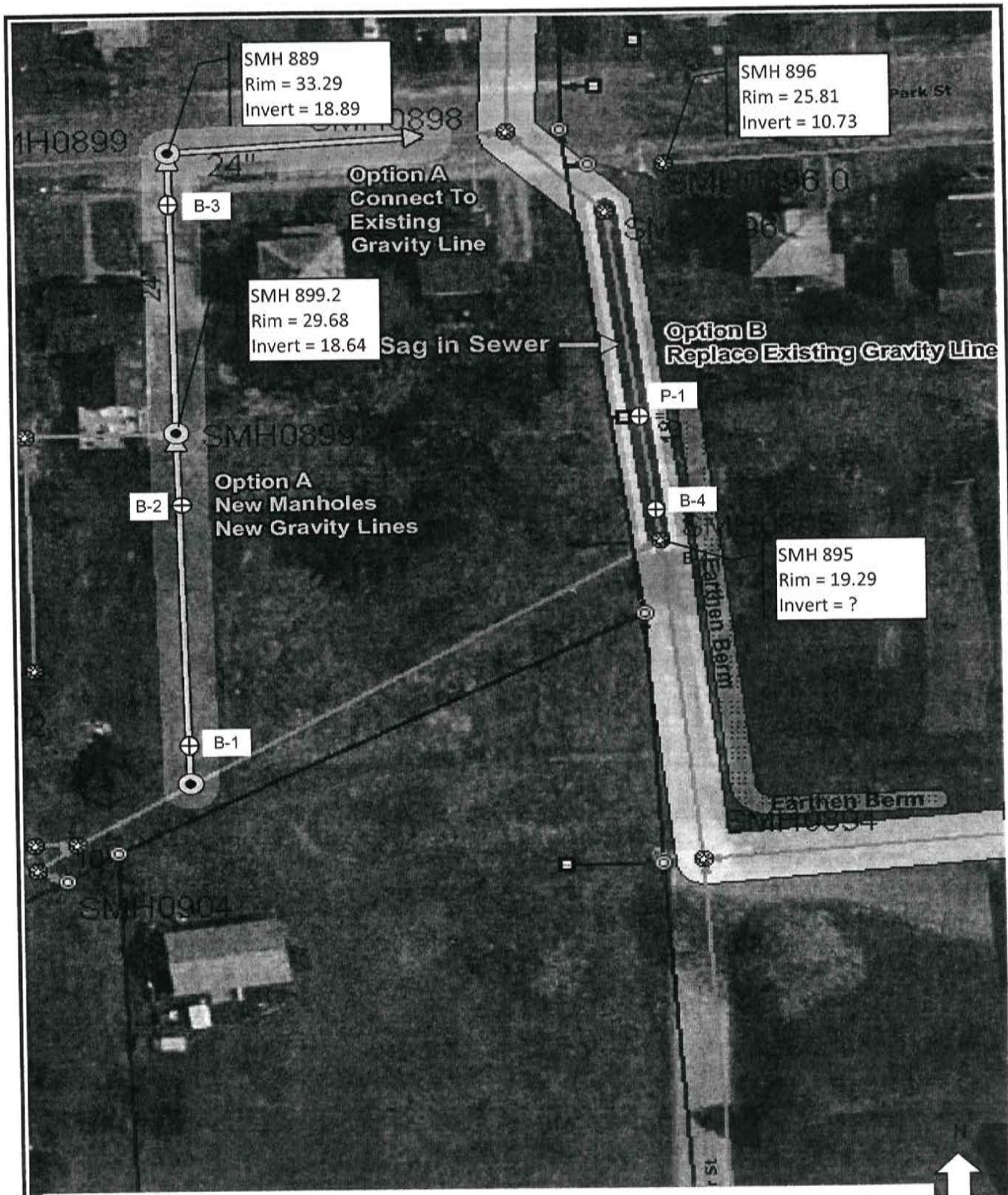
APPENDIX B
2008 Subsurface Investigation Report - Soil Metrics LLC

ATTACHMENT 1

Subsurface Investigation Report
Soil Metrics LLC

Project Manual for 2008 Combined Sewer Overflow Abatement Projects
(SRF Contract #2)
City of Bath, Maine

Ransom Environmental Consultants, Inc.
Project 076049



Notes:

1. The boring locations shown are approximate and determined by taping from known manholes.
2. Base plan prepared by Jacobs - Edwards and Kelcey. Rim and invert elevations provided by the City of Bath

Soil Metrics LLC Geotechnical Engineering	Project: Geotechnical Investigation Juniper Street CSO	Title: Site and Boring Location	By: SJR
			Date: 5/9/2007

Soil Metrics LLC
Geotechnical Engineering
12 Farms Edge Road
Cape Elizabeth, ME 04107

Project: JUNIPER STREET ABATEMENT
Proj. No: 014-09
Date: MAY 8, 2007
Subject: SECTIONS A-A' & B-B'
By: SJR
Checked:

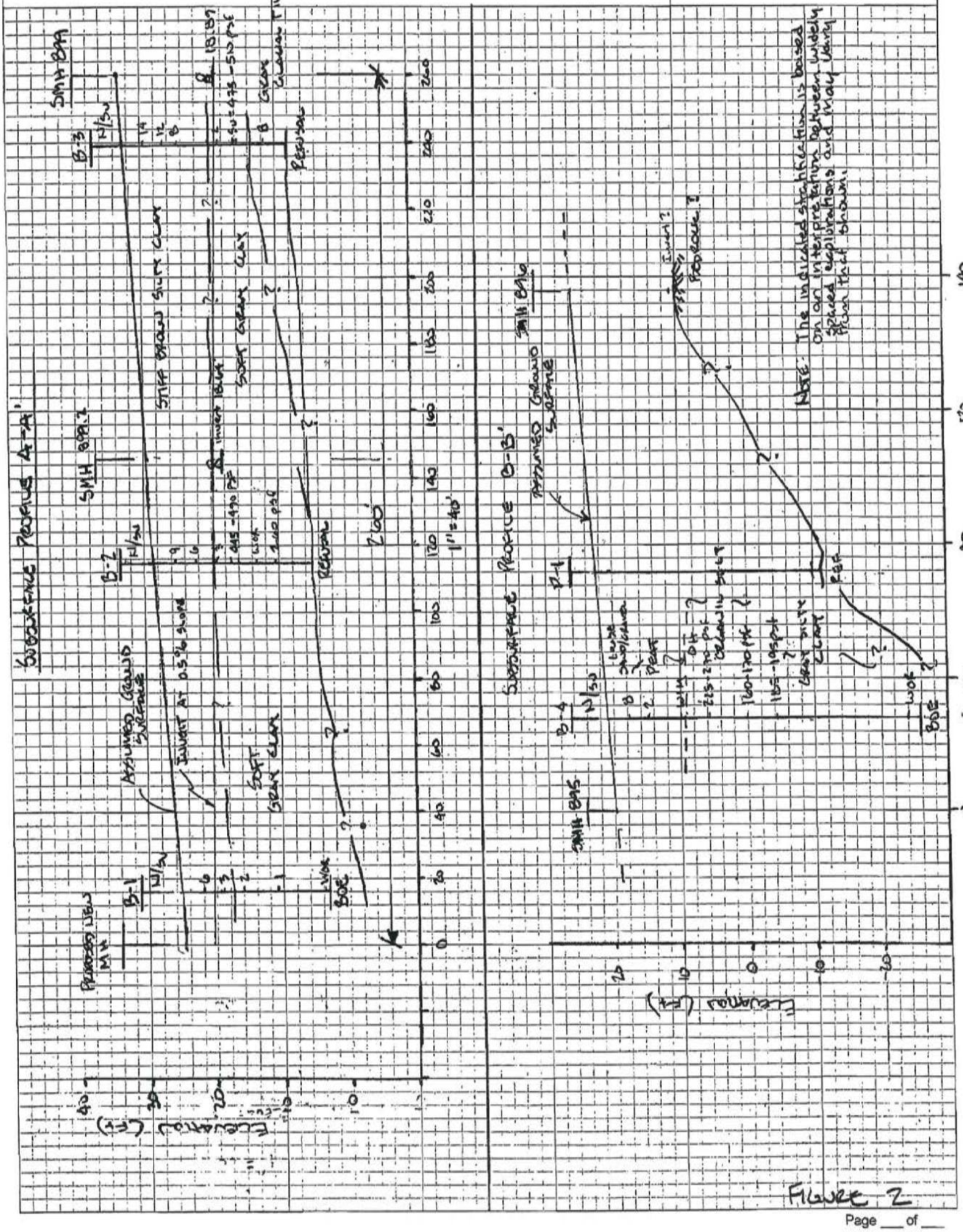


FIGURE 2

APPENDIX A

BORING LOGS

Soil Metrics LLC Geotechnical Engineering

Project:	Juniper Street Sewer Extension
Location:	Bath, Maine
Client:	Jacobs - Edwards and Kelcey Bath, Maine

Boring: B-1
File No.: 014-04

Contractor:	Great Works	Drilling Method:	Wash Boring
Operator:	Dave Dionne	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	3/19/2007	Hammer Wt./ Fall:	140# / 30 inches
Boring Location:	See Figure 1	Water Level:	See Note 2
Ref. Elevation[1]:	25.0 ft.		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_u = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
wc = Water Content, percent
oc = Organic Content, percent

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)	water content (%)	Sample Description and Classification	Unified Classification	Notes	Elevation
	S1	24/24	2.0 to 4.0	1/3/3/3	33.0	**S1:** Top 0.5 ft: Dark brown fine to medium silty SAND with organics, moist, loose	CL	▽	
					39.7	0.5 to 3.6 ft: Brown/gray SILT with fine sand, moist, medium stiff.			
5									20.0
	S2	24/12	5.0 - 7.0	1/2/1/1	34.7	**S2:** Light Brown/Gray silty sandy CLAY, saturated, medium stiff to soft, oxidation stains.	CL		
									17.0
	S3	24/24	8.0 - 10.0	1/1/1/1	40.7	**S3:** Soft gray silty CLAY with black streaks.	CL		
10									15.0
	S4	24/24	13.0-15.0	1/12" - 1/12"	49.3	**S4:** Soft dark gray silty CLAY with black streaks.	CL/CH		
15									10.0
20									5.0
	S5	24/24	20.0 - 22.0	WOR	52.9	**S5:** Similar to S4, very soft, saturated.	CL/CH		3.0
						Bottom of Exploration at 22.0 ft.			
25									0.0
30									-5.0

Notes

1. Reference elevations interpolated from Rim elevations provided by Jacobs - EK and the City of Bath. These elevations are approximate and should not be used for design and construction.
2. Water level measurements were made during the drilling process and are approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring: B-1

Soil Metrics LLC Geotechnical Engineering

Project:	Juniper Street Sewer Extension
Location:	Bath, Maine
Client:	Jacobs - Edwards and Kelcey Bath, Maine

Boring: B-2
File No.: 014-04

Contractor:	Great Works	Drilling Method:	Wash Boring
Operator:	Dave Dionne	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	3/19/2007	Hammer Wt./ Fall:	140# / 30 inches
Boring Location:	See Figure 1	Water Level:	See Note 2
Ref. Elevation[1]:	29.0 ft.		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
wc = Water Content, percent
oc = Organic Content, percent

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)	water content (%)	Sample Description and Classification	Unified Classification	Notes	Elevation
								▽	
	S1	24/24	2.0 - 4.0	3/4/5/5	19.8	S1: Brown/Gray silty CLAY, trace sand, mottled, stiff, moist	CL		
									24.0
5									
	S2	24/12	5.0 - 7.0	3/3/3/2	34.0	S2: Brown/Gray silty CLAY, stiff, saturated, mottled.	CL		
	S3	24/24	8.0 - 10.0	1/2/1/2	40.8	S3: 8.0 to 9.0 ft: Similar to S2.	CL		20.0
						9.0 to 10.0 ft: Gray silty CLAY with light brown mottles, some stiff spots.		Liquid Limit = 42.2 Plastic Limit = 21.2 Plastic Index = 21.0 Liquidity Index = 0.9	19.0
10									
	V1		10.5 to 11.2	490/55					
	V2		11.2 to 11.9	445/55					
15	U1		15.0 - 17.0	hydro push		Gray silty CLAY with black streaks	CL/CH		14.0
	V3		17.2 to 17.9	163/6		*(possibly a disturbed test)*	CL/CH		
	V4		17.9 to 18.8	260/10					9.0
20									
						Washed ahead to 23.5 ft, possible bedrock at 23.5 ft..			
									5.5
						Bottom of Exploration at 23.5 ft.			4.0
25									
									-1.0
30									

Notes
1. Reference elevations interpolated from Rim elevations provided by Jacobs - EK and the City of Bath. These elevations are approximate and should not be used for design and construction.
2. Water level measurements were made during the drilling process and are approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Soil Metrics LLC — Geotechnical Engineering

Project:	Juniper Street Sewer Extension
Location:	Bath, Maine
Client:	Jacobs - Edwards and Kelcey Bath, Maine

Boring: B-3
File No.: 014-04

Contractor:	Great Works	Drilling Method:	Wash Boring
Operator:	Dave Dionne	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	3/19/2007	Hammer Wt./ Fall:	140# / 30 inches
Boring Location:	See Figure 1	Water Level:	See Note 2
Ref. Elevation[1]:	33.0 ft.		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_p = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
wc = Water Content, percent
oc = Organic Content, percent

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)	water content (%)	Sample Description and Classification	Unified Classification	Notes	Elevation
	S1	24/24	2.0 - 4.0	3/7/7/9	23.4	**S1:** Brown silty CLAY, mottled, stiff, moist	CL	▽	
5									28.0
	S2	24/12	5.0 - 7.0	4/6/6/9	29.3	**S2:** Olive/Brown silty CLAY, stiff, saturated, mottled.	CL		
	S3	24/24	8.0 - 10.0	3/4/4/5	32.7	**S3:** Similar to S2.	CL	Liquid Limit = 48.21 Plastic Limit = 22.8 Plastic Index = 25.3 Liquidity Index = 0.4	
10									23.0
						(Becoming soft and gray 12 to 13 feet)			
									20.5
	S4	24/24	13.0 - 15.0	1/1/1/2	36.2	**S4:** Gray silty CLAY with black streaks, soft, saturated.	CL		
15									18.0
	V1		15.0 to 15.9	510/65					
	V2		15.9 - 16.8	478/65					
									14.0
20									13.0
	S5	24/12	3/4/4/6		14.2	Gray fine-medium silty SAND, medium dense to loose, Saturated, Glacial till.	SM		
25									8.5
						Refusal at 24.5 ft.			
30									3.0

Notes

1. Reference elevations interpolated from Rim elevations provided by Jacobs - EK and the City of Bath. These elevations are approximate and should not be used for design and construction.
2. Water level measurements were made during the drilling process and are approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Boring: B-3

Soil Metrics LLC Geotechnical Engineering

Project:	Juniper Street Sewer Extension
Location:	Bath, Maine
Client:	Jacobs - Edwards and Kelcey Bath, Maine

Boring: B-4
File No.: 014-04

Contractor:	Great Works	Drilling Method:	Wash Boring
Operator:	Dave Dionne	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	3/19/2007	Hammer Wt./ Fall:	140# / 30 inches
Boring Location:	See Figure 1	Water Level:	See Note 2
Ref. Elevation[1]:	21.0 ft.		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_u = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
wc = Water Content, percent
oc = Organic Content, percent

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)	water content (%)	Sample Description and Classification	Unified Classification	Notes	Elevation
								▽	
	S1	24/2	2.0 - 4.0	18/4/4/3	25.8	Poor recovery, trace wood fragments (fill)S1: Brown Gravelly SAND			
									16.0
5									
	S2	24/0	5.0 - 7.0	2/1/1/1		S2: No recovery. Drill wash indcated material consisted of wood fibers, and peat in wash water. This is likely a peat layer.			
									11.0
10									10.0
	S3	24/24	10.0 - 12.0	WO1M	155.3	S3: (S3a)10.0 to 11.0 ft: Dark Brown PEAT, very soft, saturated.	PT	(S3a)	
					68.3	(S3b)11.0 to 13.5 ft: Transition to less organic content, reeds present in sample.	OH	Liquid Limit = 163.0 Plastic Limit = 66.9 Plastic Index = 96.1 Liquidity Index = 0.9 Organic Content = 15.9 %	
						11.5 to 12.0 ft: Dark Brown Organic silt, some reeds present			6.0
15									
	V1		10.5 to 11.2	271/11				(S3b) Liquid Limit = 68.3 Plastic Limit = 25.7 Plastic Index = 22.9 Liquidity Index = 1.86 Organic Content = 4.9 %	
	V2		11.2 to 11.9	228/11					
	S4	24/24	15.0 to 17.0	push	99.5	Pushed spoon through Vane test zone, Dark gray/Black silty Saturated ORGANIC SILT or CLAY? Very soft, sea shells present. Organic content = 5.5 % Very Sensitive			
					97.3				1.0
20									
	V3		20.0 to 20.9	173/0					258.4
	V4		20.9 - 21.8	162/0					
	S5	24/24	20.0 to 22.0	push	49.9	Pushed spoon through Vane test zone, Similar to S4.	OL	(S5) Liquid Limit = 49.9 Plastic Limit = 21.6 Plastic Index = 18.6 Liquidity Index = 1.52 Organic Content = 2.7 %	-4.0
25									
	V5		25.0 to 25.9	195/0					
	V6		25.9 - 26.8	184/0					
	S6	24/24	25.0 to 27.0	push	50.2	Pushed spoon through Vane test zone, Similar to S4.			
									-9.0
30									

Notes

1. Reference elevations interpolated from Rim elevations provided by Jacobs - EK and the City of Bath. These elevations are approximate and should not be used for design and construction.
2. Water level measurements were made during the drilling process and are approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

Soil Metrics LLC — Geotechnical Engineering

Project:	Juniper Street Sewer Extension
Location:	Bath, Maine
Client:	Jacobs - Edwards and Kelcey Bath, Maine

Boring: B-4
File No.: 014-04

Contractor:	Great Works	Drilling Method:	Wash Boring
Operator:	Dave Dionne	Bore Hole ID/OD:	4.0/4.5
Logged By:	sjr	Auger ID/OD:	NA
Checked By:	sjr	Sampler:	Std Split Spoon-24 inches
Date Start/Finish:	3/19/2007	Hammer Wt./ Fall:	140# / 30 inches
Boring Location:	See Figure 1	Water Level:	See Note 2
Ref. Elevation[1]:	21.0 ft.		

Definitions:
S = Split Spoon Sample
U = Thin Wall Tube Sample
R = Rock Core Sample
V = Insitu Vane Shear Test
q_u = Unconfined Compressive Strength (psf)
woh = weight of 140 lb. hammer
wor = weight of rods
wc = Water Content, percent
oc = Organic Content, percent

Depth	Sample No.	Rec/Pen (in.)	Depth (Ft.)	Blows (/6") Shear Strength (psf) or RQD (%)	water content (%)	Sample Description and Classification	Unified Classification	Notes	Elevation
						Pushed casing to 45 ft. Washed out. Wash return indicated soft silty clay soil.		▽	
35									-14.0
40									-19.0
45									-24.0
	S7	24/24	45.0 to 47.0	WOR	39.6	S7: Gray silty CLAY Saturated, very soft.	CL		21.0
50						*Bottom of Exploration at 47.0 ft.*			-29.0
55									-34.0
60									-39.0

Notes

1. Reference elevations interpolated from Rim elevations provided by Jacobs - EK and the City of Bath. These elevations are approximate and should not be used for design and construction.
2. Water level measurements were made during the drilling process and are approximate.

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

APPENDIX B

LABORATORY DATA

SOIL METRICS
JUNIPER ST. BATH
WATER CONTENT

SAMPLE	DEPTH (ft.)	CAN No.	WT. WET SOIL & CAN (g)	WT. DRY SOIL & CAN (g)	WT. H20 (g)	WT. CAN (g)	DRY SOIL (g)	WATER CONTENT (%)
B-1 S-1a	2-3.6	1	239.74	193.45	46.29	53.1	140.35	33.0
B-1 S-1b	3.6-4	2	143.27	117	26.27	50.87	66.13	39.7
B-1 S-2	5-7	3	234.9	187.73	47.17	51.68	136.05	34.7
B-1 S-3	8-10	4	268	205.6	62.4	52.29	153.31	40.7
B-1 S-4	13-15	5	316.2	228.77	87.43	51.48	177.29	49.3
B-1 S-5	20-22	6	281.27	201.42	79.85	50.38	151.04	52.9
B-2 S-1	2-4	7	215.34	188.25	27.09	51.75	136.5	19.8
B-2 S-2	5-7	8	243.71	194.97	48.74	51.72	143.25	34.0
B-2 S-3	8-10	9	185.47	145.67	39.8	48.21	97.46	40.8
B-3 S-1	3-5	10	190.92	164.35	26.57	50.6	113.75	23.4
B-3 S-2	5-7	11	242.48	199.13	43.35	51.26	147.87	29.3
B-3 S-3	8-10	12	185.87	152.7	33.17	51.25	101.45	32.7
B-3 S-4	13-15	13	202.09	162.08	40.01	51.58	110.5	36.2
B-3 S-5	20-22	14	280.07	251.67	28.4	51.51	200.16	14.2
B-4 S-1	2-4	15	101.27	91.12	10.15	51.75	39.37	25.8
B-4 S-3a	10-	16	140.55	86.62	53.93	51.9	34.72	155.3
B-4 S-3b	-12	17	179.62	127.62	52	51.53	76.09	68.3
B-4 S-4 (1)	15-17	18	178.78	115.37	63.41	51.62	63.75	99.5
B-4 S-4 (2)	15-17	19	169.59	111.45	58.14	51.71	59.74	97.3
B-4 S-5	20-22	20	182.69	138.98	43.71	51.45	87.53	49.9
B-4 S-6	25-27	21	233.2	172.1	61.1	50.49	121.61	50.2
B-4 S-7	45-47	22	259.51	199.72	59.79	48.83	150.89	39.6

ATTERBERG LIMIT DATA SHEET

PROJECT: Soil Metrics
Juniper St. Bath.

JOB NO: 97008
DATE: 26 MAR 07
TESTED BY: EJL

BORING NO: B-2
SAMPLE NO: S-3
DEPTH (ft.): 8-10

SAMPLE SOURCE:
SAMPLE DESCRIPTION: Gray silty CLAY

SAMPLE PRETREATMENT: (X) NONE ( ) AIR DRIED ( ) OVEN DRIED @ 60 C

SPLIT ON: ( ) No. 40 SIEVE ( ) No. 10 SIEVE (X) NOT SPLIT

OVEN TEMP. FOR WATER CONTENTS: ( ) 60 C (X) 110 C

PLASTIC LIMIT

CONTAINER NO:	x-1	x-2	x-3
WT. WET SOIL + CONT.	31.22	27.78	31.13
WT. DRY SOIL + CONT.	29.53	26.71	29.51
WT. CONTAINER (g)	21.45	21.76	21.87
WATER CONTENT (%)	20.9	21.6	21.2

NAT. WATER CONTENT

40.8

LIQUID LIMIT

NO. OF BLOWS:	42	29	19	13
CONTAINER NO:	x-4	x-5	x-6	x-7
WT. WET SOIL + CONT.	30.16	31.04	28.99	30.65
WT. DRY SOIL + CONT.	27.72	28.36	26.71	27.82
WT. CONTAINER (g)	21.66	21.90	21.45	21.50
WATER CONTENT (%)	40.3	41.5	43.3	44.8

SUMMARY OF RESULTS

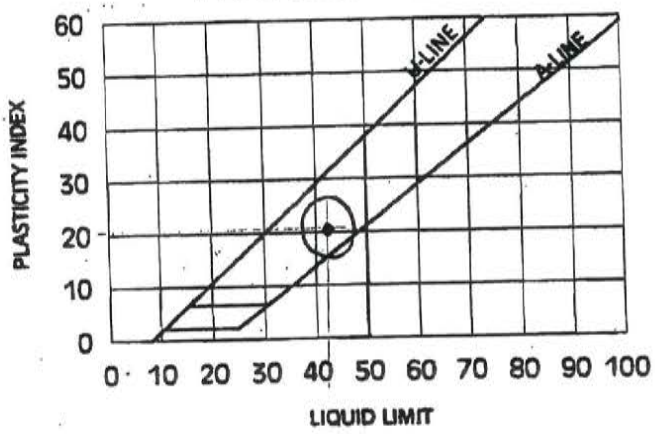
NAT. WATER CONTENT:	40.8
LIQUID LIMIT:	42.2
PLASTIC LIMIT:	21.2
PLASTIC INDEX:	21.0

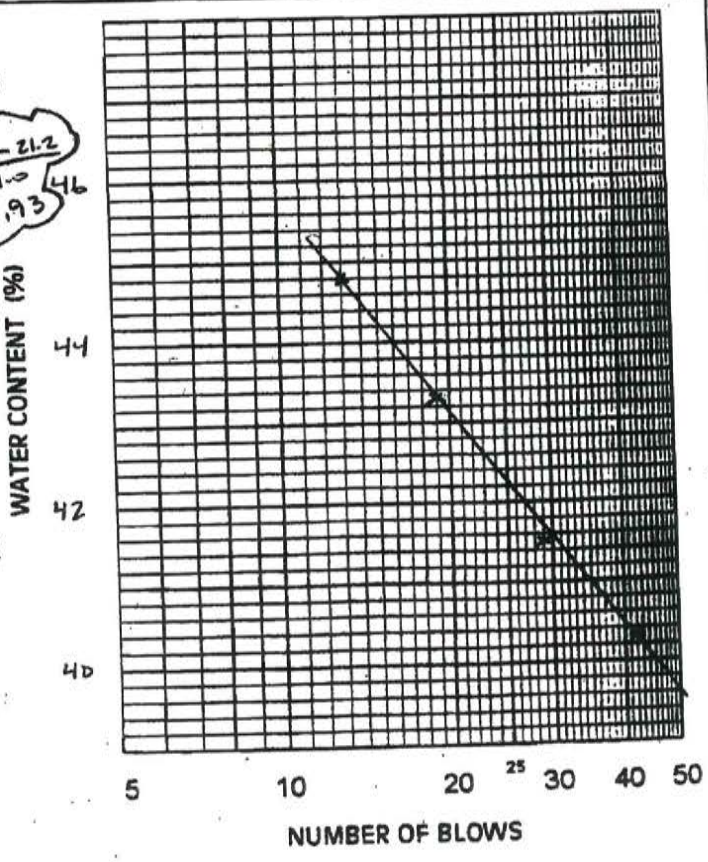
CL/CH

LI = (40.8 − 21.2) / 21.0

LI = 0.93

PLASTICITY CHART





SEVEE & MAHER ENGINEERS

ATTERBERG LIMIT DATA SHEET

PROJECT: Soil Metrics
Juniper St. Bath.

JOB NO: 9700B
DATE: 26 MAR 07
TESTED BY: EJL

BORING NO: B-3
SAMPLE NO: S-3
DEPTH (ft.): 8-10

SAMPLE SOURCE:
SAMPLE DESCRIPTION: Brown Silty CLAY

SAMPLE PRETREATMENT: (X) NONE ( ) AIR DRIED ( ) OVEN DRIED @ 60 C

SPLIT ON: ( ) No. 40 SIEVE ( ) No. 10 SIEVE (X) NOT SPLIT

OVEN TEMP. FOR WATER CONTENTS: ( ) 60 C (X) 110 C

PLASTIC LIMIT

CONTAINER NO:	X-8	X-9	X-10
WT. WET SOIL + CONT.	32.08	33.02	34.57
WT. DRY SOIL + CONT.	30.08	30.92	32.18
WT. CONTAINER (g)	21.30	21.64	21.85
WATER CONTENT (%)	22.8	22.6	23.1

NAT. WATER CONTENT

32.7

LIQUID LIMIT

No. OF BLOWS:	38	33	28	22	18
CONTAINER NO:	X-11	X-12	X-13	X-14	X-15
WT. WET SOIL + CONT.	30.20	30.15	30.15	29.89	32.02
WT. DRY SOIL + CONT.	27.53	27.43	27.37	27.14	28.50
WT. CONTAINER (g)	21.43	21.43	21.44	21.58	21.55
WATER CONTENT (%)	43.8	45.3	46.9	49.5	50.6

SUMMARY OF RESULTS

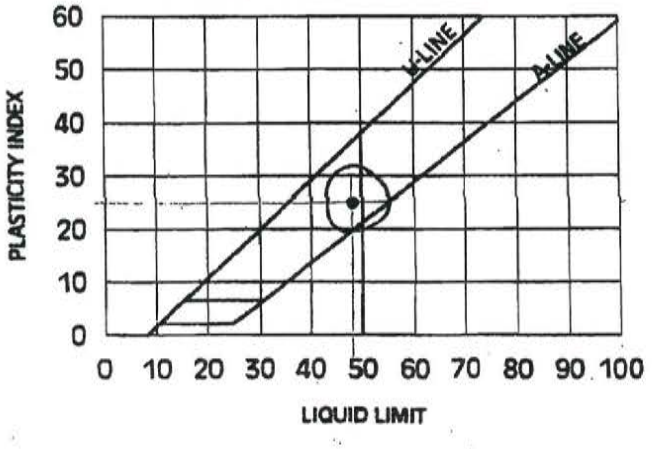
NAT. WATER CONTENT:	32.7
LIQUID LIMIT:	48.1
PLASTIC LIMIT:	22.8
PLASTIC INDEX:	25.3

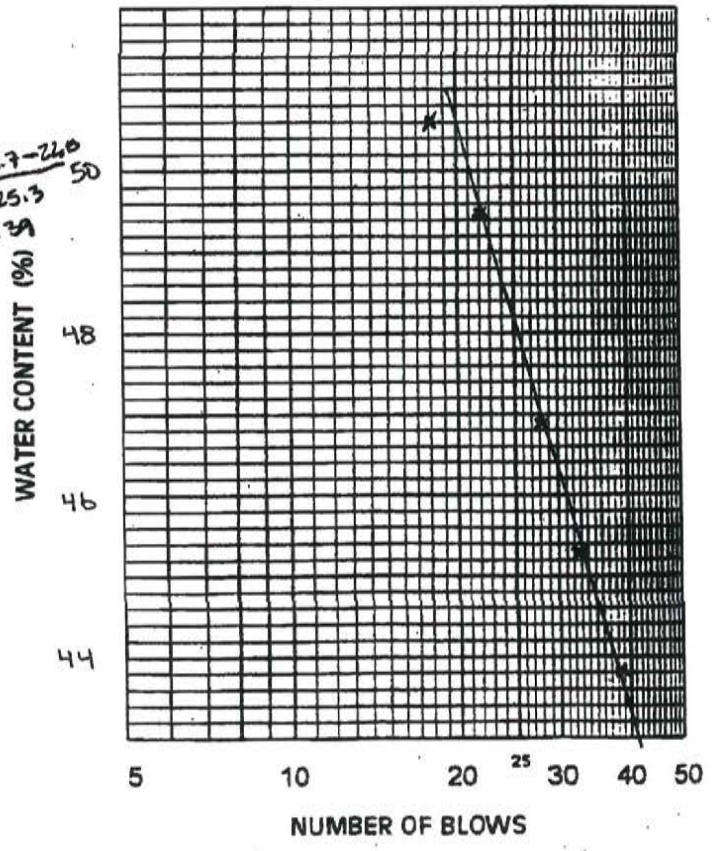
CL/CH

$LI = \frac{32.7 - 22.8}{25.3}$ 50

$LI = 0.39$

PLASTICITY CHART





SEVEE & MAHER ENGINEERS

APPENDIX C
Contaminated Soils Findings

TABLE 1: SOIL SAMPLE ANALYTICAL RESULTS
M.W. Sewall Bulk Plant - 1110 High Street, Bath, Maine

Area of Concern	**Risk-Based Soil Remediation Guidelines**				**AOC 1**					**AOC 2**				**AOC 3**			**AOC 4**					
Sample Location					SB-1-S2	TP-1-S2	TP-5-S1	TP-15-S1	TP-15-S2	TP-6-S1	TP-6-S4	TP-7-S1	TP-7-S2	TP-8-S1	TP-8-S1 DUP	TP-8-S2	SB-3-S1	SB-3-S2	SB-4-S1	SB-5-S1	SB-5-S3	TP-12-S1
Sample Depth (ft bgs)	Residential	Park User	Outdoor Commercial	Excavation/ Construction	2 - 4 feet	2 - 4 feet	0 - 2 feet	0 - 2 feet	2 - 4 feet	0 - 2 feet	0 - 2 feet	0 - 2 feet	2 - 4 feet	0 - 2 feet	0 - 2 feet	2 - 4 feet	0 - 2 feet	2 - 4 feet	0 - 2 feet	0 - 2 feet	4 - 6 feet	0 - 2 feet
Sample Date					2/10/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/11/2010	2/10/2010	2/10/2010	2/10/2010	2/10/2010	2/10/2010	2/11/2010
Volatile Organic Compounds (VOCs)	Concentrations in mg/kg				Concentrations in mg/kg																	
Benzene	17	28	86	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	1.97 J
sec-Butylbenzene	NS	NS	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	2.98
Ethylbenzene	130	210	420	2,700	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	18.00
Isopropylbenzene	NS	NS	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	4.84
p-Isopropyltoluene	NS	NS	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	2.35
Napthalene	200	330	200	32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	5.78
n-Propylbenzene	NS	NS	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	12.40
Toluene	2,700	4,500	10,000	10,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	35.60
1,2,4-Trimethylbenzene	NS	NS	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	99.20
1,3,5-Trimethylbenzene	NS	NS	NS	NS	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	46.00
o-Xylene	6,600	10,000	10,000	7,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	34.80
m,p-Xylene	6,600	10,000	10,000	7,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.104)	BRL (0.105)	89.80
All VOC's	Various	Various	Various	Various	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (Various)	BRL (Various)	BRL (Various)
Semivolatile Organic Compounds (SVOCs)	Concentrations in mg/kg				Concentrations in mg/kg																	
Napthalene	200	330	200	32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.290)	BRL (0.290)	5.10
2-Methylnapthalene	94	160	480	35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.189 J	BRL (0.290)	4.01
All other SVOC Compounds	Various	Various	Various	Various	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (Various)	BRL (Various)	BRL (Various)
Polyaromatic Hydrocarbons (PAHs)	Concentrations in mg/kg				Concentrations in mg/kg																	
Napthalene	200	330	200	32	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	BRL (0.290)	BRL (0.280)	BRL (0.320)	NA	NA	NA	NA	NA	NA
Acenapthylene	1,000	1,700	2,200	130	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.197 J	0.310	BRL (0.320)	NA	NA	NA	NA	NA	NA
Acenapthene	970	1,600	2,000	110	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	BRL (0.290)	BRL (0.280)	BRL (0.320)	NA	NA	NA	NA	NA	NA
Fluorene	830	1,400	2,700	200	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	BRL (0.290)	BRL (0.280)	BRL (0.320)	NA	NA	NA	NA	NA	NA
Phenanthrene	700	1,200	3,600	470	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.809	0.256 J	BRL (0.320)	NA	NA	NA	NA	NA	NA
Anthracene	4,300	7,200	7,800	430	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.304	0.213 J	BRL (0.320)	NA	NA	NA	NA	NA	NA
Fluoranthene	1,000	1,700	7,300	10,000	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	1.51	0.978	BRL (0.320)	NA	NA	NA	NA	NA	NA
Pyrene	750	1,200	5,500	10,000	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	1.32	1.09	BRL (0.320)	NA	NA	NA	NA	NA	NA
Benzo[a]anthracene	0.26	0.44	3.5	43	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	**0.815**	**0.573**	BRL (0.320)	NA	NA	NA	NA	NA	NA
Chrysene	26	44	350	4,300	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.711	0.614	BRL (0.320)	NA	NA	NA	NA	NA	NA
Benzo[b]fluoranthene	0.26	0.44	3.5	43	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	**1.13**	**1.03**	BRL (0.320)	NA	NA	NA	NA	NA	NA
Benzo[k]fluoranthene	2.6	4.4	35	430	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.352	0.377	BRL (0.320)	NA	NA	NA	NA	NA	NA
Benzo[a]pyrene	0.026	0.044	0.35	4.3	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	**0.678**	**0.591**	BRL (0.320)	NA	NA	NA	NA	NA	NA
Dibenzo[a,h]anthracene	0.026	0.044	0.35	4.3	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	BRL (0.290)	BRL (0.280)	BRL (0.320)	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	750	1,200	5,500	10,000	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.182 J	0.197 J	BRL (0.320)	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	0.26	0.44	3.5	43	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	0.209 J	0.183 J	BRL (0.320)	NA	NA	NA	NA	NA	NA
2-Methylnapthalene	94	160	480	35	NA	NA	NA	BRL (0.280)	NA	NA	NA	NA	NA	BRL (0.290)	BRL (0.280)	BRL (0.320)	NA	NA	NA	NA	NA	NA
Volatile Petroleum Hydrocarbon (VPH) Compounds	Concentrations in mg/kg				Concentrations in mg/kg																	
Benzene	17	28	86	30	BRL (0.480)	BRL (0.130)	BRL (0.110)	NA	BRL (1.20)	BRL (0.100)	BRL (0.130)	BRL (0.140)	BRL (5.04)	BRL (0.110)	BRL (0.110)	BRL (0.140)	BRL (0.190)	BRL (14.2)	BRL (0.130)	BRL (0.130)	BRL (0.110)	8.12 J
Ethylbenzene	130	210	420	2,700	0.578	BRL (0.130)	BRL (0.110)	NA	BRL (1.20)	0.095 J	BRL (0.130)	BRL (0.140)	3.28 J	BRL (0.110)	BRL (0.110)	BRL (0.140)	BRL (0.190)	27.8	BRL (0.130)	BRL (0.130)	BRL (0.110)	48.9
Methyl-tert-butyl ether	780	1,300	2,600	10,000	BRL (0.480)	BRL (0.130)	BRL (0.110)	NA	BRL (1.20)	BRL (0.100)	BRL (0.130)	BRL (0.140)	BRL (5.04)	BRL (0.110)	BRL (0.110)	0.077 J	BRL (0.190)	BRL (14.2)	BRL (0.130)	BRL (0.130)	BRL (0.110)	6.43 J
Napthalene	200	330	200	32	4.88	BRL (0.130)	BRL (0.110)	NA	BRL (1.20)	0.345	BRL (0.130)	BRL (0.140)	6.2	BRL (0.110)	BRL (0.110)	BRL (0.140)	BRL (0.190)	18.2	BRL (0.130)	0.157	BRL (0.110)	16.1
Toluene	2,700	4,500	10,000	10,000	BRL (0.480)	BRL (0.130)	BRL (0.110)	NA	BRL (1.20)	BRL (0.100)	0.194	BRL (0.140)	BRL (5.04)	0.072 J	BRL (0.110)	BRL (0.140)	BRL (0.190)	BRL (14.2)	BRL (0.130)	BRL (0.130)	BRL (0.110)	83.1
m- & p-Xylenes	6,600	10,000	10,000	7,000	BRL (0.960)	BRL (0.250)	BRL (0.230)	NA	BRL (2.39)	BRL (0.200)	0.372	BRL (0.270)	BRL (10.1)	BRL (0.230)	BRL (0.210)	BRL (0.280)	BRL (0.370)	36.9	BRL (0.270)	BRL (0.260)	BRL (0.230)	170.0
o-Xylene	6,600	10,000	10,000	7,000	0.306 J	BRL (0.130)	BRL (0.110)	NA	BRL (1.20)	BRL (0.100)	0.071 J	BRL (0.140)	BRL (5.04)	BRL (0.110)	BRL (0.110)	BRL (0.140)	BRL (0.190)	BRL (14.2)	BRL (0.130)	BRL (0.130)	BRL (0.110)	65.8
Volatile Petroleum Hydrocarbon (VPH) Fractions	Concentrations in mg/kg				Concentrations in mg/kg																	
C_5 through C_8 Aliphatics	1,400	2,300	10,000	10,000	BRL (12.0)	BRL (3.16)	BRL (2.82)	NA	BRL (29.90)	BRL (2.51)	3.19	BRL (3.40)	BRL (126)	BRL (2.83)	BRL (2.64)	BRL (3.54)	BRL (4.65)	437	BRL (3.35)	BRL (3.30)	BRL (2.85)	**2,300**
C_9 through C_{12} Aliphatics	2,600	4,400	10,000	9,800	91.3	BRL (3.16)	BRL (2.82)	NA	113.0	14.5	1.84 J	BRL (3.40)	655	BRL (2.83)	BRL (2.64)	BRL (3.54)	2.42 J	**2,960**	BRL (3.35)	12.8	3.82	1,590
C_9 through C_{10} Aromatics	740	1,200	5,100	5,500	55.1	BRL (1.26)	BRL (1.13)	NA	80.2	11.7	1.42 J	BRL (1.36)	496	BRL (1.13)	BRL (1.06)	BRL (1.42)	BRL (0.930)	**2,420**	BRL (0.670)	7.46	2.00	**1,430**
Extractable Petroleum Hydrocarbon (EPH) Compounds	Concentrations in mg/kg				Concentrations in mg/kg																	
Napthalene	200	330	200	32	3.02	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	0.181 J	BRL (0.285)	BRL (0.288)	BRL (0.326)	BRL (0.343)	2.94	BRL (0.315)	BRL (0.279)	BRL (0.295)	6.22
2-Methylnapthalene	94	160	480	35	4.16	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	1.57	BRL (0.285)	BRL (0.288)	BRL (0.326)	BRL (0.343)	19.0	BRL (0.315)	0.175 J	BRL (0.295)	5.57
Phenanthrene	700	1,200	3,600	470	9.28	BRL (0.315)	BRL (0.295)	NA	1.420	BRL (2.797)	BRL (0.309)	BRL (0.311)	0.398	0.229 J	0.812	BRL (0.326)	BRL (0.343)	2.68	BRL (0.315)	BRL (0.279)	BRL (0.295)	0.205 J
Acenapthene	970	1,600	2,000	110	BRL (2.746)	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	BRL (0.285)	BRL (0.288)	BRL (0.326)	BRL (0.343)	1.20 J	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Acenapthylene	1,000	1,700	2,200	130	BRL (2.746)	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	BRL (0.285)	0.204 J	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Fluorene	830	1,400	2,700	200	2.58 J	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	0.308	BRL (0.285)	BRL (0.288)	BRL (0.326)	BRL (0.343)	1.66	BRL (0.315)	BRL (0.279)	BRL (0.295)	0.192 J
Anthracene	4,300	7,200	7,800	430	2.29 J	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	BRL (0.285)	0.273 J	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Fluoranthene	1,000	1,700	7,300	10,000	3.95	0.309 J	BRL (0.295)	NA	1.240	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	0.707	1.85	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Pyrene	750	1,200	5,500	10,000	7.09	0.353	0.173 J	NA	1.25	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	0.807	1.78	BRL (0.326)	BRL (0.343)	1.27 J	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Benzo[a]anthracene	0.26	0.44	3.5	43	**1.53 J**	0.205 J	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	**0.426**	**0.925**	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Chrysene	26	44	350	4,300	2.48 J	0.247 J	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	0.445	0.916	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Benzo[b]fluoranthene	0.26	0.44	3.5	43	BRL (2.746)	**0.265 J**	BRL (0.295)	NA	**0.654 J**	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	**0.613**	**1.090**	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Benzo[k]fluoranthene	2.6	4.4	35	430	BRL (2.746)	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	0.184 J	0.392	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Benzo[a]pyrene	0.026	0.044	0.35	4.3	BRL (2.746)	**0.220 J**	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	**0.519**	**0.815**	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Indeno[1,2,3-cd]pyrene	0.26	0.44	3.5	43	BRL (2.746)	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	**0.336**	**0.354**	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Dibenzo[a,h]anthracene	0.026	0.044	0.35	4.3	BRL (2.746)	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	BRL (0.285)	BRL (0.288)	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Benzo[g,h,i]perylene	750	1,200	5,500	10,000	BRL (2.746)	BRL (0.315)	BRL (0.295)	NA	BRL (1.208)	BRL (2.797)	BRL (0.309)	BRL (0.311)	BRL (0.305)	0.386	0.366	BRL (0.326)	BRL (0.343)	BRL (1.54)	BRL (0.315)	BRL (0.279)	BRL (0.295)	BRL (0.302)
Extractable Petroleum Hydrocarbon (EPH) Fractions	Concentrations in mg/kg				Concentrations in mg/kg																	
C_9 through C_{18} Aliphatics	2,600	4,400	10,000	7,300	358 J	BRL (31.5)	BRL (29.5)	NA	995	BRL (6,990)	BRL (309)	40.9	1,150	BRL (228)	BRL (144)	BRL (32.6)	52.4	**3,130**	BRL (63.0)	113	BRL (29.5)	601
C_{19} through C_{36} Aliphatics	10,000	10,000	10,000	10,000	1,810	17.4 J	75.8	NA	1,690	**10,700**	812	67.2	BRL (610)	201 J	151	69.3	19.7 J	BRL (3,080)	186	BRL (112)	BRL (29.5)	BRL (302)
C_{11} through C_{22} Aromatics	730	1,200	4,500	4,700	**1,760**	29.7 J	BRL (29.5)	NA	561	**1,870**	89.1	BRL (31.1)	163	87.1	95.1	BRL (32.6)	244	**1,130**	90.7	18.2 J	BRL (29.5)	92.4
Poly-chlorinated Biphenyls (PCBs)	Concentrations in mg/kg				Concentrations in mg/kg																	
All Aroclors	0.49	0.82	1.2	1.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.036)	BRL (0.036)	BRL (0.036)
Metals	Concentrations in mg/kg				Concentrations in mg/kg																	
Arsenic	0.14	0.23	0.42	4.2	NA	NA	NA	NA	**16.2**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**7.0**	**11.4**	**8.3**
Barium	6,800	10,000	10,000	10,000	NA	NA	NA	NA	112	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	40	115	91
Cadmium	2.1	3.6	19	3.9	NA	NA	NA	NA	**3.3**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (1.1)	BRL (2.2)	0.3 J
Chromium	100	170	1,000	560	NA	NA	NA	NA	48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	28	62	17
Lead	170	280	560	950	NA	13	10	NA	58	7	5	11	4	7	19	9	36	8	BRL (4)	5	6	116
Mercury	10	17	100	190	NA	NA	NA	NA	0.03 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (0.06)	BRL (0.06)	0.08
Selenium	68	110	680	310	NA	NA	NA	NA	BRL (2.3)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (1.1)	BRL (2.2)	0.8 J
Silver	170	280	1,700	310	NA	NA	NA	NA	BRL (1.1)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	BRL (1.1)	BRL (1.1)	BRL (1.2)

Notes:
ft bgs = feet below ground surface; NA = Not Analyzed; NS = No Standard
BRL( ) = Below laboratory reporting limit shown in parenthesis
mg/kg = milligrams per kilogram
J = estimated concentration detected above the laboratory detection limit, but below the laboratory reporting limit
Bold type font indicates concentration exceeds Risk-Based Soil Remediation Guideline for any of the reuse scenarios.
MEDEP Remedial Action Guidelines (RAGs) for sites with multiple contaminants, January 6, 2010 (VOCs, SVOCs, PCBs, and Metals).
Remediation Guidelines for Petroleum Contaminated Sites in Maine, December 1, 2009 (EPH and VPH).

TABLE 1: SOIL SAMPLE ANALYTICAL RESULTS
M.W. Sewall Bulk Plant - 1110 High Street, Bath, Maine

Area of Concern	**Risk-Based Soil Remediation Guidelines**				**AOC 5**					**Background**			
Sample Location					SB-7-S1	SB-7-S3	TP-14-S1	TP-14-S3	TP-14-S3 DUP	SB-8-S1	SB-8-S3	BK-2	BK-3
Sample Depth (ft bgs)	Residential	Park User	Outdoor Commercial	Excavation/ Construction	0 - 2 feet	4 - 6 feet	0 - 2 feet	4 - 6 feet	4 - 6 feet	0 - 2 feet	4 - 6 feet	0 - 0.5 feet	0 - 0.5 feet
Sample Date					2/10/2010	2/10/2010	2/11/2010	2/11/2010	2/11/2010	2/10/2010	2/10/2010	2/12/2010	2/12/2010
Volatile Organic Compounds (VOCs)	Concentrations in mg/kg				Concentrations in mg/kg								
Benzene	17	28	86	30	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
sec-Butylbenzene	NS	NS	NS	NS	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
Ethylbenzene	130	210	420	2,700	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
Isopropylbenzene	NS	NS	NS	NS	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
p-Isopropyltoluene	NS	NS	NS	NS	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
Napthalene	200	330	200	32	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
n-Propylbenzene	NS	NS	NS	NS	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
Toluene	2,700	4,500	10,000	10,000	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
1,2,4-Trimethylbenzene	NS	NS	NS	NS	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
1,3,5-Trimethylbenzene	NS	NS	NS	NS	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
o-Xylene	6,600	10,000	10,000	7,000	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
m,p-Xylene	6,600	10,000	10,000	7,000	BRL (0.103)	BRL (0.105)	BRL (0.128)	BRL (0.124)	BRL (0.123)	NA	NA	NA	NA
All VOC's	Various	Various	Various	Various	BRL (Various)	BRL (Various)	BRL (Various)	BRL (Various)	BRL (Various)	NA	NA	NA	NA
Semivolatile Organic Compounds (SVOCs)	Concentrations in mg/kg				Concentrations in mg/kg								
Napthalene	200	330	200	32	BRL (0.310)	1.98	BRL (0.340)	BRL (0.340)	BRL (0.340)	NA	NA	NA	NA
2-Methylnapthalene	94	160	480	35	BRL (0.310)	3.49	BRL (0.340)	BRL (0.340)	BRL (0.340)	NA	NA	NA	NA
All other SVOC Compounds	Various	Various	Various	Various	BRL (Various)	BRL (Various)	BRL (Various)	BRL (Various)	BRL (Various)	NA	NA	NA	NA
Polyaromatic Hydrocarbons (PAHs)	Concentrations in mg/kg				Concentrations in mg/kg								
Napthalene	200	330	200	32	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenapthylene	1,000	1,700	2,200	130	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acenapthene	970	1,600	2,000	110	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	830	1,400	2,700	200	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	700	1,200	3,600	470	NA	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	4,300	7,200	7,800	430	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	1,000	1,700	7,300	10,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	750	1,200	5,500	10,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo[a]anthracene	0.26	0.44	3.5	43	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	26	44	350	4,300	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo[b]fluoranthene	0.26	0.44	3.5	43	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo[k]fluoranthene	2.6	4.4	35	430	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo[a]pyrene	0.026	0.044	0.35	4.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	0.26	0.44	3.5	43	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dibenzo[a,h]anthracene	0.026	0.044	0.35	4.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	750	1,200	5,500	10,000	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	0.26	0.44	3.5	43	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnapthalene	94	160	480	35	NA	NA	NA	NA	NA	NA	NA	NA	NA
Volatile Petroleum Hydrocarbon (VPH) Compounds	Concentrations in mg/kg				Concentrations in mg/kg								
Benzene	17	28	86	30	BRL (0.530)	BRL (13.1)	BRL (0.160)	BRL (0.150)	BRL (0.150)	NA	NA	NA	NA
Ethylbenzene	130	210	420	2,700	BRL (0.530)	28.6	BRL (0.160)	BRL (0.150)	BRL (0.150)	NA	NA	NA	NA
Methyl-tert-butyl ether	780	1,300	2,600	10,000	BRL (0.530)	BRL (13.1)	BRL (0.160)	BRL (0.150)	BRL (0.150)	NA	NA	NA	NA
Napthalene	200	330	200	32	1.39	BRL (13.1)	BRL (0.160)	0.737	0.340	NA	NA	NA	NA
Toluene	2,700	4,500	10,000	10,000	BRL (0.530)	BRL (13.1)	BRL (0.160)	BRL (0.150)	BRL (0.150)	NA	NA	NA	NA
m- & p-Xylenes	6,600	10,000	10,000	7,000	BRL (1.06)	14.6 J	BRL (0.320)	BRL (0.290)	BRL (0.300)	NA	NA	NA	NA
o-Xylene	6,600	10,000	10,000	7,000	BRL (0.530)	BRL (13.1)	BRL (0.160)	BRL (0.150)	BRL (0.150)	NA	NA	NA	NA
Volatile Petroleum Hydrocarbon (VPH) Fractions	Concentrations in mg/kg				Concentrations in mg/kg								
C_5 through C_8 Aliphatics	1,400	2,300	10,000	10,000	BRL (13.3)	**2,040**	BRL (3.95)	BRL (3.66)	BRL (3.76)	NA	NA	NA	NA
C_9 through C_{12} Aliphatics	2,600	4,400	10,000	9,800	77.9	1,410	BRL (3.95)	35.6	11.3	NA	NA	NA	NA
C_9 through C_{10} Aromatics	740	1,200	5,100	5,500	46.2	**906**	BRL (1.58)	29.1	8.27	NA	NA	NA	NA
Extractable Petroleum Hydrocarbon (EPH) Compounds	Concentrations in mg/kg				Concentrations in mg/kg								
Napthalene	200	330	200	32	BRL (0.316)	1.26	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
2-Methylnapthalene	94	160	480	35	BRL (0.316)	2.31	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Phenanthrene	700	1,200	3,600	470	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Acenapthene	970	1,600	2,000	110	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Acenapthylene	1,000	1,700	2,200	130	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Fluorene	830	1,400	2,700	200	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Anthracene	4,300	7,200	7,800	430	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Fluoranthene	1,000	1,700	7,300	10,000	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Pyrene	750	1,200	5,500	10,000	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Benzo[a]anthracene	0.26	0.44	3.5	43	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Chrysene	26	44	350	4,300	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Benzo[b]fluoranthene	0.26	0.44	3.5	43	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Benzo[k]fluoranthene	2.6	4.4	35	430	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Benzo[a]pyrene	0.026	0.044	0.35	4.3	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene	0.26	0.44	3.5	43	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Dibenzo[a,h]anthracene	0.026	0.044	0.35	4.3	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Benzo[g,h,i]perylene	750	1,200	5,500	10,000	BRL (0.316)	BRL (0.326)	BRL (0.346)	BRL (0.345)	BRL (0.336)	NA	NA	NA	NA
Extractable Petroleum Hydrocarbon (EPH) Fractions	Concentrations in mg/kg				Concentrations in mg/kg								
C_9 through C_{18} Aliphatics	2,600	4,400	10,000	7,300	219	272	29.6 J	222	101	NA	NA	NA	NA
C_{19} through C_{36} Aliphatics	10,000	10,000	10,000	10,000	128.0	BRL (131)	31.8 J	BRL (138)	BRL (67.1)	NA	NA	NA	NA
C_{11} through C_{22} Aromatics	730	1,200	4,500	4,700	21.9 J	34.5	34.6	47	20.1 J	NA	NA	NA	NA
Poly-chlorinated Biphenyls (PCBs)	Concentrations in mg/kg				Concentrations in mg/kg								
All Aroclors	0.49	0.82	1.2	1.3	BRL (0.040)	BRL (0.040)	BRL (0.043)	BRL (0.043)	BRL (0.043)	NA	NA	NA	NA
Metals	Concentrations in mg/kg				Concentrations in mg/kg								
Arsenic	0.14	0.23	0.42	4.2	**18.0**	**12.8**	**10.2**	**11.5**	**16.9**	**16.9**	**19.2**	**5.8**	**11.9**
Barium	6,800	10,000	10,000	10,000	135	117	117	151	147	124	139	67	103
Cadmium	2.1	3.6	19	3.9	BRL (2.4)	BRL (2.4)	BRL (1.3)	BRL (1.3)	BRL (2.6)	BRL (2.5)	BRL (2.5)	BRL (1.9)	BRL (1.5)
Chromium	100	170	1,000	560	67	62	44	66	68	67	67	14	50
Lead	170	280	560	950	11	7	57	11	16	16	9	124	37
Mercury	10	17	100	190	BRL (0.06)	BRL (0.06)	0.08	0.03	0.03 J	BRL (0.06)	BRL (0.06)	0.19	0.08
Selenium	68	110	680	310	BRL (2.4)	BRL (2.4)	BRL (2.6)	BRL (2.6)	BRL (2.6)	BRL (2.5)	BRL (2.5)	BRL (1.9)	BRL (3.1)
Silver	170	280	1,700	310	BRL (1.2)	BRL (1.2)	BRL (1.3)	BRL (1.3)	BRL (1.3)	BRL (1.3)	BRL (1.3)	BRL (1.9)	BRL (1.5)

Notes:
ft bgs = feet below ground surface; NA = Not Analyzed; NS = No Standard
BRL( ) = Below laboratory reporting limit shown in parenthesis
mg/kg = milligrams per kilogram
J = estimated concentration detected above the laboratory detection limit, but below the laboratory reporting limit
Bold type font indicates concentration exceeds Risk-Based Soil Remediation Guideline for any of the reuse scenarios.
MEDEP Remedial Action Guidelines (RAGs) for sites with multiple contaminants, January 6, 2010 (VOCs, SVOCs, PCBs, and Metals).
Remediation Guidelines for Petroleum Contaminated Sites in Maine, December 1, 2009 (EPH and VPH).

TABLE 2: WATER SAMPLE ANALYTICAL RESULTS
M.W. Sewall Bulk Plant
1110 High Street
Bath, Maine

AREA OF CONCERN	AOC 2	AOC 4	Background	MCDC Maximum Exposure Guidelines (MEGs)
LOCATION	MW-2	MW-3	MW-5	
SAMPLING DATE	2/12/2010	2/12/2010	2/12/2010	
Volatile Organic Compounds (VOCs)	Concentrations in µg/L			
Benzene	NA	**9 J**	NA	6
Bromomethane	NA	5.3 J	NA	10
sec-Butylbenzene	NA	21	NA	NS
Ethylbenzene	NA	**133**	NA	70
Isopropylbenzene	NA	35	NA	NS
p-Isopropyltoluene	NA	35	NA	70
Nathalene	NA	**94**	NA	14
n-Propylbenzene	NA	54	NA	NS
1,2,4-Trimethylbenzene	NA	610	NA	NS
1,3,5-Trimethylbenzene	NA	179	NA	NS
o-Xylene	NA	6.2 J	NA	1,400
m,p-Xylene	NA	443	NA	1,400
All Other VOCs	NA	BRL (Various)	NA	Various
Semivolatile Organic Compounds (SVOCs)	Concentrations in µg/L			
2-Methylnaphthalene	NA	144	NA	NS
Naphthalene	NA	**40**	NA	14
Phenanthrene	NA	4	NA	NS
Dibenzofuran	NA	3 J	NA	NS
All Other SVOCs	NA	BRL (Various)	NA	Various
Volatile Petroleum Hydrocarbon (VPH) Compounds	Concentrations in µg/L			
Ethylbenzene	BRL (2)	**120**	NA	70
Naphthalene	BRL (2)	**142**	NA	14
m- & p-Xylenes	BRL (4)	336	NA	1,400
All Other VPH Compounds	BRL (2)	BRL (40)	NA	Various
Volatile Petroleum Hydrocarbon (VPH) Fractions	Concentrations in µg/L			
C_5 through C_8 Aliphatics	BRL (50)	BRL (1,000)	NA	NS
C_9 through C_{12} Aliphatics	BRL (50)	8,990	NA	NS
C_9 through C_{10} Aromatics	BRL (10)	6,500	NA	NS
Extractable Petroleum Hydrocarbon (EPH) Compounds	Concentrations in µg/L			
Naphthalene	BRL (4)	**41**	NA	14
2-Methylnaphthalene	BRL (4)	156	NA	NS
Phenanthrene	BRL (4)	5	NA	NS
Acenapthene	BRL (4)	3 J	NA	NS
Fluorene	BRL (4)	5	NA	NS
All Other EPH Compounds	BRL (4)	BRL (4)	NA	Various
Extractable Petroleum Hydrocarbon (EPH) Fractions	Concentrations in µg/L			
C_9 through C_{18} Aliphatics	137 J	4,680	NA	NS
C_{19} through C_{36} Aliphatics	BRL (220)	BRL (200)	NA	NS
C_{11} through C_{22} Aromatics	BRL (165)	1,810	NA	NS
Metals	Concentrations in ug/L			
Arsenic	NA	**51**	3	10
Barium	NA	29	3	2,000
Cadmium	NA	0.4 J	0.3	3.5
Chromium	NA	4 J	BRL (5)	35
Lead	7	1 J	2	10
Mercury	NA	BRL (0.5)	BRL (0.5)	2
Selenium	NA	13	BRL (5)	35
Silver	NA	0.4 J	BRL (1)	35

Notes:
µg/L = micrograms per liter
BRL( ) = Below laboratory reporting limit shown in parenthesis
NA= Not Analyzed
NS = No Standard
Groundwater guidelines for VOCs and Metals taken from Maine Center for Disease Control Maximum Exposure Guidelines, December 5, 2008.
Bold type font indicates concentration exceeds the MCDC Maximum Exposure Guideline (MEGs).

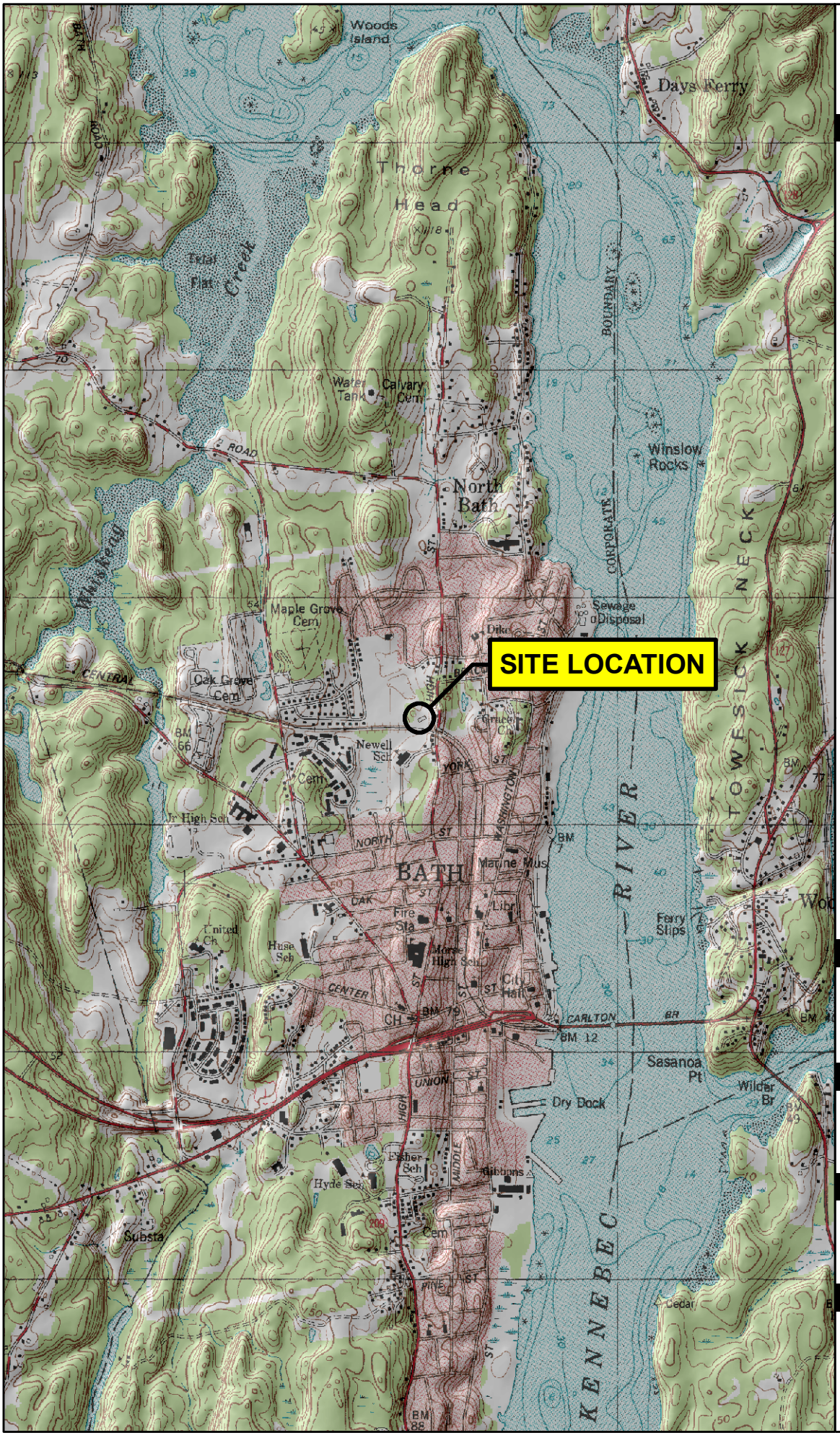
TABLE 3: SOIL VAPOR ANALYTICAL RESULTS
M.W. Sewall Bulk Plant
1110 High Street
Bath, Maine

LOCATION	SV-1	SV-2	SV-3	Soil Gas Target	Indoor Air Target
SAMPLING DATE	2/10/2010	2/10/2010	2/10/2010	(multi-contaminant site)	(multi-contaminant site)
Volatile Organic Compounds (VOC's)	Concentrations in µg/m^3				
1,3-Butadiene	BRL (0.942)	BRL (1.00)	**6.12**	4.10	0.081
2-Butanone	1.72	6.62	10.4	52,000	1,000
Acetone	15.7	25.9	44.8	NS	NS
Benzene	BRL (1.36)	1.77	5.47	16	0.31
Carbon disulfide	BRL (1.33)	BRL (1.41)	4.68	7,300	150
Chloroform	BRL (2.08)	BRL (2.21)	**41.8**	5.3	0.11
Chloromethane	1.16	1.21	BRL (0.905)	940.0	19
Cyclohexane	BRL (1.47)	BRL (1.56)	1.64	NS	NS
Dichlorodifluoromethane	2.49	2.54	2.37	2,100	42
Ethanol	BRL (10.0)	15.5	BRL (10.3)	NS	NS
Heptane	BRL (1.75)	BRL (1.85)	5.08	NS	NS
n-Hexane	BRL (1.50)	4.08	19.8	NS	NS
Propylene	BRL (0.733)	9.75	35	NS	NS
Toluene	2.35	2.53	4.03	52,000	1,000
All Other VOCs	BRL (Various)	BRL (Various)	BRL (Various)	Various	Various

Notes:
NS = No Standard
BRL( ) = Below laboratory reporting limit shown in parenthesis
Soil vapor guidelines taken from the Maine Department of Environmental Protection Bureau of Remediation Draft Vapor Intrusion Evaluation Guidance, August 5, 2009
Bold type font indicates concentration exceeds the Soil Gas Target for a multi-contaminant site.

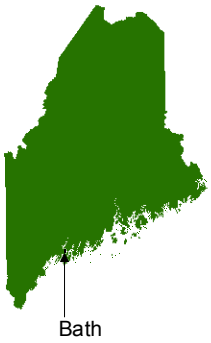
TABLE 4: SUMMARY OF DUPLICATE SAMPLE ANALYTICAL RESULTS
M.W. Sewall Bulk Plant - 1110 High Street, Bath, Maine

Sample Location	TP-8-S1	TP-8-S1 DUP	Relative	TP-14-S3	TP-14-S3 DUP	Relative
Sample Depth (ft bgs)	0 - 2 feet	0 - 2 feet	Percent	4 - 6 feet	4 - 6 feet	Percent
Sample Date	2/11/2010	2/11/2010	Difference	2/11/2010	2/11/2010	Difference
Volatile Organic Compounds (VOCs)	Concentrations in mg/kg		%	Concentrations in mg/kg		%
Benzene	NA	NA		BRL (0.124)	BRL (0.123)	
sec-Butylbenzene	NA	NA		BRL (0.124)	BRL (0.123)	
Ethylbenzene	NA	NA		BRL (0.124)	BRL (0.123)	
Isopropylbenzene	NA	NA		BRL (0.124)	BRL (0.123)	
p-Isopropyltoluene	NA	NA		BRL (0.124)	BRL (0.123)	
Napthalene	NA	NA		BRL (0.124)	BRL (0.123)	
n-Propylbenzene	NA	NA		BRL (0.124)	BRL (0.123)	
Toluene	NA	NA		BRL (0.124)	BRL (0.123)	
1,2,4-Trimethylbenzene	NA	NA		BRL (0.124)	BRL (0.123)	
1,3,5-Trimethylbenzene	NA	NA		BRL (0.124)	BRL (0.123)	
o-Xylene	NA	NA		BRL (0.124)	BRL (0.123)	
m,p-Xylene	NA	NA		BRL (0.124)	BRL (0.123)	
All VOC's	NA	NA		BRL (Various)	BRL (Various)	
Semivolatile Organic Compounds (SVOCs)	Concentrations in mg/kg		%	Concentrations in mg/kg		%
Napthalene	NA	NA		BRL (0.340)	BRL (0.340)	
2-Methylnapthalene	NA	NA		BRL (0.340)	BRL (0.340)	
All other SVOC Compounds	NA	NA		BRL (Various)	BRL (Various)	
Polyaromatic Hydrocarbons (PAHs)	Concentrations in mg/kg		%	Concentrations in mg/kg		%
Napthalene	BRL (0.290)	BRL (0.280)		NA	NA	
Acenapthylene	0.197 J	0.310		NA	NA	
Acenapthene	BRL (0.290)	BRL (0.280)		NA	NA	
Fluorene	BRL (0.290)	BRL (0.280)		NA	NA	
Phenanthrene	0.809	0.256 J		NA	NA	
Anthracene	0.304	0.213 J		NA	NA	
Fluoranthene	1.51	0.978	42.8	NA	NA	
Pyrene	1.32	1.09	19.1	NA	NA	
Benzo[a]anthracene	**0.815**	**0.573**	34.9	NA	NA	
Chrysene	0.711	0.614	14.6	NA	NA	
Benzo[b]fluoranthene	**1.13**	**1.03**	9.3	NA	NA	
Benzo[k]fluoranthene	0.352	0.377	-6.9	NA	NA	
Benzo[a]pyrene	**0.678**	**0.591**	13.7	NA	NA	
Dibenzo[a,h]anthracene	BRL (0.290)	BRL (0.280)		NA	NA	
Benzo(g,h,i)perylene	0.182 J	0.197 J		NA	NA	
Indeno[1,2,3-cd]pyrene	0.209 J	0.183 J		NA	NA	
2-Methylnapthalene	BRL (0.290)	BRL (0.280)		NA	NA	
Volatile Petroleum Hydrocarbon (VPH) Compounds	Concentrations in mg/kg		%	Concentrations in mg/kg		%
Benzene	BRL (0.110)	BRL (0.110)		BRL (0.150)	BRL (0.150)	
Ethylbenzene	BRL (0.110)	BRL (0.110)		BRL (0.150)	BRL (0.150)	
Methyl-tert-butyl ether	BRL (0.110)	BRL (0.110)		BRL (0.150)	BRL (0.150)	
Napthalene	BRL (0.110)	BRL (0.110)		0.737	0.340	73.7
Toluene	0.072 J	BRL (0.110)		BRL (0.150)	BRL (0.150)	
m- & p-Xylenes	BRL (0.230)	BRL (0.210)		BRL (0.290)	BRL (0.300)	
o-Xylene	BRL (0.110)	BRL (0.110)		BRL (0.150)	BRL (0.150)	
Volatile Petroleum Hydrocarbon (VPH) Fractions	Concentrations in mg/kg		%	Concentrations in mg/kg		%
C_5 through C_8 Aliphatics	BRL (2.83)	BRL (2.64)		BRL (3.66)	BRL (3.76)	
C_9 through C_{12} Aliphatics	BRL (2.83)	BRL (2.64)		35.6	11.3	103.6
C_9 through C_{10} Aromatics	BRL (1.13)	BRL (1.06)		29.1	8.27	111.5
Extractable Petroleum Hydrocarbon (EPH) Compounds	Concentrations in mg/kg		%	Concentrations in mg/kg		%
Napthalene	BRL (0.285)	BRL (0.288)		BRL (0.345)	BRL (0.336)	
2-Methylnapthalene	BRL (0.285)	BRL (0.288)		BRL (0.345)	BRL (0.336)	
Phenanthrene	0.229 J	0.812		BRL (0.345)	BRL (0.336)	
Acenapthene	BRL (0.285)	BRL (0.288)		BRL (0.345)	BRL (0.336)	
Acenapthylene	BRL (0.285)	0.204 J		BRL (0.345)	BRL (0.336)	
Fluorene	BRL (0.285)	BRL (0.288)		BRL (0.345)	BRL (0.336)	
Anthracene	BRL (0.285)	0.273 J		BRL (0.345)	BRL (0.336)	
Fluoranthene	0.707	1.85	-89.4	BRL (0.345)	BRL (0.336)	
Pyrene	0.807	1.78	-75.2	BRL (0.345)	BRL (0.336)	
Benzo[a]anthracene	**0.426**	**0.925**	-73.9	BRL (0.345)	BRL (0.336)	
Chrysene	0.445	0.916	-69.2	BRL (0.345)	BRL (0.336)	
Benzo[b]fluoranthene	**0.613**	**1.090**	-56.0	BRL (0.345)	BRL (0.336)	
Benzo[k]fluoranthene	0.184 J	0.392		BRL (0.345)	BRL (0.336)	
Benzo[a]pyrene	**0.519**	**0.815**	-44.4	BRL (0.345)	BRL (0.336)	
Indeno[1,2,3-cd]pyrene	**0.336**	**0.354**	-5.2	BRL (0.345)	BRL (0.336)	
Dibenzo[a,h]anthracene	BRL (0.285)	BRL (0.288)		BRL (0.345)	BRL (0.336)	
Benzo[g,h,i]perylene	0.386	0.366	5.3	BRL (0.345)	BRL (0.336)	
Extractable Petroleum Hydrocarbon (EPH) Fractions	Concentrations in mg/kg		%	Concentrations in mg/kg		%
C_9 through C_{18} Aliphatics	BRL (228)	BRL (144)		222	101	74.9
C_{19} through C_{36} Aliphatics	201 J	151		BRL (138)	BRL (67.1)	
C_{11} through C_{22} Aromatics	87.1	95.1	-8.8	47	20.1 J	
Poly-chlorinated Biphenyls (PCBs)	Concentrations in mg/kg		%	Concentrations in mg/kg		%
All Aroclors	NA	NA		BRL (0.043)	BRL (0.043)	
Metals	Concentrations in mg/kg		%	Concentrations in mg/kg		%
Arsenic	NA	NA		**11.5**	**16.9**	-38.0
Barium	NA	NA		151	147	2.7
Cadmium	NA	NA		BRL (1.3)	BRL (2.6)	
Chromium	NA	NA		66	68	-3.0
Lead	7	19	-92.3	11	16	-37.0
Mercury	NA	NA		0.03	0.03 J	
Selenium	NA	NA		BRL (2.6)	BRL (2.6)	
Silver	NA	NA		BRL (1.3)	BRL (1.3)	



RANSOM Environmental Consultants, Inc.

Regional Locator Map



Notes

1. Data Source: USGS National Map Seamless Server, 24K DRG, 1/3" NED
2. USGS Quad Name: Bath
3. Latitude: 43° 55' 24.13" N
   Longitude: 69° 49' 12.17" W
   UTM Northing: 4863688.37 mN
   UTM Easting: 434168.08 mE

Scale and Orientation

0 1,000 2,000

1 inch = 2,000 feet

Prepared For

City of Bath
55 Front Street
Bath, Maine

Site Address

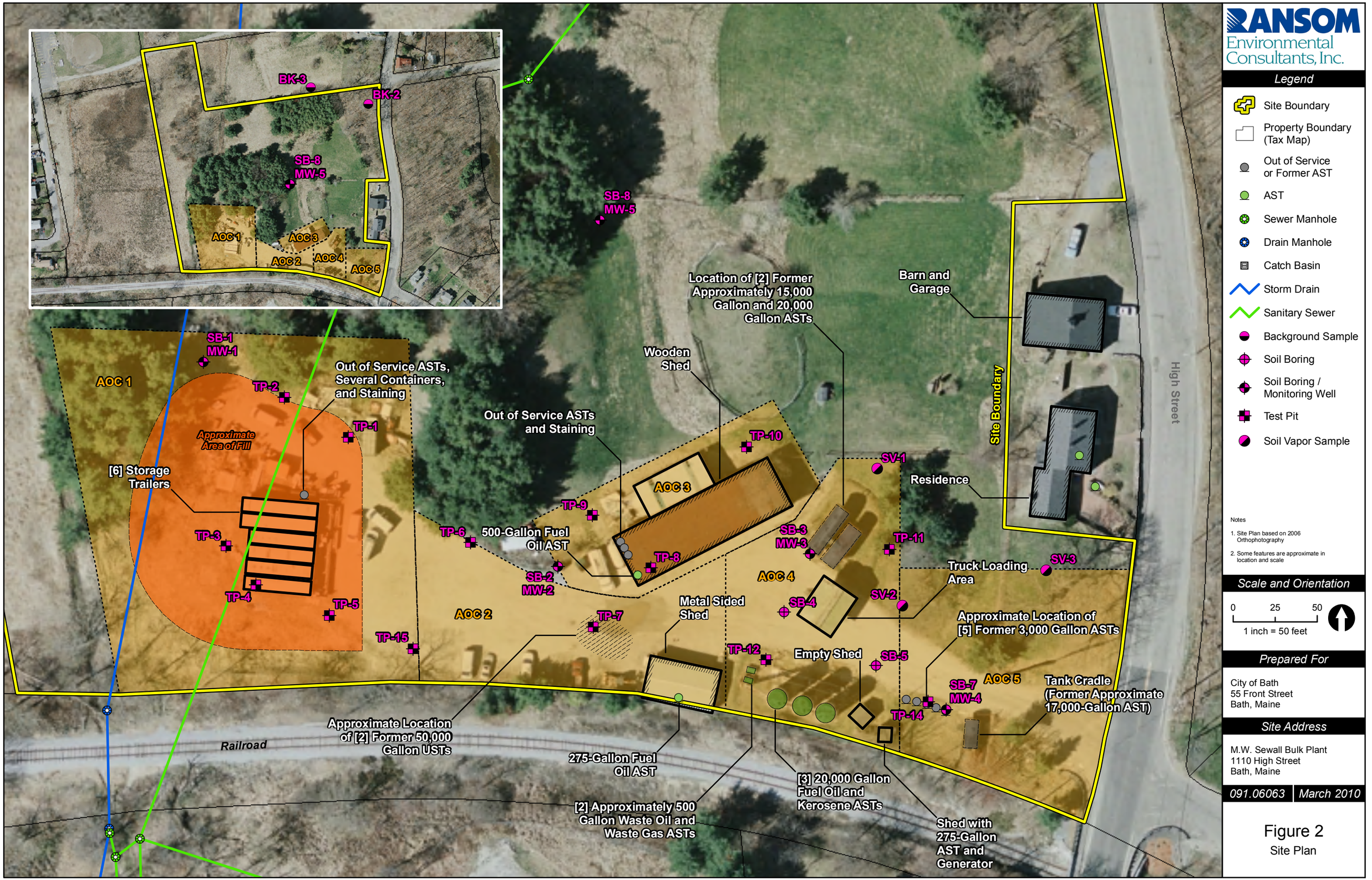
M.W. Sewall Bulk Plant
1110 High Street
Bath, Maine

091.06063 | March 2010

Figure 1

Site Location

G:\Data\ME\Project\091_06063\Maps\MXD\Figure_1.mxd



RANSOM
Environmental
Consultants, Inc.

Legend

- Site Boundary
- Property Boundary (Tax Map)
- Out of Service or Former AST
- AST
- Sewer Manhole
- Drain Manhole
- Catch Basin
- Storm Drain
- Sanitary Sewer
- Background Sample
- Soil Boring
- Soil Boring / Monitoring Well
- Test Pit
- Soil Vapor Sample

Notes

1. Site Plan based on 2006 Orthophotography
2. Some features are approximate in location and scale

Scale and Orientation

0 25 50

1 inch = 50 feet

Prepared For

City of Bath
55 Front Street
Bath, Maine

Site Address

M.W. Sewall Bulk Plant
1110 High Street
Bath, Maine

091.06063 | March 2010

Figure 2

Site Plan

G:\Data\ME\Project\091_06063\Maps\MXD\Figure_2_Phase_II.mxd



SB-1 / MW-1
PAHs (2-4')
EPH Fractions (2-4')
AOC 1
TP-2
Out of Service ASTs,
Several Containers,
and Staining
TP-1
PAHs (2-4')
Approximate
Area of Fill
[6] Storage
Trailers
TP-3
TP-4
TP-5
TP-6
EPH Fractions
(0-2')
500-Gallon Fuel
Oil AST
SB-2
MW-2
TP-15
PAHs (2-4')
Cd (2-4')
AOC 2
TP-7
Approximate Location
of [2] Former 50,000
Gallon USTs
Railroad
275-Gallon Fuel
Oil AST
[2] Approximately 500
Gallon Waste Oil and
Waste Gas ASTs
SB-8
MW-5
Location of [2] Former
Approximately 15,000
Gallon and 20,000
Gallon ASTs
Wooden
Shed
Out of Service ASTs
and Staining
TP-10
AOC 3
TP-9
TP-8
PAHs (0-2')
Metal Sided
Shed
TP-12
VPH Fractions (0-2')
Empty Shed
SB-4
SB-5
AOC 4
SV-1
Residence
SB-3 / MW-3
VPH Fractions (2-4')
EPH Fractions (2-4')
TP-11
Truck Loading
Area
SV-2
SV-3
1,3 - Butadiene
Chloroform
Barn and
Garage
Site Boundary
High Street
Approximate Location of
[5] Former 3,000 Gallon ASTs
AOC 5
SB-7 / MW-4
VPH Fractions (4-6')
TP-14
Tank Cradle
(Former Approximate
17,000-Gallon AST)
[3] 20,000 Gallon
Fuel Oil and
Kerosene ASTs
Shed with
275-Gallon
AST and
Generator

RANSOM
Environmental
Consultants, Inc.

Legend

- Site Boundary
- Property Boundary (Tax Map)
- Out of Service or Former AST
- AST
- Background Sample
- Soil Boring
- Soil Boring / Monitoring Well
- Test Pit
- Soil Vapor Sample
- Sample Exceedance (With Contaminant Name and depth in Feet)

Notes

1. Soil results presented on this figure are for contaminants detected at concentrations exceeding MEDEP RAGs for any of the expsoure scenarios.
2. Soil Vapor results presented on this figure are for contaminants detected at concentrations exceeding Maine Soil Gas Targets.
3. Site Plan based on 2006 Orthophotography
4. Some features are approximate in location and scale

Scale and Orientation

0 25 50
1 inch = 50 feet

Prepared For

City of Bath
55 Front Street
Bath, Maine

Site Address

M.W. Sewall Bulk Plant
1110 High Street
Bath, Maine

091.06063 | *March 2010*

Figure 3

Soil & Soil Vapor
Sample Exceedances

G:\Data\ME\Project\091_06063\Maps\MXD\Figure_3_Phase_II.mxd



RANSOM Environmental Consultants, Inc.

Legend

- Site Boundary
- Property Boundary (Tax Map)
- Out of Service or Former AST
- AST
- Background Sample
- Soil Boring
- Test Pit
- Soil Vapor Sample
- Soil Boring / Monitoring Well
- Groundwater Contour
- Sample Exceedance

Notes

1. Groundwater results presented on this figure are for contaminants detected at concentrations exceeding Maine MEGs.
2. Elevations are based on an assumed benchmark elevation of 100 feet.
3. Site Plan based on 2006 Orthophotography
4. Some features are approximate in location and scale

Scale and Orientation

0 25 50

1 inch = 50 feet

Prepared For

City of Bath
55 Front Street
Bath, Maine

Site Address

M.W. Sewall Bulk Plant
1110 High Street
Bath, Maine

091.06063 | *March 2010*

Figure 4

Groundwater Contours & Sample Exceedances

G:\Data\ME\Project\091_06063\Maps\MXD\Figure_4_Phase_II.mxd

APPENDIX A

Soil Boring and Test Pit Logs

Phase II Investigation
M.W. Sewall & Co. Bulk Plant Site
1110 High Street
Bath, Maine

RANSOM Environmental Consultants, Inc.

BORING AND MONITORING WELL LOG: SB-1/MW-1

Reviewed by:		Total Depth: 13 Feet	Logged By: EPP
Date Reviewed: 3-31-10		Boring Diameter: 2 Inches	Date Drilled: 2/10/10 to 2/10/10
GW Observed at: NA Feet		Well Stickup: NM	Driller: Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)	DEPTH	WELL CONSTRUCTION
	S1 (0.0'-2.0') - Top 5" - Brown, sandy loam. Middle 14" - pulverized granite rock. Bottom 5" - Gray/brown, CLAY, some fine SAND, moist. (No evidence of coal ash/residue)		S1	NM	24/24	1.8		
	S2 (2.0'-4.0') - Top 7" - Gray/brown, CLAY, some fine Sand, moist. Bottom 3" - Black coal ash/residue, slight petroleum odor.		S2	NM	24/10	20.0		
5	S3 (4.0'-6.0') - Top 5" - Pulverized rock (granite) mixed with coal ash/residue (sluff). Bottom 19" - Brown, medium to coarse SAND, some Clay, little gravel, moist to wet.		S3	NM	24/24	<1	5	
	S4 (6.0'-8.0') - Top 5" - Brown, SAND and CLAY, little gravel, moist. Bottom 6" - Blue-green, low plasticity CLAY.		S4	NM	24/11	<1		
	S5 (8.0'-10.0') - 24" - Mottled gray/brown, CLAY, coarse sand lense at 8.5', moist.		S5	NM	24/24	<1		
10	S6 (10.0'-12.0') - 24" - Mottled gray/brown, CLAY, moist.		S6	NM	24/24	<1	10	
	S7 (12.0'-13.0') - 12" - Gray/brown, CLAY, some fine Sand, little gravel, moist. Probe refusal at 13' bgs.		S7	NM	12/12	<1		
15							15	

LEGEND: Filter Sand; Native Fill; Bentonite; Bentonite Grout; Concrete; PVC Screen; Solid PVC Riser

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Sample designated with solid fill submitted for laboratory analysis. 3) Groundwater not observed. 4) NA = Not Applicable; NM = Not Measured.

CLIENT: City of Bath

SITE: MW Sewall Bulk Plant
1110 High Street
Bath, ME

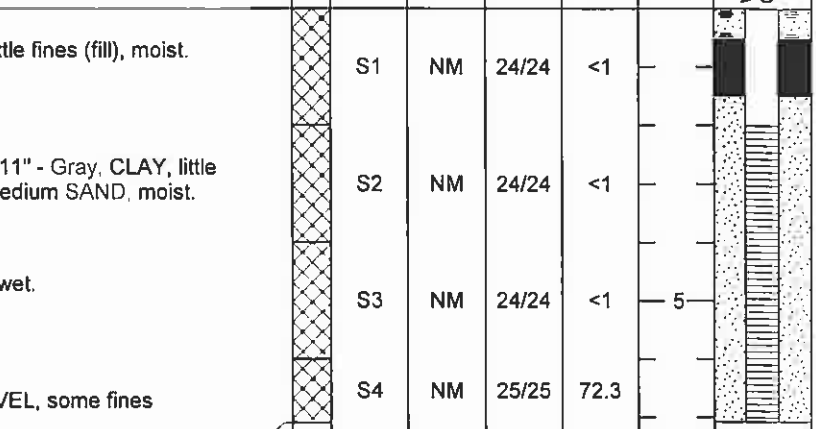
Project No.: 091.06063 Page: 1

RANSOM Environmental Consultants, Inc.

BORING AND MONITORING WELL LOG: SB-2/MW-2

Reviewed by:	SJD	Total Depth:	7.08 Feet	Logged By:	EPP
Date Reviewed:	3-31-10	Boring Diameter:	2 Inches	Date Drilled:	2/10/10 to 2/10/10
GW Observed at:	4 Feet	Well Stickup:	NA	Driller:	Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)
	S1 (0.0'-2.0') - 24" - Brown, SAND and GRAVEL, little fines (fill), moist.		S1	NM	24/24	<1
	S2 (2.0'-4.0') - Top 4" - Brown, fine SAND. Middle 11" - Gray, CLAY, little fine sand, moist. Bottom 9" - Brown/gray, fine to medium SAND, moist.		S2	NM	24/24	<1
5	S3 (4.0'-6.0') - 24" - Brown, fine SAND and CLAY, wet.		S3	NM	24/24	<1
	S4 (6.0'-7.1') - 25" - Rusty brown, SAND and GRAVEL, some fines (weathered bedrock), dry. Probe refusal at 7'1" bgs.		S4	NM	25/25	72.3
10						
15						



LEGEND: Filter Sand; Native Fill; Bentonite; Bentonite Grout; Concrete; PVC Screen; Solid PVC Riser

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Well finished with a locking, flush-mounted roadbox, cemented into ground. 3) Groundwater encountered at 4 ft. bgs. 4) NA = Not Applicable; NM = Not Measured.

CLIENT: City of Bath

SITE: MW Sewall Bulk Plant
1110 High Street
Bath, ME

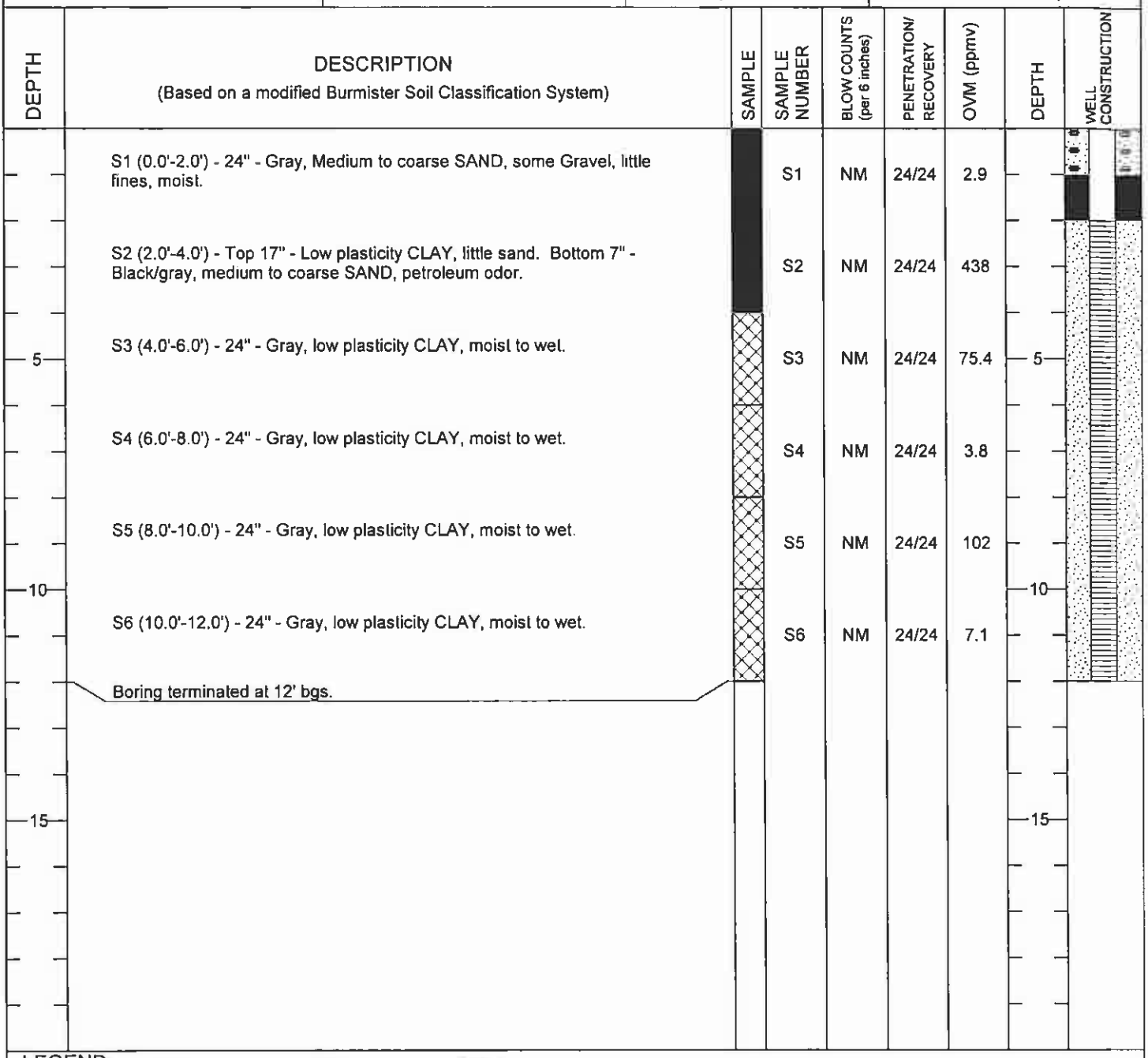
Project No.: 091.06063 Page: 1

RANSOM Environmental Consultants, Inc.

BORING AND MONITORING WELL LOG: SB-3/MW-3

Reviewed by:		Total Depth:	12 Feet	Logged By:	EPP
Date Reviewed:	3-31-10	Boring Diameter:	2 Inches	Date Drilled:	2/10/10 to 2/10/10
GW Observed at:	4 Feet	Well Stickup:	NA	Driller:	Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)
	S1 (0.0'-2.0') - 24" - Gray, Medium to coarse SAND, some Gravel, little fines, moist.		S1	NM	24/24	2.9
	S2 (2.0'-4.0') - Top 17" - Low plasticity CLAY, little sand. Bottom 7" - Black/gray, medium to coarse SAND, petroleum odor.		S2	NM	24/24	438
5	S3 (4.0'-6.0') - 24" - Gray, low plasticity CLAY, moist to wet.		S3	NM	24/24	75.4
	S4 (6.0'-8.0') - 24" - Gray, low plasticity CLAY, moist to wet.		S4	NM	24/24	3.8
	S5 (8.0'-10.0') - 24" - Gray, low plasticity CLAY, moist to wet.		S5	NM	24/24	102
10	S6 (10.0'-12.0') - 24" - Gray, low plasticity CLAY, moist to wet.		S6	NM	24/24	7.1
	Boring terminated at 12' bgs.					
15						



LEGEND: Filter Sand; Native Fill; Bentonite; Bentonite Grout; Concrete; PVC Screen; Solid PVC Riser

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Sample designated with solid fill submitted for laboratory analysis. 3) Well finished with a locking, flush-mounted roadbox, cemented into ground. 4) Groundwater encountered at 4 ft. bgs. 5) NA = Not Applicable; NM = Not Measured.

CLIENT: City of Bath

SITE: MW Sewall Bulk Plant
1110 High Street
Bath, ME

Project No.: 091.06063 | Page: 1

RANSOM Environmental Consultants, Inc.

BORING LOG: SB-4

Reviewed By:		Total Depth:	12 Feet	Logged By:	EPP
Date Reviewed:	3-31-10	Boring Diameter:	2 Inches	Date Drilled:	2/10/10 to 2/10/10
GW Observed at:	NA Feet	Well Stickup:	NA	Driller:	Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)	DEXSIL (ppm)	DEPTH
	S1 (0.0'-2.0') - 24" - Gray, fine to coarse SAND and GRAVEL (fill), moist.		S1	NM	24/24	<1		
	S2 (2.0'-4.0') - 24" - Gray, fine to coarse SAND and GRAVEL (fill), moist.		S2	NM	24/24	<1		
5	S3 (4.0'-6.0') - 24" - Gray/brown, low plasticity CLAY.		S3	NM	24/24	<1		5
	S4 (6.0'-8.0') - 24" - Gray/brown, low plasticity CLAY.		S4	NM	24/24	<1		
	S5 (8.0'-10.0') - Top 10" - Gray/brown, CLAY, some fine Sand. Bottom 14" - low plasticity CLAY.		S5	NM	24/24	<1		
10	S6 (10.0'-12.0') - 24" - Gray/brown, low plasticity CLAY, moist.		S6	NM	24/24	<1		10
	Boring terminated at 12' bgs.							
15								15

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Sample designated with solid fill submitted for laboratory analysis. 3) Groundwater not observed. 4) NA = Not Applicable; NM = Not Measured.

CLIENT:
City of Bath

SITE:
MW Sewall Bulk Plant
1110 High Street
Bath, ME

Project No.: 091.06063

RANSOM Environmental Consultants, Inc.

BORING LOG: SB-5

Reviewed By:		Total Depth: 5.25 Feet	Logged By: KDG
Date Reviewed: 3-31-10		Boring Diameter: 2 Inches	Date Drilled: 2/10/10 to 2/10/10
GW Observed at: NA Feet		Well Stickup: NA	Driller: Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)	DEXSIL (ppm)	DEPTH
	S1 (0.0'-2.0') - Top 5" - Asphalt. Bottom 19" - Brown, fine to coarse SAND, black fill material 11"-14", dry, no odor.		S1	NM	24/24	<1		
	S2 (2.0'-4.0') - 24" - Gray, CLAY, moist, no odor.		S2	NM	24/24	<1		
5	S3 (4.0'-6.0') - Top 6" - Gray, CLAY. Bottom 3" - Black fill material over Brown/gray, CLAY, moist, no odor. Probe refusal at 5.25'		S3	NM	15/8	<1		5
10								10
15								15

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Sample designated with solid fill submitted for laboratory analysis. 3) Groundwater not observed. 4) NA = Not Applicable; NM = Not Measured.

CLIENT:
City of Bath

SITE:
MW Sewall Bulk Plant
1110 High Street
Bath, ME

Project No.: 091.06063

RANSOM Environmental Consultants, Inc.

BORING LOG: SB-7

Reviewed By:		Total Depth:	5.5 Feet	Logged By:	EPP
Date Reviewed:	3-31-10	Boring Diameter:	2 Inches	Date Drilled:	2/10/10 to 2/10/10
GW Observed at:	NA Feet	Well Stickup:	NA	Driller:	Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)	DEXSIL (ppm)	DEPTH
	S1 (0.0'-2.0') - Top 6" - Dark brown, sandy loam. Bottom 18" - Gray, low plasticity CLAY.		S1	NM	24/24	3.5		
	S2 (2.0'-4.0') - 24" - Gray/brown, low plasticity, CLAY.		S2	NM	24/24	<1		
5	S3 (4.0'-5.5') - Gray/brown, low plasticity, CLAY, moist. Petroleum odor noted in soils at 5.5' bgs.		S3	NM	18/18	1.4		5
	Probe refusal at 5.5' bgs.							
10								10
15								15

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Sample designated with solid fill submitted for laboratory analysis. 3) Groundwater not observed. 4) NA = Not Applicable; NM = Not Measured.

CLIENT:
City of Bath

SITE:
MW Sewall Bulk Plant
1110 High Street
Bath, ME

Project No.: 091.06063

RANSOM Environmental Consultants, Inc.

BORING AND MONITORING WELL LOG: SB-7B/MW-4

Reviewed by:	[illegible]	Total Depth:	7.8 Feet	Logged By:	KDG
Date Reviewed:	3-31-10	Boring Diameter:	2 Inches	Date Drilled:	2/10/10 to 2/10/10
GW Observed at:	6 Feet	Well Stickup:	NM	Driller:	Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)
	S1 (0.0'-2.0') - Top 9" - Dark brown to brown, sandy loam. Bottom 15" - Gray, low plasticity, CLAY.		S1	NM	24/24	<1
	S2 (2.0'-4.0') - 24" - Gray, low plasticity, CLAY, moist.		S2	NM	24/24	8.0
5	S3 (4.0'-6.0') - 24" - Gray, low plasticity CLAY, moist to wet.		S3	NM	24/24	8.5
	S4 (6.0'-7.10') - 24" - Gray, CLAY, wet.		S4	NM	24/24	<1
	Probe refusal at 7'10" bgs.					
10						
15						

DEPTH: 5, 10, 15

WELL CONSTRUCTION

LEGEND: Filter Sand; Native Fill; Bentonite; Bentonite Grout; Concrete; PVC Screen; Solid PVC Riser

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Well finished with a PVC well casing stickup and expansion plug cap. 3) Groundwater encountered at 6 ft. bgs. 4) NA = Not Applicable; NM = Not Measured.

CLIENT:
City of Bath

SITE:
MW Sewall Bulk Plant
1110 High Street
Bath, ME

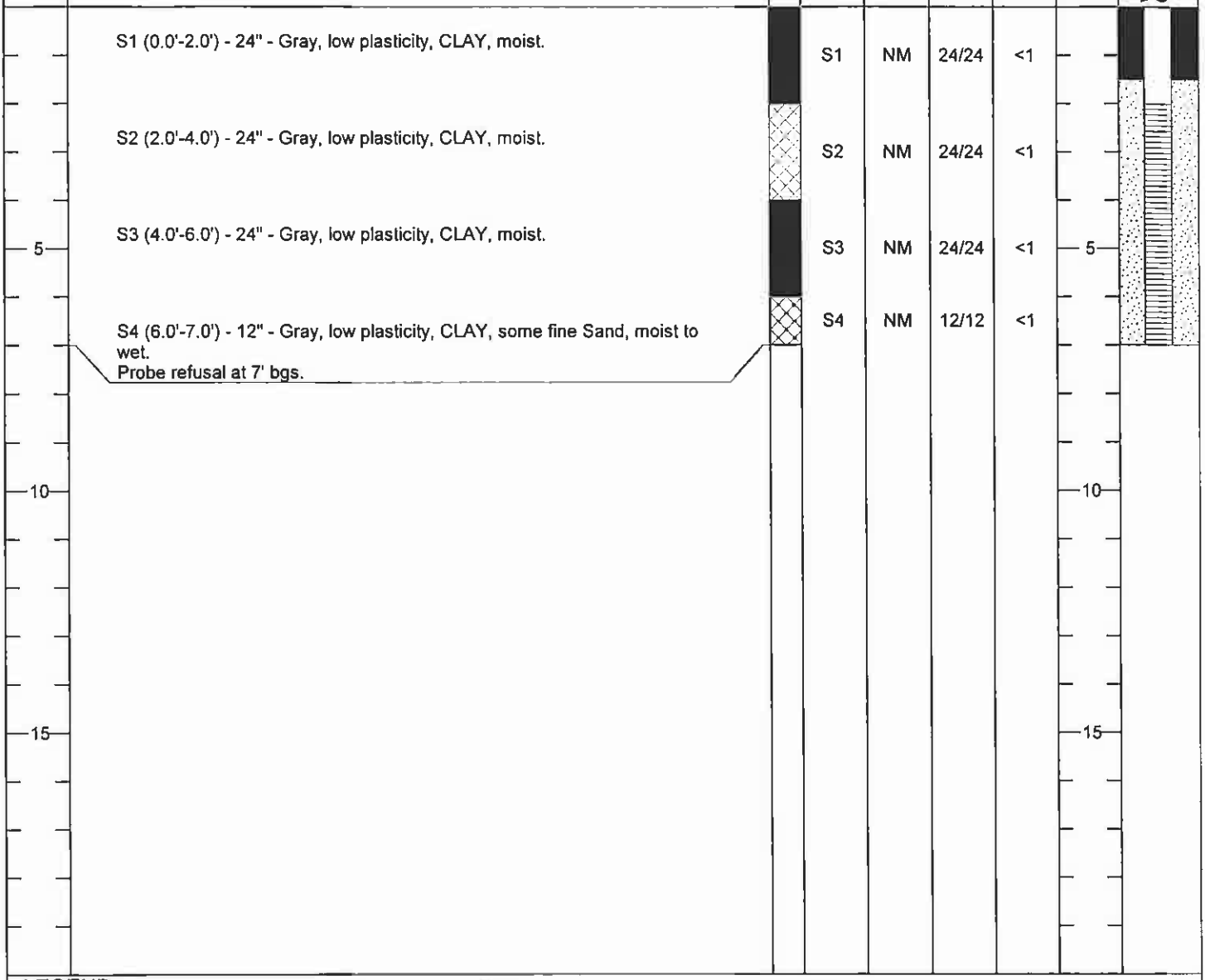
Project No.: 091.06063

RANSOM Environmental Consultants, Inc.

BORING AND MONITORING WELL LOG: SB-8/MW-5

Reviewed by:		Total Depth:	7 Feet	Logged By:	EPP
Date Reviewed:	3-31-10	Boring Diameter:	2 Inches	Date Drilled:	2/10/10 to 2/10/10
GW Observed at:	7 Feet	Well Stickup:	NM	Driller:	Eastern Analytical

DEPTH	DESCRIPTION (Based on a modified Burmister Soil Classification System)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS (per 6 inches)	PENETRATION/ RECOVERY	OVM (ppmv)
	S1 (0.0'-2.0') - 24" - Gray, low plasticity, CLAY, moist.		S1	NM	24/24	<1
	S2 (2.0'-4.0') - 24" - Gray, low plasticity, CLAY, moist.		S2	NM	24/24	<1
5	S3 (4.0'-6.0') - 24" - Gray, low plasticity, CLAY, moist.		S3	NM	24/24	<1
	S4 (6.0'-7.0') - 12" - Gray, low plasticity, CLAY, some fine Sand, moist to wet. Probe refusal at 7' bgs.		S4	NM	12/12	<1
10						
15						



LEGEND: Filter Sand; Native Fill; Bentonite; Bentonite Grout; Concrete; PVC Screen; Solid PVC Riser

NOTES:
1) Boring advanced using Truck-mounted Simco Earth Probe 200. 2) Sample designated with solid fill submitted for laboratory analysis. 3) Well finished with a PVC well casing stickup and expansion plug cap. 4) Groundwater encountered at 7 ft. bgs. 5) NA = Not Applicable; NM = Not Measured.

CLIENT: City of Bath

SITE: MW Sewall Bulk Plant, 1110 High Street, Bath, ME

Project No.: 091.06063 Page: 1

RANSOM
Environmental
Consultants, Inc.

Soil Classification Terms

Grain Size		
Material	*Fraction*	*Sieve Size*
Boulders		12" +
Cobbles		3"–12"
Gravel	coarse	¾"–3"
	fine	No. 4 to ¾"
Sand	coarse	No. 10 to No. 4
	medium	No. 40 to No. 10
	fine	No. 200 to No. 40
Fines (Silt & Clay)		Passing No. 200

Identification of soil type Is made on the basis of an estimate of particle sizes, and in the case of fine-grained soils, also on basis of plasticity.

Coarse and Fine Grained Soils	
Descriptive Adjective	**Percentage Requirement*
Trace	1–10%
Little	10–20%
Some	20–35%
And	35–50%

When sampling gravelly soils with a standard split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter.
*Percentage measured by weight.

Standard Penetration Values (N) v. Relative Density & Consistency

GRANULAR		**COHESIVE**	
N	***Relative Density (%)***	***N***	***Consistency***
		<2	Very Soft
0–4	Very Loose (0-15)	2–4	Soft
4–10	Loose (15-35)	4–8	Medium
10–30	Firm (35-65)	8–15	Stiff
30–50	Dense (65-85)	15–30	Very Stiff
>50	Very Dense (>85)	>30	Hard

RANSOM Environmental Consultants, Inc.

Rock Classification Terms

Weathering Classification		
Grade	***Symbol***	***Diagnostic Features***
Fresh	**F**	No visible sign of decomposition or discoloration. Rings under hammer impact.
Slightly Weathered	**WS**	Slight discoloration inwards from open fracture, otherwise similar to F.
Moderately Weathered	**WM**	Discoloration throughout. Weaker mineral such as feldspar decomposed. Strength somewhat less than fresh rock but cores can not be broken by hand or scraped by knife.
Highly Weathered	**WH**	Most minerals somewhat decomposed. Specimens can be broken by hand with effort or shaved with knife. Core stones present in rock mass. Texture becoming distinct but fabric.
Completely Weathered	**WC**	Minerals decomposed to soil but fabric and structure preserved (Saprolite). Specimens easily crumbled or penetrated.
Residual Soil	**RS**	Advanced state of decomposition resulting in Plastic soils. Rock fabric and structure completely destroyed. Large volume change.

Rock Descriptors			
Term		Meaning	
Hardness	Soft	Scratched by fingernail	
	Medium Hard	Scratched easily by penknife	
	Hard	Scratched with difficulty by penknife	
	Very Hard	Cannot be scratched by penknife	
Jointing/ Fractures	Slight	2 to 6 ft. spacing	
	Moderate	8in. to 2 ft.	
	High	2 in. to 8 in.	
	Intense	< 2in.	
Bedding	Laminated	(< 1")	Natural Break in Rock Layers
	Thin Bedded	(1" - 4")	
	Bedded	(4" - 12")	
	Thick Bedded	(12" - 36")	
	Massive	(> 36")	

RANSOM
Environmental
Consultants, Inc.

Unified System Classification of Soils (ASTM D-2487)

Major Divisions			*Group Symbols*	*Typical Names*
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fracton retained on No. 4 sieve	Clean Gravels	**GW**	Well-graded gravels and gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
		Gravels w/ Fines	**GM**	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	Sands More than 50% coarse fraction passes No. 4 sieve	Clean Sands	**SW**	Well-graded sands and gravelly sands little or no fines.
			SP	Poorly graded sands and gravelly sands little or no fines.
		Sands w/ Fines	**SM**	Silty gravels, gravel-sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures.
Fine-Grained Soils 50% or more passes No. 200 sieve	Silts and Clays Liquid Limit 50% or less		**ML**	Inorganic silts, very fine sands, rock flour, silty or clayey sands.
			CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays.
			OL	Organic silts and organic silty clays of low plasticity.
	Silts and Clays Liquid limit greater than 50%		**MH**	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity.
Highly Organic Soils			**Pt**	Peat, much and other highly organic soils

RANSOM
Environmental
Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.:R091.06063
TEST PIT IDENTIFICATION: TP-1	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 9:00 Time Completed: 9:40
Weather: 20°F, Windy, Mostly Sunny	
Logged by: KDG	Date: 2/11/10
Checked by: BJD	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to coarse SAND, some Gravel, dry, some fill materials (cobbles, bricks)	<1
Lab (S2) EPH, VPH, Lead	S2	2-4'	SAND and Gravel as above over gray CLAY and SAND. Fill throughout (brick, asphalt, concrete)	<1
	S3	4-5'	CLAY as above, fill throughout, moist. Rock and brick/concrete at base.	<1

Pit Dimensions (Ft.) Length 6 Width 4 Depth 5	Remarks: 1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-2	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☐Yes ☒No
Capacity/Reach: 15'	Time Started: 13:35 Time Completed: 14:00
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: BPP	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to coarse SAND, some Gravel, little fines	<1
	S2	2-4'	Same as above	<1
	S3	4-6'	SAND as above	<1
7.5'	S4	6-8'	SAND and GRAVEL, change to gray low plasticity CLAY	<1
	S5	8-9'	CLAY (native)	<1

Pit Dimensions (Ft.)
Length 8
Width 5
Depth 9

Remarks:
1) Test pit backfilled with native material.

RANSOM
Environmental
Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-3	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☐Yes ☒No
Capacity/Reach: 15'	Time Started: 9:55 Time Completed: 10:25
Weather: 20°F, Windy, Mostly Sunny	
Logged by: KDG	Date: 2/11/10
Checked by: BJD	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to medium SAND, little gravel, green PVC pipe approximately 1.5' bgs – (appears to head toward existing sewer line; filled with SAND) dry, no odor.	<1
	S2	2-4'	SAND as above, little clay, (fill) pieces of metal and clay pipes, dry, no odor.	<1
	S3	4-6'	SAND as above, little fill (pipe pieces primarily), dry, no odor. Encountered rocks/cobbles at 6'.	<1

Pit Dimensions (Ft.) Length 6 Width 6 Depth 6	Remarks: 1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-4	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☐Yes ☒No
Capacity/Reach: 15'	Time Started: 10:35 Time Completed: 11:00
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: SJE	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to coarse SAND and GRAVEL.	<1
3	S2	2-4'	SAND and GRAVEL, change to gray CLAY, some fine SAND at 3'bgs, occasional bricks.	<1
	S3	4-6'	Gray, sandy CLAY	<1
	S4	6-8'	Gray, low plasticity CLAY (native)	<1

Pit Dimensions (Ft.)
Length 9
Width 5
Depth 8

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-5	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 11:05 Time Completed: 12:00
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: [signature]	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to coarse SAND and GRAVEL, some Fines.	<1
	S2	2-4'	SAND and GRAVEL, some Fines.	<1
	S3	4-6'	SAND and GRAVEL, some Fines.	<1
	S4	6-8'	Gray, SAND and GRAVEL, some Fines, some Cobbles.	<1
	S5	8-8.5'	Same as above. Groundwater at 8.5'	<1

Pit Dimensions (Ft.)
Length 7
Width 5
Depth 8.5

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-6	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 12:30 Time Completed: 13:00
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: SQE	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown/gray, SAND and GRAVEL, some Fines, petroleum odor..	<1
	S2	2-4'	Brown/gray, SAND and GRAVEL, some Fines, some Cobble, petroleum odor.	12.3
6	S3	4-6'	Brown/gray, SAND and GRAVEL, some Fines, some Cobble, petroleum odor.	4.1
	S4	6-8'	Gray, CLAY, some Sand and Gravel, petroleum odor. Groundwater at 8'bgs.	1.0

Pit Dimensions (Ft.) Length 8 Width 5 Depth 8	Remarks: 1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-7	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 8:15 Time Completed: 9:10
Weather: 20°F, Windy, Mostly Sunny	
Logged by: KDG	Date: 2/12/10
Checked by: [illegible]	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to coarse SAND, some Gravel, dry, no odor.	<1
	S2	2-4'	Brown, SAND and gray CLAY, moist, petroleum odor.	514
	S3	4-7'	Brown, SAND and gray CLAY, petroleum odor, moist to wet. Groundwater approximately 5'bgs. Refusal at approximately 7'bgs.	683

Pit Dimensions (Ft.) Length 6 Width 4 Depth 7	Remarks: 1) Test pit backfilled with native material.

RANSOM
Environmental
Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-8	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 14:55 Time Completed: 15:15
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: EPP	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown/gray/black, SAND and GRAVEL (fill).	4
	S2	2-4'	Transitioning to Gray low plasticity CLAY	3.3
	S3	4-6'	CLAY	<1

Pit Dimensions (Ft.)
Length 7
Width 3
Depth 6

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-9	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☐Yes ☒No
Capacity/Reach: 15'	Time Started: 14:30 Time Completed: 14:35
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: AFD	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, CLAY, little fine sand and gravel. Bedrock refusal at 2'4"	<1

Pit Dimensions (Ft.)
Length 8
Width 3
Depth 2'4"

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-10	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☐Yes ☒No
Capacity/Reach: 15'	Time Started: 14:35 Time Completed: 14:50
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date: 2/11/10
Checked by: SQD	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Light brown, poorly graded, fine SAND.	<1
2	S2	2-4'	Gray, low plasticity CLAY, moist.	<1
	S3	4-6'	Gray, low plasticity CLAY, moist.	<1
	S4	6-8'	Gray, low plasticity CLAY, moist.	<1

Pit Dimensions (Ft.)
Length 8
Width 4
Depth 8

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-11	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☐Yes ☒No
Capacity/Reach: 15'	Time Started: 9:00 Time Completed: 9:35
Weather: 20°F, Windy, Mostly Sunny	
Logged by: KDG	Date: 2/12/10
Checked by: BJO	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, CLAY, little fine sand.	19.3
	S2	2-4'	Brown/gray, low plasticity CLAY.	<1
	S3	4-6'	Native CLAY.	<1
	S4	6-7	Native CLAY. Bedrock refusal at 7'	<1

Pit Dimensions (Ft.)
Length 8
Width 4
Depth 7

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-12	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 11:15 Time Completed: 11:45
Weather: 20°F, Windy, Mostly Sunny	
Logged by: KDG	Date: 2/12/10
Checked by: BJE	Date: 3/31/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to medium SAND, little gravel, over 6" black-stained soils, moist, strong petroleum odor. Encountered rocks/gravel approximately 2'bgs, black staining, strong odor. Excavation terminated due to utilities.	2,543

Pit Dimensions (Ft.)
Length 5
Width 3.5
Depth 2.25

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-14	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 9:45 Time Completed: 10:55
Weather: 20°F, Windy, Mostly Sunny	
Logged by: KDG	Date: 2/12/10
Checked by: BJE	Date: 3/10/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to medium SAND, dry, no odor.	<1
	S2	2-4'	Brown, SAND and gray CLAY, moist, slight odor.	14.6
	S3	4-6'	Brown, SAND and blue/gray CLAY, moist, petroleum odor. Groundwater observed approximately 5'bgs.	<1
	S4	6-8'	Brown, SAND and blue/gray CLAY, moist.	<1
	S5	8-9.5'	Brown, SAND and blue/gray CLAY, moist. Bedrock refusal at approximately 9.5'bgs.	

Pit Dimensions (Ft.)
Length 6
Width 4
Depth 9.5

Remarks:
1) Test pit backfilled with native material.

RANSOM Environmental Consultants, Inc.

TEST PIT LOG

Project: MW Sewall Bulk Plant	Project No.: R091.06063
TEST PIT IDENTIFICATION: TP-15	
Location: 1110 High St., Bath, ME	Ground Elevation: NM
Client: City of Bath	Datum: NA
Contractor: ESN	Operator: Justin
Equipment: CX75SR	Samples Collected ☒Yes ☐No
Capacity/Reach: 15'	Time Started: 11:30 Time Completed: 12:05
Weather: 20°F, Windy, Mostly Sunny	
Logged by: EPP	Date:
Checked by:	Date: 3/3/10

TEST PIT INFORMATION

Depth of Stratum Change Feet	Sample No. and Type	Sample Depth Feet	Soil Description	PID
	S1	0-2'	Brown, fine to medium SAND.	<1
	S2	2-4'	SAND mixed with black/gray CLAY, petroleum odor, may be coal ash, etc. Refusal (bedrock) at 4'.	19.8

Pit Dimensions (Ft.)
Length 8
Width 3
Depth 4

Remarks:
1) Test pit backfilled with native material.

9 RAGs Tables

NOTE: Microsoft Excel™ versions of Tables 4-8 can be found on the DEP website at:
http://www.maine.gov/dep/spills/publications/guidance/index.html

Table 4: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
83-32-9	Acenaphthene	SVOC	300	4,900	62,000	14,000	16,000	48,000		0.22	0.21	0.29
208-96-8	Acenaphthylene	SVOC	290	4,900	45,000	14,000	16,000	48,000		1.9	2	0.49
67-64-1	Acetone	VOC	200	96,000	100,000	100,000	100,000	100,000				
75-05-8	Acetonitrile	VOC	1.4	1,200	5,100	28,000	100,000	4,600				
98-86-2	Acetophenone	SVOC	32	11,000	100,000	30,000	35,000	100,000				
107-02-8	Acrolein	VOC	0.00046	0.21	0.90	4.7	180	0.58				
107-13-1	Acrylonitrile	VOC	0.0063	3.7	17	34	58	14				
15972-60-8	Alachlor	PESTICIDE	0.48	130	560	380	440	2,600				
309-00-2	Aldrin	SVOC	0.083	0.54	2.5	1.6	1.8	14				
107-05-1	Allyl Chloride	VOC	0.037	2.5	10	56	1,500	14				
7429-90-5	Aluminum	METAL	100,000	100,000	100,000	100,000	100,000	27,000				
62-53-3	Aniline	SVOC	2.5	610	5,500	1,700	2,000	1,700				
120-12-7	Anthracene	SVOC	3,200	25,000	100,000	70,000	81,000	100,000		2.3	2.2	3.7
7440-36-0	Antimony (metallic)	METAL	19	43	640	120	140	130				
12674-11-2	Aroclor 1016	PCB	7.4	5.6	70	16	18	16				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
7440-38-2	Arsenic, Inorganic	METAL	0.83	9.3	41	26	30	54	28			
1912-24-9	Atrazine	SVOC	0.11	32	140	92	110	770				
7440-39-3	Barium	METAL	8,600	21,000	100,000	61,000	70,000	20,000	79			
100-52-7	Benzaldehyde	SVOC	2.3	2,400	11,000	6,800	7,800	62,000				
71-43-2	Benzene	VOC	0.13	17	75	230	570	240				
56-55-3	Benzo(a)anthracene	SVOC	5.8	16	280	45	52	1,700		17	4.6	16
50-32-8	Benzo(a)pyrene	SVOC	16	1.6	29	4.5	5.2	9.9		5.4	4.6	16
205-99-2	Benzo(b)fluoranthene	SVOC	170	16	290	45	52	1,700		6.9	19	34
191-24-2	Benzo(g,h,i)perylene	SVOC	100,000	2,500	23,000	7,000	8,100	72,000		3	8.2	6
207-08-9	Benzo(k)fluoranthene	SVOC	1,600	160	2,900	450	520	17,000		3.6	6.6	14
65-85-0	Benzoic Acid	SVOC	830	100,000	100,000	100,000	100,000	11,000				
100-51-6	Benzyl Alcohol	SVOC	26	8,600	100,000	25,000	28,000	77,000				
100-44-7	Benzyl Chloride	VOC	0.054	16	70	120	180	81				
7440-41-7	Beryllium and compounds	METAL	1,100	210	3,200	610	700	110				
92-52-4	Biphenyl, 1,1'-	SVOC	0.48	71	300	1,600	3,900	400				
111-44-4	Bis(2-chloroethyl)ether	SVOC	0.002	3.3	15	21	28	62				
117-81-7	Bis(2-ethylhexyl)phthalate	SVOC	730	530	2,200	1,500	1,700	26				
7440-42-8	Boron And Borates Only	METAL	700	21,000	100,000	61,000	70,000	43,000				
108-86-1	Bromobenzene	VOC	2.3	380	650	530	2,800	620				
74-97-5	Bromochloromethane	VOC	1.1	220	940	4,000	100,000	330				
75-27-4	Bromodichloromethane	VOC	0.02	4.4	19	83	500	70				
75-25-2	Bromoform	VOC	0.48	280	790	720	4,000	890				
74-83-9	Bromomethane	VOC	0.11	10	45	160	490	120				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
106-94-5	Bromopropane, 1-	VOC	0.26	24	110	550	100,000	390				
106-99-0	Butadiene, 1,3-	VOC	0.021	1.1	4.9	17	52	1.6				
75-65-0	Butyl Alcohol, tert-	ALCOHOL	17	19,000	89,000	54,000	62,000	67,000				
85-68-7	Butyl Benzyl Phthalate	SVOC	130	3,900	17,000	11,000	13,000	99,000				
104-51-8	Butylbenzene, n-	VOC	180	5,400	80,000	15,000	18,000	34,000				
135-98-8	Butylbenzene, sec-	VOC	320	11,000	100,000	30,000	35,000	34,000				
98-06-6	Butylbenzene, tert-	VOC	86	11,000	100,000	30,000	35,000	34,000				
DEP2041	C11-C22 Aromatics	FUEL	340	2,600	33,000	7,300	8,400	74,000				
DEP2042	C19-C36 Aliphatics	FUEL	NC	100,000	100,000	100,000	100,000	1,200,000				
DEP2038	C5-C8 Aliphatics	FUEL	92	1,700	11,000	7,500	9,500	430				
DEP2040	C9-C10 Aromatics	FUEL	15	660	3,500	4,700	7,000	2,600				
DEP2039	C9-C12 Aliphatics	FUEL	5,800	2,500	14,000	17,000	24,000	2,300				
DEP2043	C9-C18 Aliphatics	FUEL	26,000	2,500	14,000	17,000	24,000	4,800				
7440-43-9	Cadmium (Diet)	METAL	7.6	9.8	140	28	32	42	0.62			
86-74-8	Carbazole	SVOC	15	270	110	750	870	6,700				
75-15-0	Carbon Disulfide	VOC	13	690	740	720	35,000	720				
56-23-5	Carbon Tetrachloride	VOC	0.097	9.7	43	150	450	160				
12789-03-6	Chlordane	PESTICIDE	1.5	24	110	69	80	100				
115-28-6	Chlorendic acid	SVOC	15	0.81	35	230	270	2,000				
75-68-3	Chloro-1,1-difluoroethane, 1-	VOC	2,900	1,200	1,200	1,200	100,000	1,200				
106-47-8	Chloroaniline, p-	SVOC	0.086	37	160	110	120	130				
108-90-7	Chlorobenzene	VOC	2.9	410	740	680	7,000	740				
67-66-3	Chloroform	VOC	0.034	4.7	21	97	1,000	75				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
74-87-3	Chloromethane	VOC	2.7	160	690	1,300	100,000	1,300				
91-58-7	Chloronaphthalene, Beta-	SVOC	210	6,500	82,000	19,000	22,000	48,000				
95-57-8	Chlorophenol, 2-	SVOC	4.9	540	8,000	1,500	1,800	2,700				
76-06-2	Chloropicrin	VOC	0.014	2.9	12	66	100,000	1.7				
95-49-8	Chlorotoluene, o-	VOC	13	2,100	32,000	6,100	7,000	800				
106-43-4	Chlorotoluene, p-	VOC	13	2,100	32,000	6,100	7,000	68,000				
16065-83-1	Chromium(III), Insoluble Salts	METAL	100,000	100,000	100,000	100,000	100,000	27,000				
18540-29-9	Chromium(VI)	INORGANIC	0.37	4.2	89	12	14	46				
218-01-9	Chrysene	SVOC	5,000	1,600	29,000	4,500	5,200	100,000		32	13	21
7440-48-4	Cobalt	METAL	15	32	480	91	110	100	12			
7440-50-8	Copper	METAL	1,600	4,300	64,000	12,000	14,000	14,000	23			
108-39-4	Cresol, m-	SVOC	41	4,300	56,000	12,000	14,000	100,000				
95-48-7	Cresol, o-	SVOC	41	4,300	56,000	12,000	14,000	51,000				
106-44-5	Cresol, p-	SVOC	16	1,700	22,000	4,900	5,700	5,100				
59-50-7	Cresol, p-chloro-m-	SVOC	94	8,600	100,000	25,000	28,000	26,000				
98-82-8	Cumene	VOC	41	260	270	270	35,000	270				
57-12-5	Cyanide (CN-)	INORGANIC	0.81	33	220	160	210	38				
110-82-7	Cyclohexane	VOC	720	120	120	120	100,000	120				
75-99-0	Dalapon	HERBICIDE	6.8	2,600	34,000	7,400	8,500	7,700				
72-54-8	DDD, p,p`- (DDD)	PESTICIDE	4.1	31	130	88	100	130				
72-55-9	DDE, p,p'-	PESTICIDE	6.0	27	130	79	92	100				
50-29-3	DDT	PESTICIDE	43	26	120	73	85	160				
124-18-5	Decane	VOC	NC	NC	NC	NC	NC	100,000				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
53-70-3	Dibenz(a,h)anthracene	SVOC	53	1.6	29	4.5	5.2	170		0.73	1.4	0.46
132-64-9	Dibenzofuran	SVOC	8.0	110	1,600	300	350	1,400				
96-12-8	Dibromo-3-chloropropane, 1,2-	PESTICIDE	0.000079	0.078	1.0	1.5	8.6	3.5				
124-48-1	Dibromochloromethane	VOC	0.13	110	530	320	370	3,000				
106-93-4	Dibromoethane, 1,2-	VOC	0.0012	0.54	2.4	6.8	16	8.9				
74-95-3	Dibromomethane (Methylene Bromide)	VOC	0.11	35	150	800	100,000	190				
84-74-2	Dibutyl Phthalate	SVOC	130	8,600	100,000	25,000	28,000	100,000				
110-57-6	Dichloro-2-butene, trans-1,4-	VOC	0.00034	0.11	0.48	2.5	100,000	1.8				
95-50-1	Dichlorobenzene, 1,2-	SVOC	16	360	380	370	32,000	380				
541-73-1	Dichlorobenzene, 1,3-	SVOC	16	290	300	290	32,000	280				
106-46-7	Dichlorobenzene, 1,4-	VOC	0.25	39	170	770	5,800	620				
91-94-1	Dichlorobenzidine, 3,3'-	SVOC	0.45	17	70	47	54	400				
75-71-8	Dichlorodifluoromethane	VOC	17	130	550	830	70,000	730				
107-06-2	Dichloroethane, 1,2-	VOC	0.027	6.9	30	110	340	110				
75-34-3	Dichloroethane,1,1-	VOC	0.43	53	230	980	5,500	850				
75-35-4	Dichloroethylene, 1,1-	VOC	5.6	340	1,200	1,100	18,000	4.2				
156-59-2	Dichloroethylene, 1,2-cis-	VOC	0.41	90	540	480	700	800				
156-60-5	Dichloroethylene, 1,2-trans-	VOC	1.2	100	450	1,400	7,000	1,200				
120-83-2	Dichlorophenol, 2,4-	SVOC	1.2	260	3,400	740	850	5,100				
78-87-5	Dichloropropane, 1,2-	VOC	0.15	23	99	420	840	32				
142-28-9	Dichloropropane, 1,3-	VOC	7.1	2,100	32,000	6,100	7,000	68,000				
542-75-6	Dichloropropene, 1,3-	VOC	0.093	27	120	210	310	120				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
60-57-1	Dieldrin	PESTICIDE	0.039	0.46	2.0	1.3	1.5	12				
84-66-2	Diethyl Phthalate	SVOC	330	69,000	100,000	100,000	100,000	100,000				
108-20-3	Diisopropyl Ether	VOC	21	2,300	2,300	2,300	100,000	2,000				
105-67-9	Dimethylphenol, 2,4-	SVOC	23	1,700	22,000	4,900	5,700	13,000				
576-26-1	Dimethylphenol, 2,6-	SVOC	0.70	52	670	150	170	1,500				
528-29-0	Dinitrobenzene, 1,2-	SVOC	0.098	8.6	110	25	28	260				
99-65-0	Dinitrobenzene, 1,3-	SVOC	0.097	8.6	110	25	28	130				
100-25-4	Dinitrobenzene, 1,4-	SVOC	0.097	8.6	110	25	28	260				
51-28-5	Dinitrophenol, 2,4-	SVOC	2.4	170	2,200	490	570	5,100				
121-14-2	Dinitrotoluene, 2,4-	SVOC	0.18	24	100	68	78	600				
606-20-2	Dinitrotoluene, 2,6-	SVOC	0.037	5.0	21	14	16	130				
88-85-7	Dinoseb	PESTICIDE	7.1	86	1,100	250	280	260				
123-91-1	Dioxane, 1,4-	SVOC	0.052	74	340	260	310	1,700				
115-29-7	Endosulfan	PESTICIDE	76	640	9,600	1,800	2,100	1,700				
72-20-8	Endrin	PESTICIDE	5.1	26	340	74	85	150				
75-00-3	Ethyl Chloride	VOC	130	2,100	2,100	2,100	100,000	2,000				
60-29-7	Ethyl Ether	VOC	48	21,000	100,000	61,000	70,000	8,100				
97-63-2	Ethyl Methacrylate	VOC	8.1	1,100	1,100	1,100	100,000	830				
637-92-3	Ethyl Tertiary Butyl Ether (ETBE)	VOC	9.6	1,900	2,900	2,800	100,000	2,900				
100-41-4	Ethylbenzene	VOC	0.9	86	380	400	2,800	470				
107-21-1	Ethylene Glycol	VOC	180	69,000	100,000	100,000	100,000	100,000				
111-76-2	Ethylene Glycol Monobutyl Ether	VOC	22	8,600	100,000	25,000	28,000	18,000				
206-44-0	Fluoranthene	SVOC	4,900	3,300	41,000	9,300	11,000	24,000		59	22	30

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
86-73-7	Fluorene	SVOC	300	3,300	41,000	9,300	11,000	96,000		0.67	0.47	0.64
16984-48-8	Fluoride	ANION	6,600	4,300	64,000	12,000	14,000	12,000				
50-00-0	Formaldehyde	VOC	0.043	160	720	1,100	1,500	2,500				
76-44-8	Heptachlor	PESTICIDE	0.063	1.9	8.7	5.9	6.9	34				
1024-57-3	Heptachlor Epoxide	PESTICIDE	0.016	1.0	4.5	2.9	3.4	4.4				
118-74-1	Hexachlorobenzene	SVOC	0.068	1.1	14	3.0	3.5	3.4				
87-68-3	Hexachlorobutadiene	SVOC	0.15	15	16	16	350	17				
319-84-6	Hexachlorocyclohexane, Alpha-	PESTICIDE	0.023	1.2	5.0	3.4	3.9	29				
319-85-7	Hexachlorocyclohexane, Beta-	PESTICIDE	0.081	4.1	17	12	14	100				
58-89-9	Hexachlorocyclohexane, Gamma-(Lindane)	PESTICIDE	0.13	7.8	35	22	26	200				
67-72-1	Hexachloroethane	SVOC	0.11	27	120	210	250	450				
13252-13-6	Hexafluoropropylene oxide dimer acid (HFPO-DA)	PFAS	0.00081	0.32	4.8	0.9	1.1	10				
121-82-4	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	WMD	0.20	110	530	320	370	3,000				
110-54-3	Hexane, N-	VOC	570	140	140	140	100,000	140				
591-78-6	Hexanone, 2-	VOC	0.48	290	2,000	1,000	1,800	300				
193-39-5	Indeno(1,2,3)pyrene	SVOC	540	16	290	45	52	1,700		7.3	9.4	9.7
7439-89-6	Iron	METAL	19,000	75,000	100,000	100,000	100,000	100,000				
78-59-1	Isophorone	SVOC	14	7,800	33,000	22,000	26,000	100,000				
67-63-0	Isopropanol	ALCOHOL	4.6	8,300	36,000	93,000	100,000	94,000				
7439-92-1	Lead	METAL	50	200	440	420	420	460	52			
121-75-5	Malathion	PESTICIDE	5.6	1,700	22,000	4,900	5,700	4,900				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
7439-96-5	Manganese (Non-diet)	METAL	1,600	2,600	38,000	7,300	8,400	280	770			
94-74-6	MCPA	HERBICIDE	0.11	43	560	120	140	130				
93-65-2	MCPP	HERBICIDE	0.26	86	1,100	250	280	2,600				
7487-94-7	Mercuric Chloride	METAL	NC	32	480	91	110	640				
7439-97-6	Mercury (elemental)	METAL	1.8	3.1	3.1	3.1	100,000	3.1				
72-43-5	Methoxychlor	PESTICIDE	110	430	5,600	1,200	1,400	1,300				
79-20-9	Methyl Acetate	VOC	230	100,000	100,000	100,000	100,000	740				
78-93-3	Methyl Ethyl Ketone (2-Butanone)	VOC	64	20,000	28,000	25,000	100,000	11,000				
108-10-1	Methyl Isobutyl Ketone (4-methyl-2-pentanone)	VOC	78	3,400	3,400	3,400	100,000	3,300				
22967-92-6	Methyl Mercury	METAL	770	11	160	30	35	34				
80-62-6	Methyl Methacrylate	VOC	17	2,300	2,400	2,400	100,000	2,200				
1634-04-4	Methyl tert-Butyl Ether (MTBE)	VOC	1.8	690	3,000	5,600	17,000	8,300				
88-19-7	Methylbenzene sulfonamide, 2-	SVOC	2.3	3,500	33,000	9,800	11,000	10,000				
70-55-3	Methylbenzene sulfonamide, 4-	SVOC	41	9,900	94,000	28,000	32,000	29,000				
75-09-2	Methylene Chloride	VOC	1.5	490	2,500	1,200	2,100	1,900				
90-12-0	Methylnaphthalene, 1-	SVOC	3.3	240	990	680	790	6,000				
91-57-6	Methylnaphthalene, 2-	SVOC	10	330	4,100	930	1,100	960		0.15	0.9	0.08
7439-98-7	Molybdenum	METAL	110	540	8,000	1,500	1,800	7,400	1.3			
91-20-3	Naphthalene	SVOC	0.21	29	120	150	190	130		5	2.9	0.2
7440-02-0	Nickel Soluble Salts	METAL	1,400	2,100	32,000	6,100	7,000	990	35			
14797-55-8	Nitrate	NUTRIENT	NC	100,000	100,000	100,000	100,000	100,000				
100-01-6	Nitroaniline, 4-	SVOC	0.87	350	1,600	980	1,100	2,500				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
55-63-0	Nitroglycerin	WMD	0.047	8.6	110	25	28	26				
86-30-6	Nitrosodiphenylamine, N-	SVOC	37	1,500	6,400	4,300	5,000	37,000				
2691-41-0	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	WMD	70	5,300	78,000	15,000	17,000	17,000				
117-84-0	Octyl Phthalate, di-N-	SVOC	3,100	860	11,000	2,500	2,800	26,000				
56-38-2	Parathion	PESTICIDE	24	520	6,700	1,500	1,700	110				
608-93-5	Pentachlorobenzene	SVOC	1.3	86	1,300	240	280	2,700				
87-86-5	Pentachlorophenol	HERBICIDE	0.031	14	54	40	46	340				
78-11-5	Pentaerythritol tetranitrate (PETN)	WMD	14	780	7,300	2,200	2,600	2,300				
14797-73-0	Perchlorate and Perchlorate Salts	INORGANIC	NC	75	1,100	210	250	240				
375-73-5	Perfluorobutane sulfonic acid (PFBS)	PFAS	0.11	26	340	74	85	230				
375-22-4	Perfluorobutanoic acid (PFBA)	PFAS	0.36	110	1,600	300	350	2,000		0.00043		
355-46-4	Perfluorohexanesulfonic acid (PFHxS)	PFAS	0.00047	1.7	22	4.9	5.7	5.1				
307-24-4	Perfluorohexanoic acid (PFHxA)	PFAS	0.13	43	560	120	140	130		0.0015		
375-95-1	Perfluorononanoic acid (PFNA)	PFAS	0.0046	0.26	3.4	0.74	0.85	0.77		0.0019		
1763-23-1	Perfluorooctane sulfonic acid (PFOS)	PFAS	0.001	0.17	2.2	0.49	0.57	0.51		0.00055	0.003	
335-67-1	Perfluorooctanoic acid (PFOA)	PFAS	0.017	0.26	3.4	0.74	0.85	0.77		0.0022		
85-01-8	Phenanthrene	SVOC	320	2,500	23,000	7,000	8,100	72,000		54	11	18
108-95-2	Phenol	SVOC	180	26,000	100,000	74,000	85,000	100,000				
298-02-2	Phorate	PESTICIDE	0.19	17	220	49	57	51				
88-99-3	Phthalic Acid	SVOC	790	100,000	100,000	100,000	100,000	94,000				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
1336-36-3	Polychlorinated Biphenyls (high risk)	PCB	3.8	3.1	13	9.6	11	74				
103-65-1	Propyl benzene	VOC	67	260	260	260	35,000	260				
107-98-2	Propylene Glycol Monomethyl Ether	VOC	36	44,000	97,000	71,000	100,000	100,000				
129-00-0	Pyrene	SVOC	720	2,500	31,000	7,000	8,100	72,000		33	20	28
7782-49-2	Selenium	METAL	29	540	8,000	1,500	1,800	1,700				
7440-22-4	Silver	METAL	44	540	8,000	1,500	1,800	1,700				
7440-24-6	Strontium, Stable	METAL	23,000	64,000	100,000	100,000	100,000	100,000				
100-42-5	Styrene	VOC	73	830	870	860	70,000	860				
1746-01-6	TCDD, 2,3,7,8- Dioxin and Dioxin-like PCBs, TEQ	DIOXIN/FURAN	0.000033	0.000065	0.0003	0.00019	0.00022	0.0016				
95-94-3	Tetrachlorobenzene, 1,2,4,5-	SVOC	0.044	3.2	48	9.1	11	10				
630-20-6	Tetrachloroethane, 1,1,1,2-	VOC	0.12	30	130	410	1,200	480				
79-34-5	Tetrachloroethane, 1,1,2,2-	VOC	0.016	8.9	39	88	160	150				
127-18-4	Tetrachloroethylene	VOC	1.0	120	160	150	2,100	84				
58-90-2	Tetrachlorophenol, 2,3,4,6-	SVOC	9.9	2,600	34,000	7,400	8,500	2,600				
109-99-9	Tetrahydrofuran	VOC	41	27,000	100,000	100,000	100,000	20,000				
479-45-8	Tetryl (Trinitrophenylmethylnitramine)	WMD	20	210	3,200	610	700	6,800				
7440-28-0	Thallium (Soluble Salts)	METAL	0.78	1.1	16	3.0	3.5	14				
7440-31-5	Tin	METAL	100,000	64,000	100,000	100,000	100,000	100,000				
108-88-3	Toluene	VOC	42	750	810	790	28,000	820				
76-13-1	Trichloro-1,2,2-trifluoroethane, 1,1,2-	VOC	1,400	910	910	910	100,000	910				

Dry Weight Basis			Soil RAG (mg/kg)						BTVs (mg/kg)			
CAS	Chemical	Chemical Class	Leaching to Groundwater	Resident	Commercial Worker	Park User	Recreator Sediment	Construction Worker	Undeveloped	Rural Developed	Urban Developed	Urban Fill
87-61-6	Trichlorobenzene, 1,2,3-	VOC	1.2	86	1,300	240	280	2,700				
120-82-1	Trichlorobenzene, 1,2,4-	SVOC	0.64	86	380	360	1,100	400				
71-55-6	Trichloroethane, 1,1,1-	VOC	150	640	640	640	100,000	640				
79-00-5	Trichloroethane, 1,1,2-	VOC	0.0074	2.2	9.4	49	550	68				
79-01-6	Trichloroethylene	VOC	0.056	6.1	28	77	180	4.2				
75-69-4	Trichlorofluoromethane	VOC	180	32,000	100,000	91,000	100,000	940				
95-95-4	Trichlorophenol, 2,4,5-	SVOC	220	8,600	100,000	25,000	28,000	77,000				
88-06-2	Trichlorophenol, 2,4,6-	SVOC	0.64	86	1,100	250	280	1,300				
93-76-5	Trichlorophenoxyacetic Acid, 2,4,5-	PESTICIDE	3.7	860	11,000	2,500	2,800	26,000				
93-72-1	Trichlorophenoxypropionic acid, -2,4,5	HERBICIDE	3.4	690	9,000	2,000	2,300	2,100				
96-18-4	Trichloropropane, 1,2,3-	VOC	0.00018	0.07	1.5	0.20	0.23	4.3				
526-73-8	Trimethylbenzene, 1,2,3-	VOC	4.4	230	290	270	3,500	290				
95-63-6	Trimethylbenzene, 1,2,4-	VOC	4.4	180	220	200	3,500	220				
108-67-8	Trimethylbenzene, 1,3,5-	VOC	4.8	160	180	170	3,500	180				
118-96-7	Trinitrotoluene, 2,4,6-	SVOC	3.1	50	700	140	160	150				
7440-33-7	Tungsten	METAL	130	86	1,300	240	280	2,700				
7440-62-2	Vanadium and Compounds	METAL	4,800	540	8,000	1,500	1,800	490	40			
108-05-4	Vinyl Acetate	VOC	4.8	1,400	2,700	2,700	100,000	140				
593-60-2	Vinyl Bromide	VOC	0.059	3.8	17	87	100,000	61				
75-01-4	Vinyl Chloride	VOC	0.0036	0.64	24	0.71	0.71	80				
1330-20-7	Xylenes	VOC	11	260	260	260	70,000	260				
7440-66-6	Zinc and Compounds	METAL	21,000	32,000	100,000	91,000	100,000	100,000	98			

APPENDIX D
Forcemain Record Drawings

Record Drawings

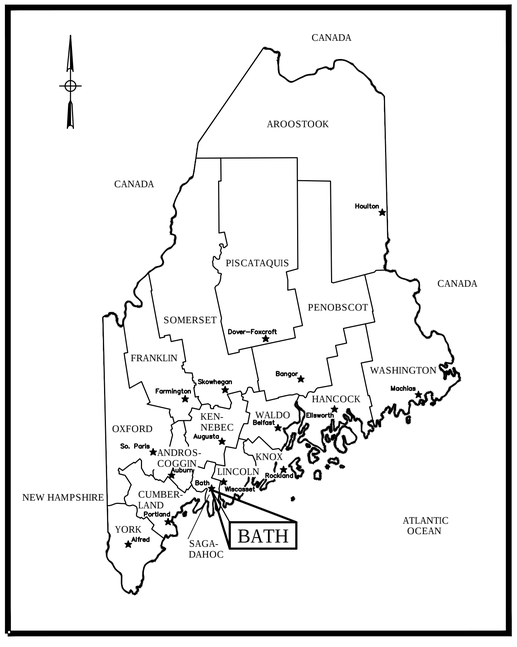
WASHINGTON STREET FORCEMAIN REPLACEMENT

Bath, Maine

February, 2014

Prepared for:

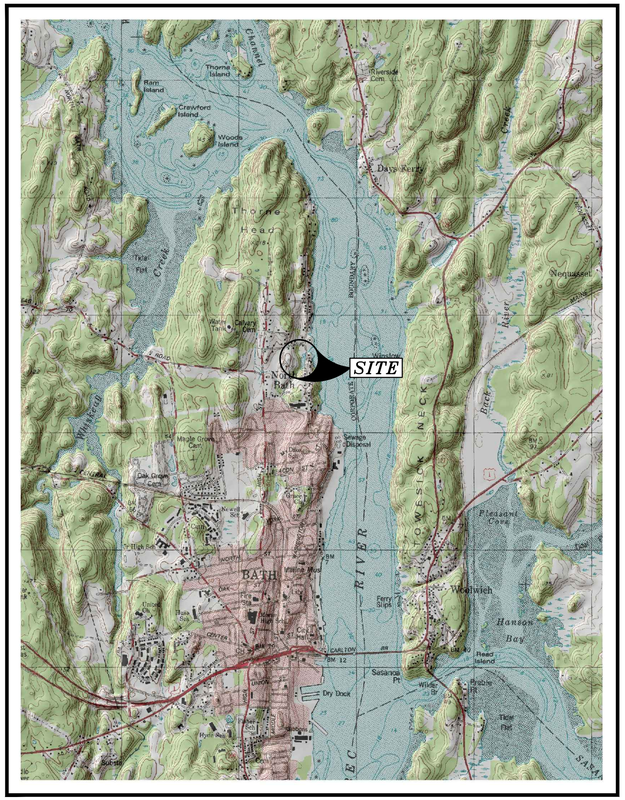
City of Bath
55 Front Street
Bath, Maine



VICINITY MAP
NOT TO SCALE

Description

SHT. NO.	TITLE	
1	COVER SHEET	
2	PLAN AND PROFILE STA 0+00 TO STA 5+00	C-100
3	PLAN AND PROFILE STA 5+00 TO STA 10+00	C-101
4	PLAN AND PROFILE STA 10+00 TO STA 15+00	C-102
5	PLAN AND PROFILE STA 15+00 TO STA 20+00	C-103
6	PLAN AND PROFILE STA 20+00 TO STA 25+00	C-104
7	PLAN AND PROFILE STA 25+00 TO STA 30+00	C-105
8	PLAN AND PROFILE STA 30+00 TO STA 34+50	C-106
9	CONSTRUCTION DETAILS	C-107
10	CONSTRUCTION DETAILS	C-108
11	NOTES AND CONSTRUCTION DETAILS	C-109
12	CONSTRUCTION DETAILS	C-110
13	PUMP STATION DETAILS	C-111


Thorne Head
Thorne Island
Ram Island
Crawford Island
Woods Island
Day's Ferry
Tidal Flat
Creek
Whiskeag Creek
Whiskeag
Cemetery
Cemetery
Sewage Disposal
Oak Grove Cem.
Middle Grove Cem.
Pleasant Grove Cem.
Nequasset
Nequasset Cem.
Winslow Park
Winslow
Washington
Summer St
Summer St
Whiskeag
Whiskeag
Whiskeag

NORTH

rim=35.26
inv/in=22.4 S 30" conc
inv/out=22.1 E 30" conc
inv/in=25.3 W 12" drop

BOWERY STREET

CORE DRILL NEW 15" PVC PIPE INTO EXISTING SMH AND CONNECT WITH ELASTOMERIC BOOT (SEE DETAIL).
15" INV IN=25.12

rim=35.17
inv/in=21.7 SW 30" conc
inv/out=21.9 E 36" conc
inv/in=30.0 NE 2" pvc drop

NEW 8"ø DI WATERMAIN

15"ø SDR 35 PVC
L=76'
S=.068

INSTALL NEW 8" GATE VALVE. CONNECT EXISTING WATERMAIN TO NEW GATE VALVE

TOWNLANDING ROAD

NEW 4'ø SMH(REMOVE EXISTING)
STA 0+76.7 17.76' RT
RIM: MATCH EXISTING GRADE
15" INV IN: 30.87
15" INV OUT: 30.77

rim=39.96
inv/in=30.5 NW
inv/out=30.5 S

15"ø SDR 35 PVC
L=106'
S=.132

rim=54.96
inv/in=49.6 NW 6" clay
inv/in=49.7 N 6" clay
inv/in=49.6 NE 6" clay
inv/out=49.5 SE 6" clay

TRENCH PAVE BASE AND FULL WIDTH SURFACE PAVE SEE DETAIL

REPLACE EXISTING WATER SERVICES FROM MAIN TO CURB STOP, TYPICAL

RET. WALL

REMOVE EXISTING GRAVITY SEWER AS ENCOUNTERED (PLUG ENDS WITH MASONARY PLUG), TYPICAL

NEW 4'ø SMH(REMOVE EXISTING)
STA 1+81.7 2.74' RT
RIM: MATCH EXISTING GRADE
15" INV IN: 45.10
15" INV OUT: 44.60

#115
Sill=57.84

rim=53.35
inv/in=45.1 NW 12" clay
inv/out=44.6 SE 12" clay

NEW 5'ø TERMINUS SMH (SEE DETAIL). REMOVE EXISTING
STA 2+78 1.43' RT
RIM: MATCH EXISTING GRADE
16" INV IN(FM): 51.90
8" INV IN: 51.90
15" INV OUT: 51.40

Sill=62.77

15"ø SDR 35 PVC
L=91'
S=.069

CONNECT NEW 6" WATERMAIN TO EXISTING WITH SOLID SLEEVE

8"x6" REDUCER

8" ø SDR 35 PVC SEWER
L=106

Sill=67.54

#121
Sill=62.61

Terminus Sewer Manhole
rim=60.13
inv/in=53.3 NW force main
inv/out=51.4 SE 12" clay gravity

8" DI 45° BEND

REMOVE EXISTING WATERMAIN AS ENCOUNTERED (PLUG ENDS WITH MASONRY PLUG)

6" Watermain

WASHINGTON STREET

NEW 5' WIDE BITUMINOUS SIDEWALK, TYP

NEW GRANITE CURB, TYPICAL

RELOCATE RESIDENTIAL WATER SERVICE

#234
Sill=67.39

REMOVE SERVICE AND CORPORATION AND PLUG AT WATERMAIN

EXISTING 6" WATERMAIN TO BE REMOVED AS ENCOUNTERED (PLUG ENDS WITH MASONRY PULG)

6" Watermain Cap
Approx. Location of Watermain(abandoned)

Bituminous Curb Typical

Sill=58.30
#1242

MECHANIC STREET

ADA ACCESS RAMP WITH TRUNCATED DOMES (SEE DETAIL)

NEW 4' ø SMH

CAP EXISTING SEWER

16"FM

8"FM

CONNECT NEW 8" WATERMAIN TO EXISTING WITH DI SOLID SLEEVE, TYPICAL

NEW 8" GATE VALVE

8"x8"x8" TEE

REMOVE EXISTING GATE VALVE INSTALL NEW 8" GATE VALVE

NEW HYDRANT AND 6" GATE VALVE ASSEMBLY

6" Watermain Cap
Approximate Location of 6" Dia. Watermain (Abandoned)

6" Watermain

rim=61.22
inv/in=58.3 SW 8" pvc
inv/out=58.2 NE 8" pvc

Sill=64.75

DRUMMOND STREET

tfel=60.45
#1241

8" Watermain

NEW 16" DUCTILE IRON FORCEMAIN (REMOVE EXISTING 14" FORCEMAIN)

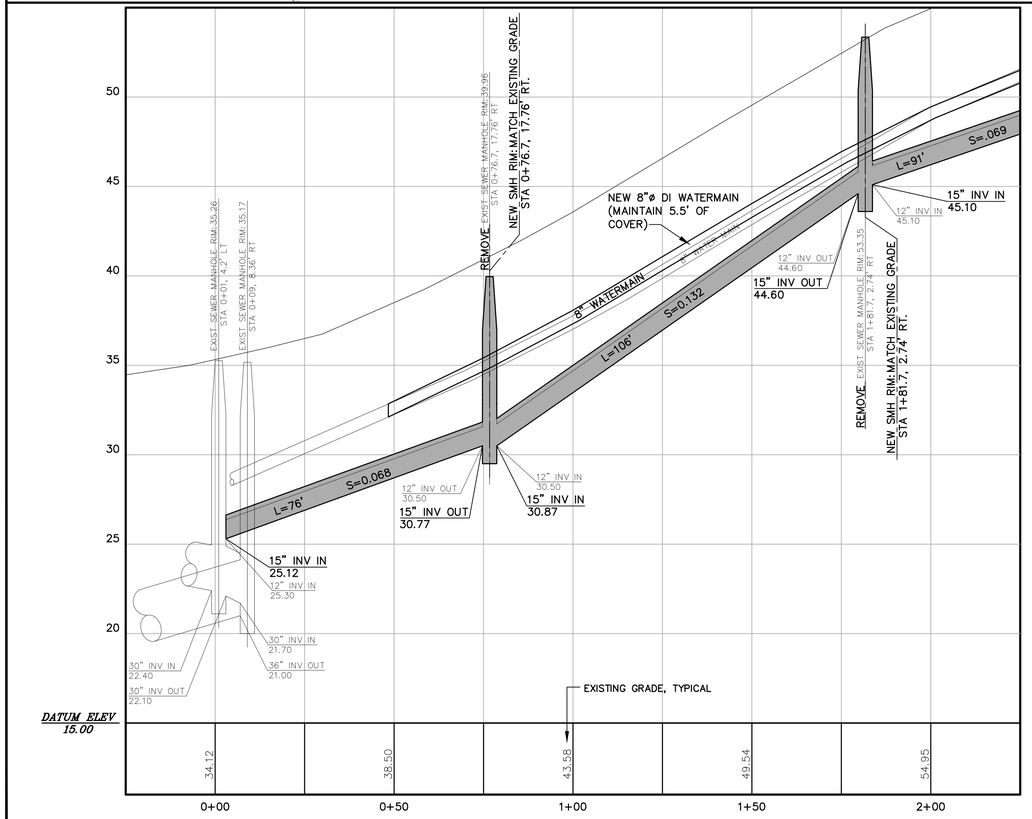
NEW 8" DUCTILE IRON FORCEMAIN

MAINTAIN 3' OF SEPARATION BETWEEN NEW 16" DI FORCEMAIN AND NEW 8" DI FORCEMAIN

MATCH LINE SEE SHT C101

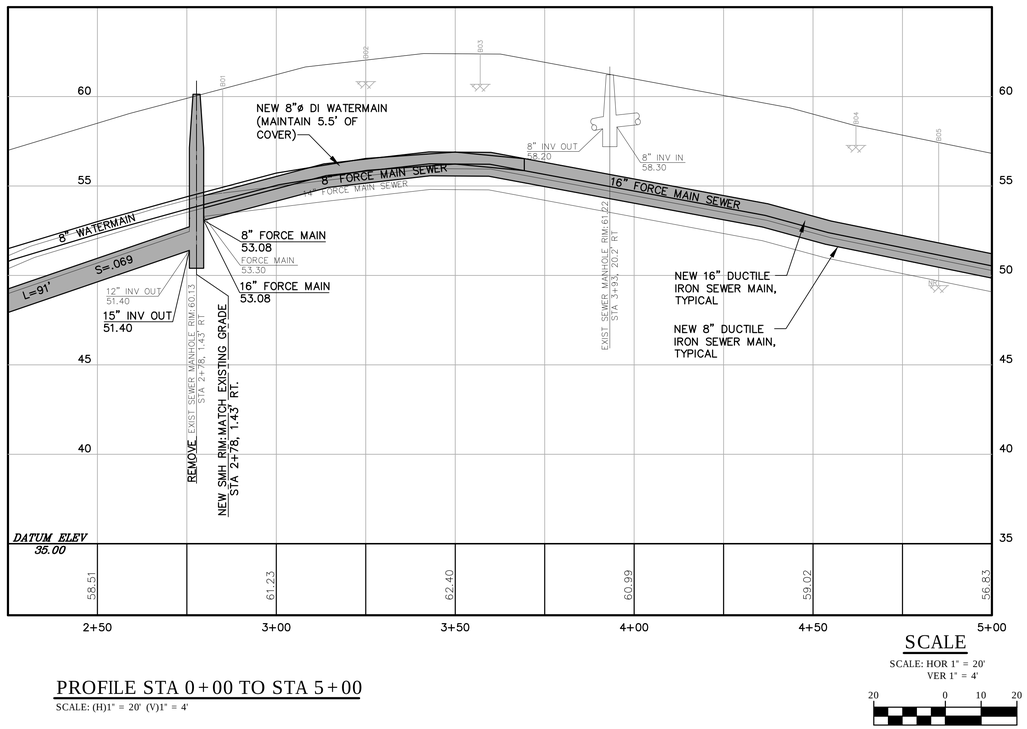
PLAN STA 0+00 TO STA 5+00

SCALE: 1" = 20'



PROFILE STA 0+00 TO STA 5+00

SCALE: (H)1" = 20' (V)1" = 4'



SCALE

SCALE: HOR 1" = 20'
VER 1" = 4'

20 0 10 20

4 0 2 4

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT

CITY OF BATH
BATH, MAINE

Prepared for:

CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER #7934
REGISTERED PROFESSIONAL ENGINEER
CIVIL

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

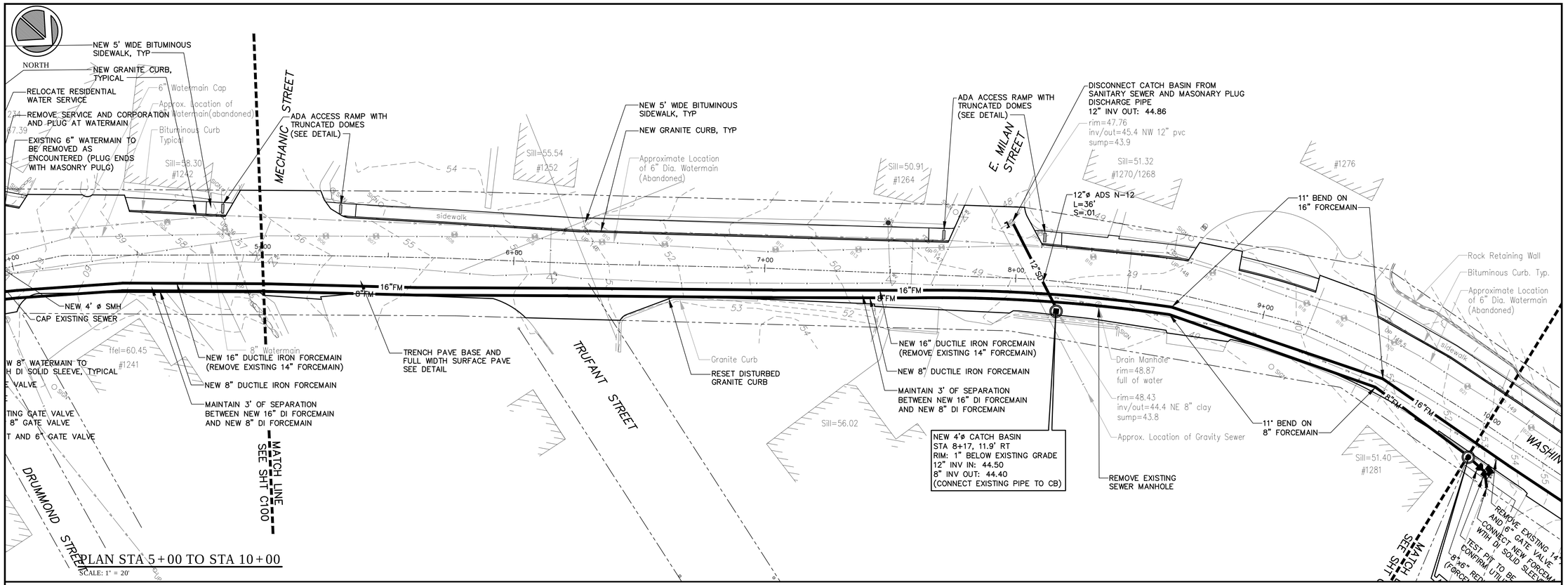
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PLAN AND PROFILE STA 0+00 TO STA 5+00

No.	Revision/Issue	Date
D	RECORD DRAWINGS	2/10/14
C	ADDENDUM #1	7/28/11
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

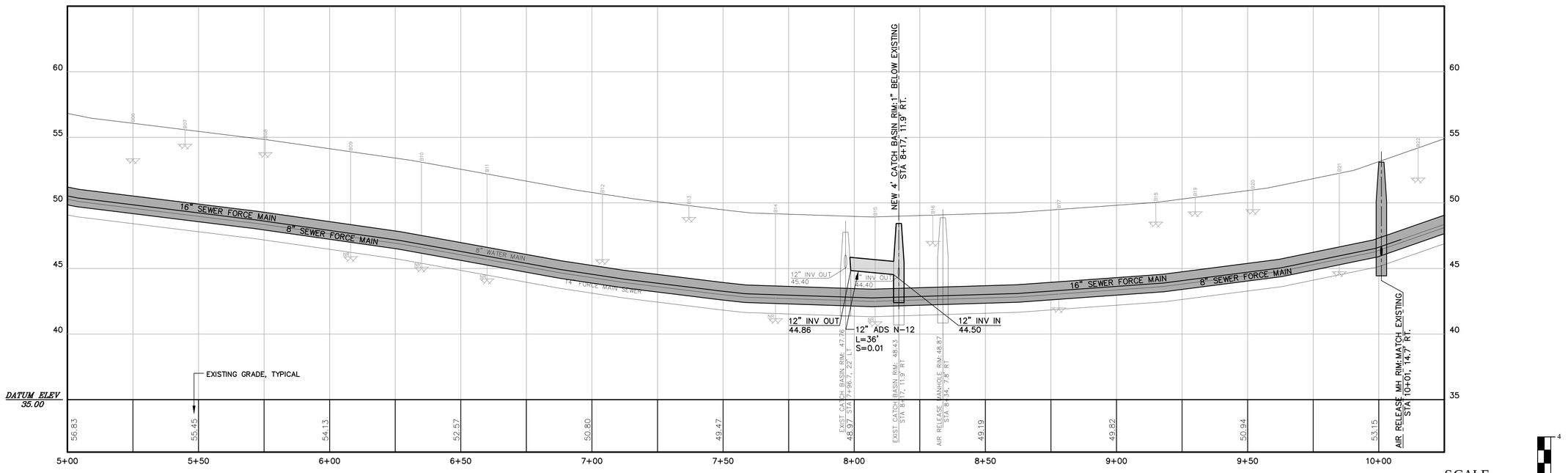
Design by: JLM
Drawn by: KDG
Checked by: SSJ
Approved by: SJD
Project: 071.06049.009
Date: APRIL 2011

Sheet No: C-100
Sheet 2 of 13



PLAN STA 5+00 TO STA 10+00

SCALE: 1" = 20'



PROFILE STA 5+00 TO STA 10+00

SCALE: (H)1" = 20' (V)1" = 4'

SCALE
SCALE: HOR 1" = 20'
VER 1" = 4'

20 0 10 20

4 0 2 4

P:\2007\076049\.009 Washington Street Force Main\Drawings\071.06049 Working Drawings\071.06049_C-100_10_C-106.dwg C101 Jul 25,2014- 10:57am

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEVEN S JOHNSON #8214
REGISTERED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PLAN AND PROFILE STA 5+00 TO STA 10+00

No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM
Drawn by: KDG
Checked by: SSJ
Approved by: SJD
Project: 071.06049.009
Date: APRIL 2011

Sheet No: C-101
Sheet 3 of 13

NORTH

NEW 4'ø CATCH BASIN
STA 13+76 10' LT
RIM: 1" BELOW EXISTING GRADE
12" INV OUT: 53.00

NEW 5' WIDE BITUMINOUS SIDEWALK, TYP

NEW GRANITE CURB, TYP

PROTECT EXISTING DECK

REMOVE PAVEMENT AND LOAM & SEED, TYP.

NEW 4'ø SEWER MANHOLE
STA 14+46, 15.5' LT
RIM: MATCH EXISTING GRADE
8" INV IN: 45.82
8" INV OUT: 45.70

NEW 4'ø CATCH BASIN
STA 15+04, 12' LT
RIM: 1" BELOW EXISTING GRADE
12" INV IN: 49.23
12" INV OUT: 49.11

RELOCATE EXISTING HYDRANT AND RECONNECT WITH SOLID SLEEVE COUPLING

REMOVE EXISTING CATCH BASIN & STORMDRAIN

8"ø SDR 35 PVC
L=216'
S=0.017

12"ø TYPE "C" UNDERDRAIN
L=123'
S=0.005

ADA ACCESS RAMP WITH TRUNCATED DOMES (SEE DETAIL)

12"ø ADS N-12
L=68'
S=0.035

NEW BITUMINOUS CURB, MOLD 2, TYPICAL

PARK STREET

WASHINGTON STREET

CURTIS PL.

12"ø ADS N-12
L=27'
S=0.0072

12" TYPE "C" UNDERDRAIN
L=70'
S=0.0026

8"ø SDR 35 PVC
L=82'
S=0.0195

NEW 4'ø CATCH BASIN
(REMOVE EXISTING CB)
STA 15+13, 17.5' RT
RIM: 4" BELOW EXISTING GRADE
12" INV IN: 49.00
12" INV OUT: 48.90

CAP EXISTING SEWER WITH MASONRY PLUG

CONNECT NEW 8" PVC SEWER TO EXISTING SMH BY CORE DRILL & RUBBER BOOT
8" INV IN: 44.10

12"ø ADS N-12
L=107'
S=0.08

NEW 4'ø CATCH BASIN
12" INV IN: 39.82
6: INV IN: 40.68
12" INV OUT: 39.82

NEW 16" DUCTILE IRON FORCEMAIN (REMOVE EXISTING 14" FORCEMAIN)

REPLACE EXISTING AIR RELEASE MANHOLE
STA 11+93 9.46' RT
RIM: MATCH EXISTING GRADE

TRENCH PAVE BASE AND FULL WIDTH SURFACE PAVE (SEE DETAIL)

NEW 4'ø CATCH BASIN
STA 14+39 14.8' RT
RIM: 1" BELOW EXISTING GRADE
12" INV IN: 50.65
12" INV IN: 48.72
12" INV OUT: 48.45

REMOVE EXISTING 14"x14"x6" WYE AND 6" GATE VALVE

CONNECT NEW FORCEMAIN TO EXISTING WITH DI SOLID SLEEVE AND FITTINGS

TEST PIT TO BE CONDUCTED TO CONFIRM UTILITY ELEVATIONS

8"x6" REDUCER
(FORCEMAIN BENDS NOT EXCEED 45°)

AIR RELEASE MANHOLE
STA 10+01 14.7' RT
RIM: MATCH EXISTING GRADE

MATCH LINE SEE SHT C101

MATCH LINE SEE SHT C103

Air Release Manhole

Garage

Sidewalk

Bituminous Curb. Typ.

Granite Curb. Typ.

Retaining Wall

Approximate Location of 6" Dia. Watermain (Abandoned)

16"FM

8"FM

12"SD

8"S

12 UD

rim=43.54
inv/out=41.2 NE 6" pvc

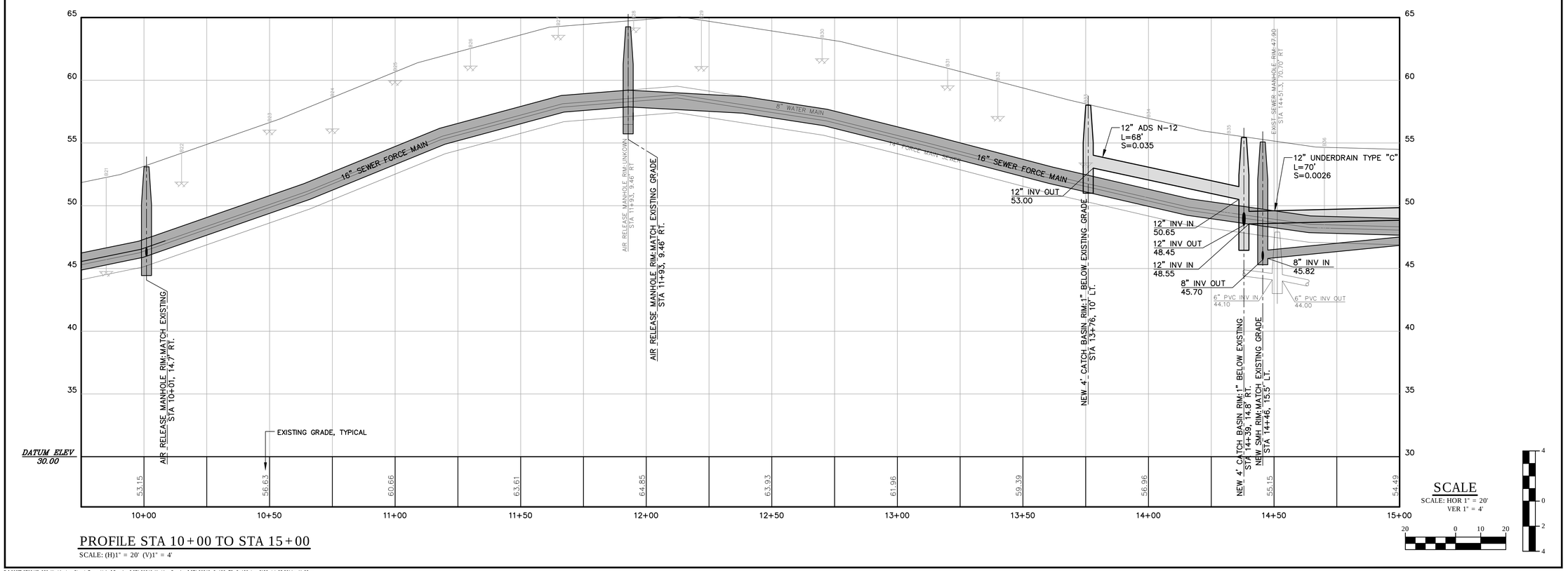
rim=47.90
inv/in=44.1 NW 6" pvc
inv/out=44.0 SE 6" pvc

rim=53.04
inv/in=51.0 N 8" clay
inv/out=49.4 S 6"
sump=48.0

rim=54.02
could not open
Drain Manhole

IRF w/CAP
flush

PLAN STA 10+00 TO STA 15+00
SCALE: 1" = 20'



PROFILE STA 10+00 TO STA 15+00
SCALE: (H)1" = 20' (V)1" = 4'

SCALE
SCALE: HOR 1" = 20'
VER 1" = 4'

P:\2007\076049\.009 Washington Street Force Main\Drawings\071.06049 Working Drawings\071.06049_C-100_10_C-106.dwg C102 Jul 25,2014- 11:02am

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7954
REGISTERED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

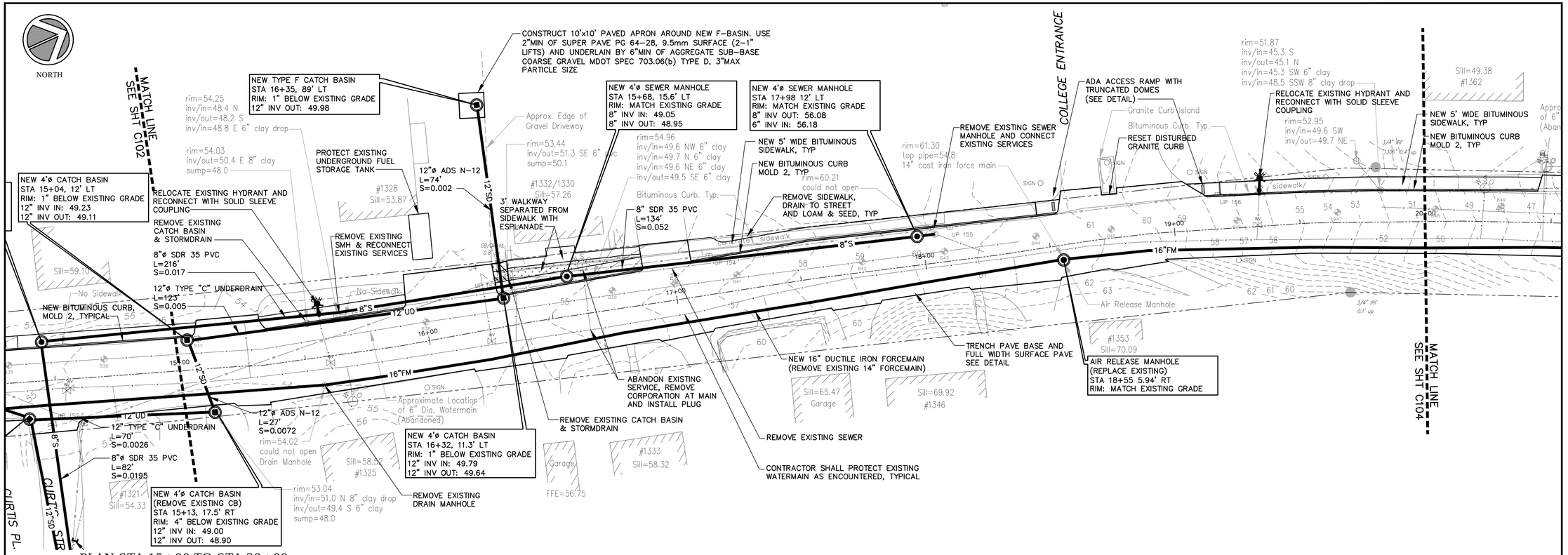
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PLAN AND PROFILE STA 10+00 TO STA 15+00

No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

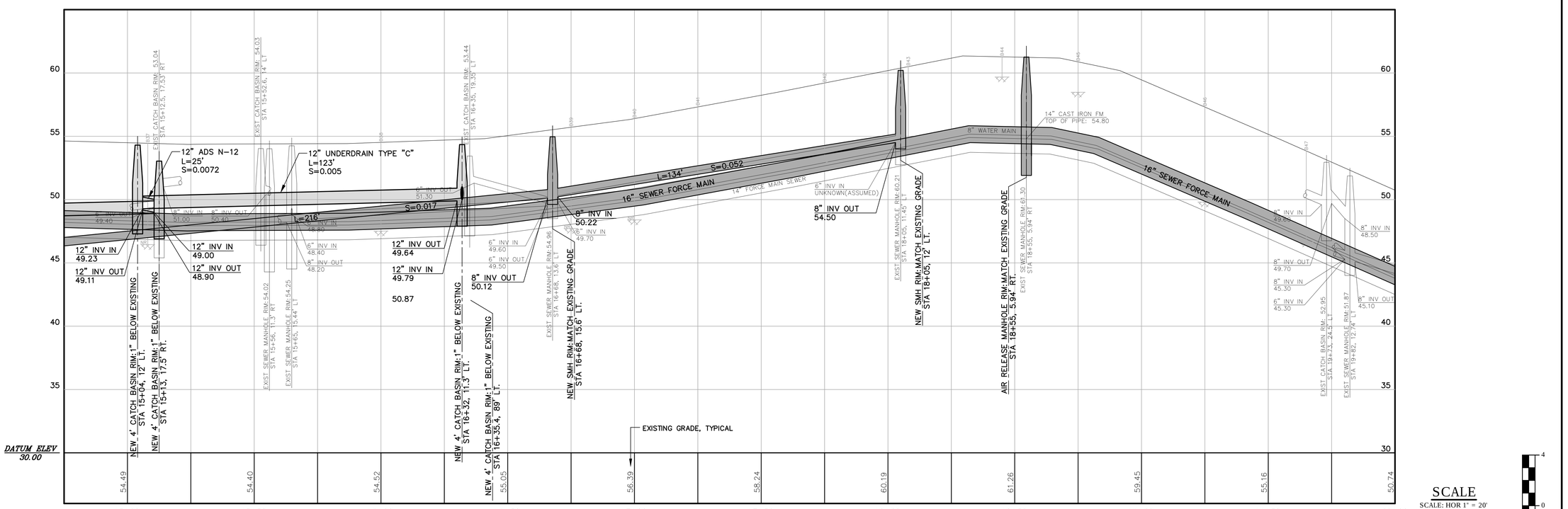
Design by: JLM | Checked by: SSJ
Drawn by: KDG | Approved by: SJD
Project: 071.06049.009 | Date: APRIL 2011

Sheet No: C-102
Sheet 4 of 13



PLAN STA 15+00 TO STA 20+00

SCALE: 1" = 20'



PROFILE STA 15+00 TO STA 20+00

SCALE: (H)1" = 20' (V)1" = 4'

SCALE
SCALE: HOR 1" = 20'
VER 1" = 4'

P:\2007\076049_009 Washington Street Force Mains\Drawings\071.06049 Working Drawings\071.06049_C-100_TO_C-106.dwg C103 Jul 25,2014- 11:00am

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7934
REGISTERED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

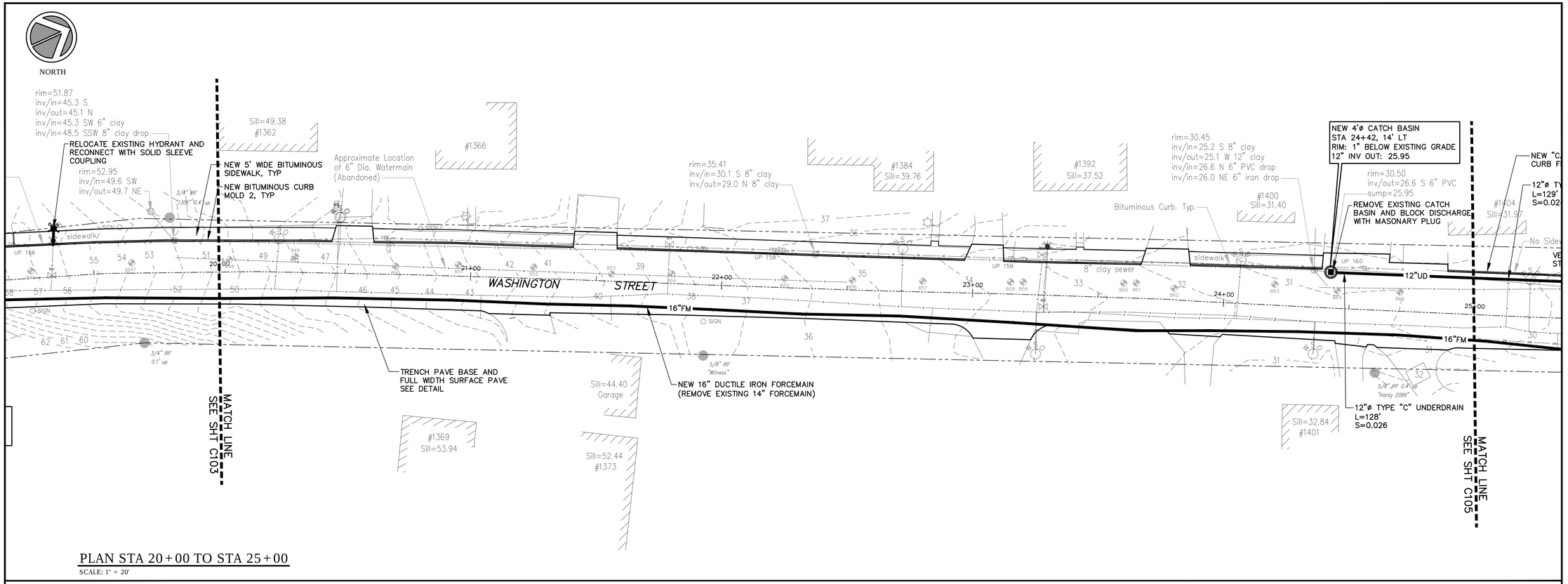
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PLAN AND PROFILE STA 15+00 TO STA 20+00

No.	Revision/Issue	Date
D	RECORD DRAWINGS	2/10/14
C	ADDENDUM #1	7/28/11
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

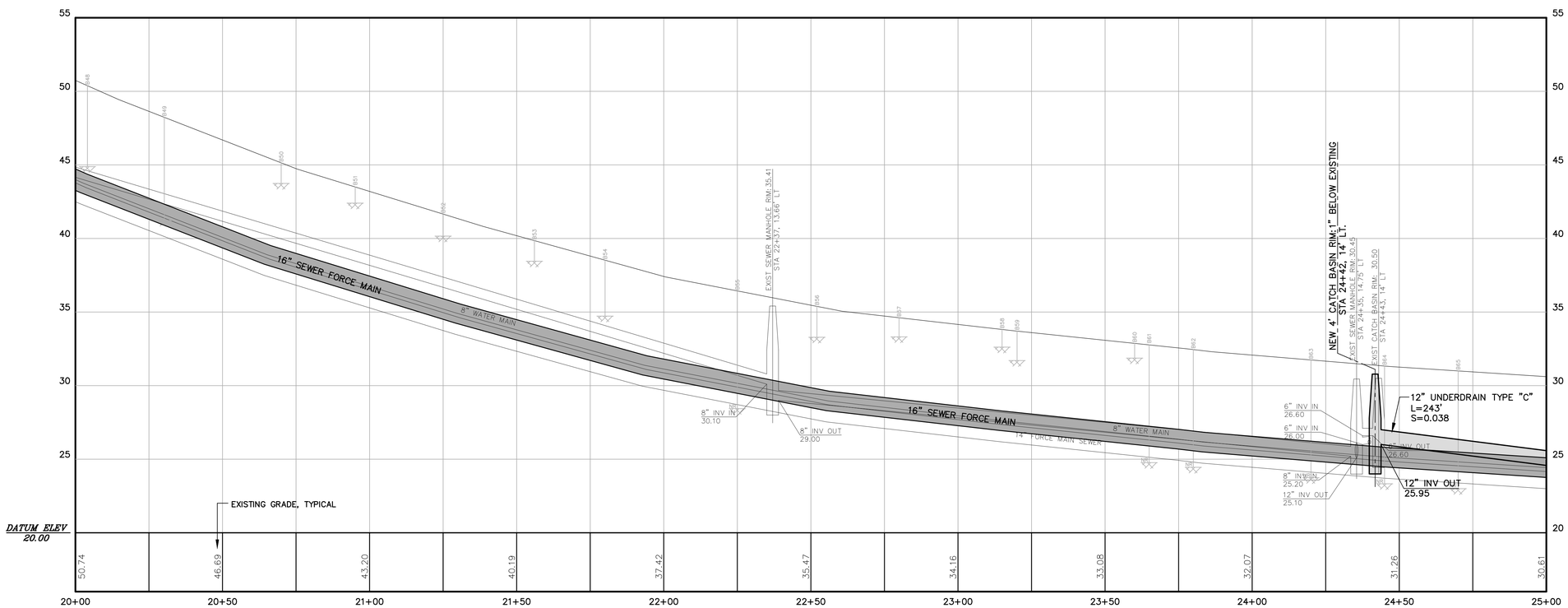
Design by: JLM
Checked by: SSJ
Drawn by: KDG
Approved by: SJD
Project: 071.06049.009
Date: APRIL 2011

Sheet No: C-103
Sheet 5 of 13



PLAN STA 20+00 TO STA 25+00

SCALE: 1" = 20'



PROFILE STA 20+00 TO STA 25+00

SCALE: (H)1" = 20' (V)1" = 4'

SCALE
SCALE: HOR 1" = 20'
VER 1" = 4'

P:\2007\076049_009 Washington Street Force Mains\Drawings\071.06049 Working Drawings\071.06049_C-100_TO_C-106.dwg C104 Jul 25,2014- 11:03am

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7934
REGISTERED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

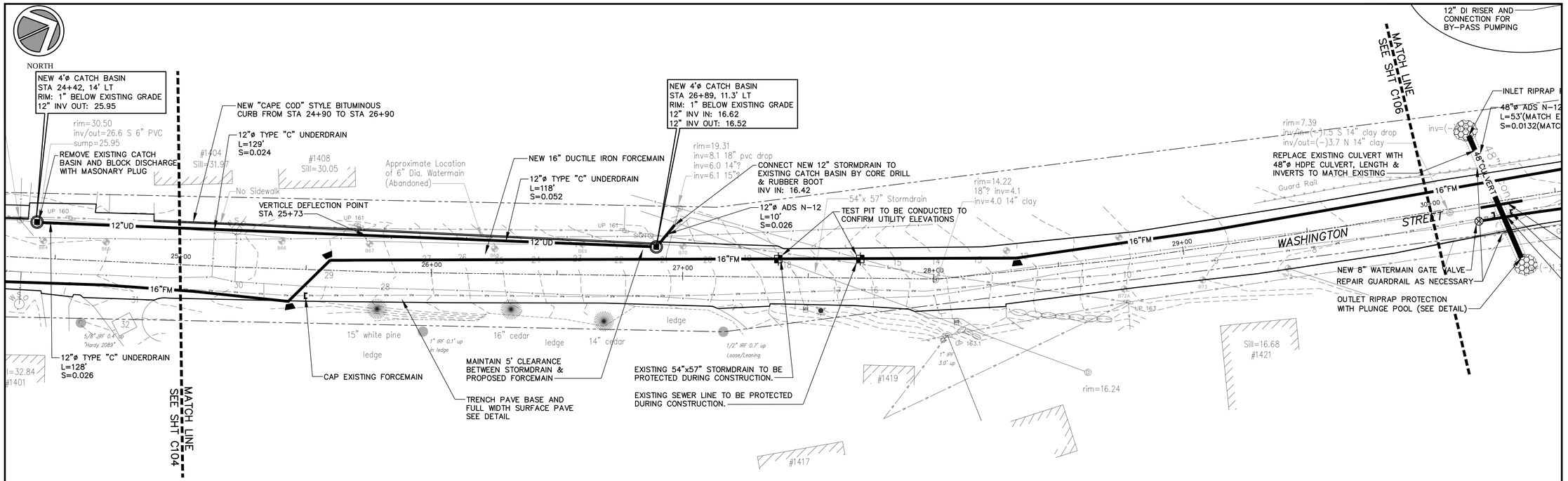
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PLAN AND PROFILE
STA 20+00 TO
STA 25+00

No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

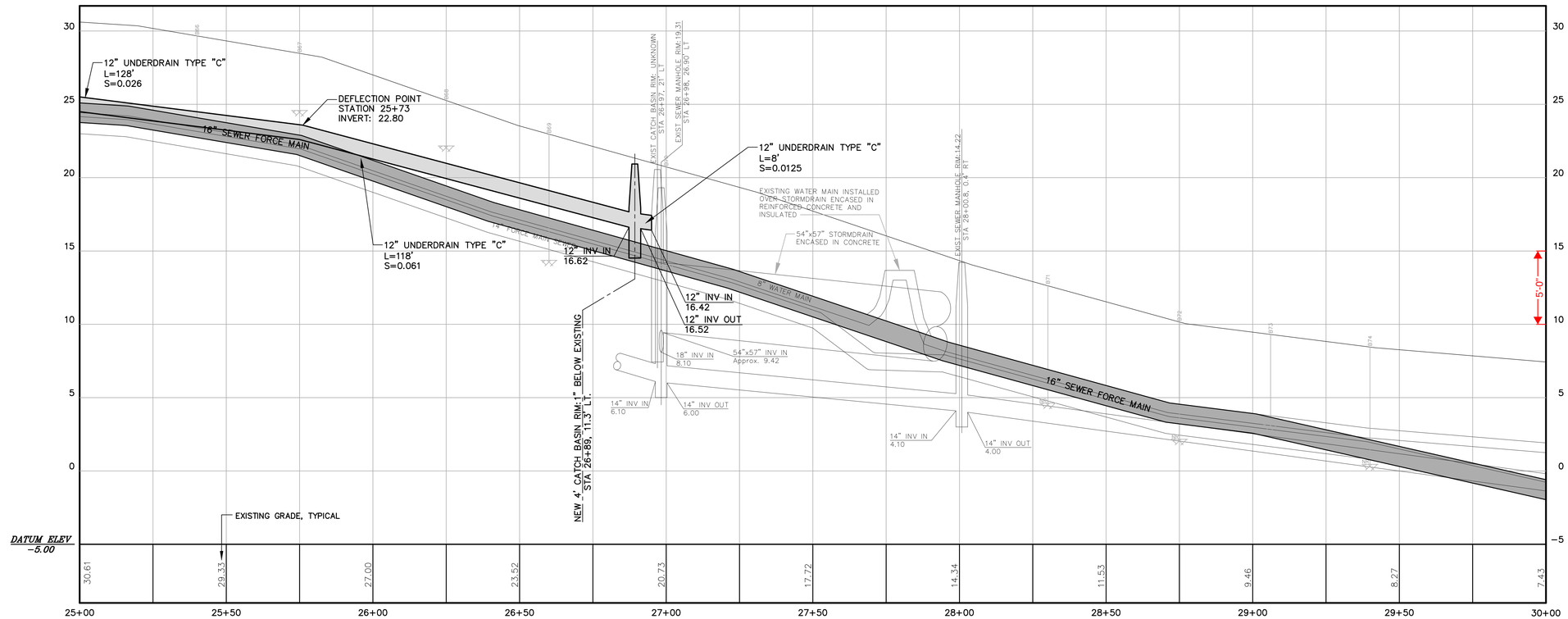
Design by: JLM
Drawn by: KDG
Checked by: SSJ
Approved by: SJD
Project: 071.06049.009
Date: APRIL 2011

Sheet No: C-104
Sheet 6 of 13



PLAN STA 25+00 TO STA 30+00

SCALE: 1" = 20'



PROFILE STA 25+00 TO STA 30+00

SCALE: (H)1" = 20' (V)1" = 4'

SCALE
SCALE: HOR 1" = 20'
VER 1" = 4'

P:\2007\076049_009 Washington Street Force Mains\Drawings\071.06049 Working Drawings\071.06049_C-100_10_C-106.dwg C105 Jul 25,2014- 11:04am

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7934
LICENSED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

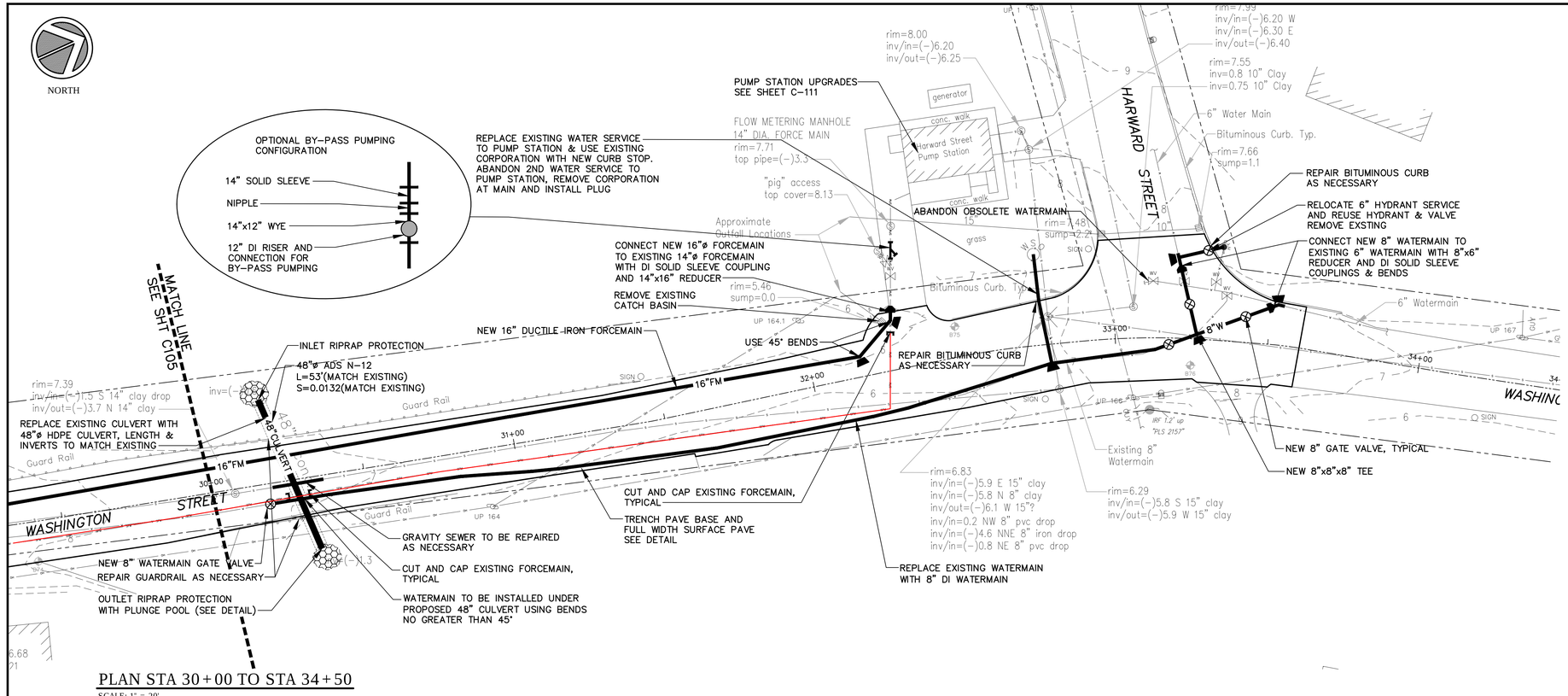
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PLAN AND PROFILE STA 25+00 TO STA 30+00

No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM
Drawn by: KDG
Checked by: SSJ
Approved by: SJD
Project: 071.06049.009
Date: APRIL 2011

Sheet No: C-105
Sheet 7 of 13

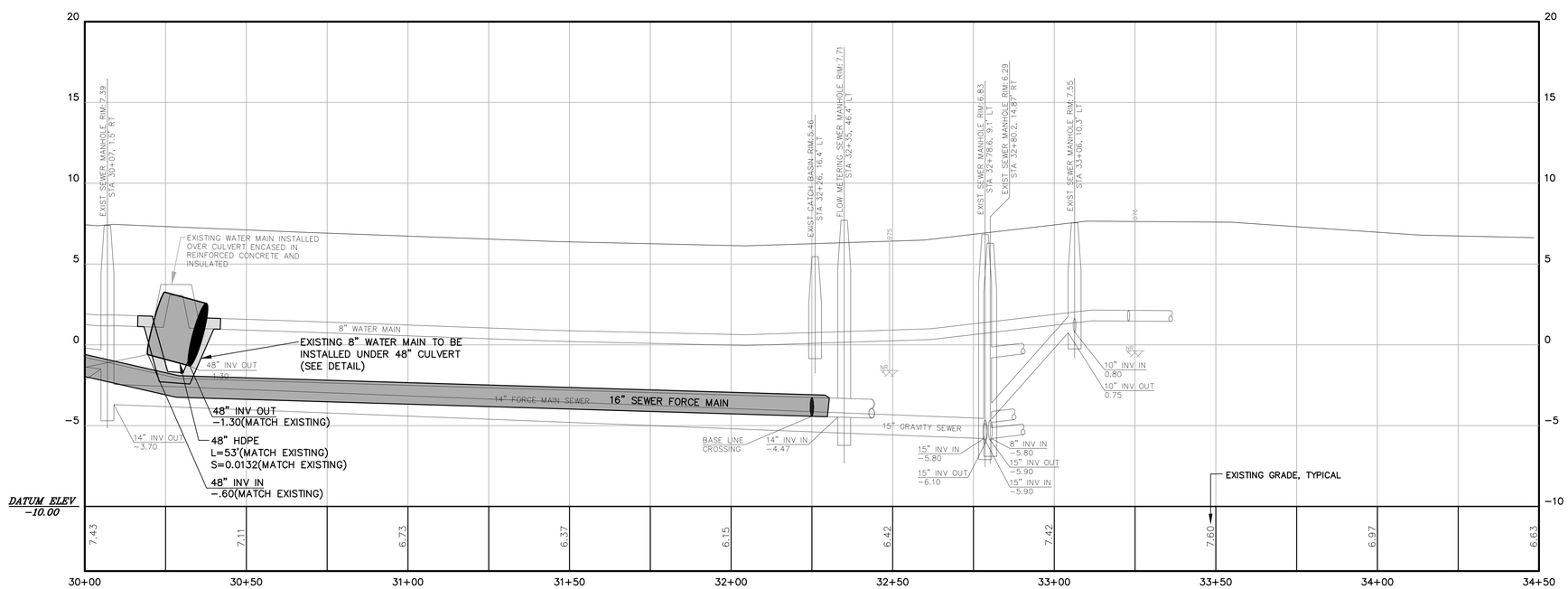


PLAN STA 30+00 TO STA 34+50

SCALE: 1" = 20'

NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL SANITARY SEWER FLOW FOR THE DURATION OF THE PROJECT.
2. THE CONTRACTOR SHALL RESET ALL EXISTING FRAME AND COVERS AS REQUIRED.
3. THE CONTRACTOR SHALL REPLACE ALL WATER SERVICES NOTED, INCLUDING CORPORATION, CURB STOP AND CURB BOX TO THE PROPERTY LINE.
4. THE CONTRACTOR SHALL REMOVE EXISTING SEWER INFRASTRUCTURE AS REQUIRED FOR NEW SEWER INSTALLATION.
5. THE CONTRACTOR SHALL RESET EXISTING MAILBOXES AND SIGNS AS REQUIRED.
6. ALL CONNECTIONS TO EXISTING PRECAST CONCRETE STRUCTURES SHALL BE CORE DRILLED AND SHALL USE AN ELASTOMERIC BOOT CONNECTION WITH DOUBLE STAINLESS STEEL BANDS, KOR-N-SEAL OR APPROVED EQUAL.
7. ALL SANITARY SEWER SERVICES THAT ARE DAMAGED SHALL BE REPLACED FROM THE SEWER MAIN TO THE PROPERTY LINE.
8. BATH WATER DISTRICT (BWD) SHALL BE SOLEY RESPONSIBLE FOR OPERATING ALL WATER MAIN INFRASTRUCTURE.
9. THE CONTRACTOR SHALL PROVIDE AT LEAST 24 HOURS NOTIFICATION PRIOR TO REQUIRING WATER SYSTEM OPERATION OR INSPECTION SERVICES.
10. ALL PROPOSED NEW AND RELOCATED HYDRANTS SHALL BE FIELD LOCATED BY THE BWD AS REQUIRED BY FIELD CONDITIONS.
11. ALL EXISTING HYDRANTS AND VALVES SHALL REMAIN THE PROPERTY OF THE BWD AND CONTRACTOR SHALL DELIVER TO THE BWD MATERIAL STOCKPILE LOCATION.
12. THE CONTRACTOR SHALL SUPPLY ALL PIPE, FITTINGS, VALVES, REDUCERS, COUPLINGS AND REQUIRED APPURTENANCES TO CONNECT NEW DOMESTIC SERVICES TO THE EXISTING SERVICES AT THE PROPERTY LINE.
13. ALL PIPE DEFLECTION SHALL NOT EXCEED THE MANUFACTURE'S RECOMMENDED MAXIMUM DEFLECTION PER JOINT FOR EACH PIPE SIZE.
14. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL BY-PASS PUMPING. CONTRACTOR MAY INSTALL 14"x12" DI WYE FITTING AND OTHER APPURTENANCES TO FACILTATE BY-PASS PUMPING AT STATION 32+34, 38' LEFT, WORK SHALL ALSO INCLUDE REMOVAL OF REQUIRED TEMPORARY PIPING AND THE INSTALLATION OF BLIND FLANGE, AS REQUIRED AS WELL AS SURFACE RESTORATION.
15. BWD INDICATES THAT MOST DOMESTIC WATER SERVICES IN BATH CONSIST OF 3/4 INCH COPPER PIPE.
16. ALL WALKWAYS SHALL BE TRANSITIONED BY THE CONTRACTOR FROM THE BACK OF THE SIDEWALK TO THE ROW AS REQUIRED AND SHALL MATCH EXISTING WALKWAY CONSTRUCTION. THIS WORK SHALL BE CONSIDERED INCIDENTAL TO THE PROJECT.
17. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD MEASURING THE EXISTING PAVEMENT WIDTH AT EACH 50' STATION AND DOCUMENTING THIS INFORMATION FOR FUTURE REFERENCE.
18. ALL PIPE, VALVES AND FITTINGS FOR THE RELOCATED 8" WATER MAIN AT STATION 30+25 RIGHT SHALL BE WRAPPED IN HDPE FILM IN ACCORDANCE WITH AWWA STANDARD C105-LATEST REVISION, METHOD "A" AND POLYETHELENE ENCASEMENT SHALL BE EITHER LINEAR LOW DENSITY POLYETHELENE (LLDPE) FILM WITH A MINIMUM THICKNESS OF 8-MIL OR HIGH DENSITY, CROSS LAMINATED POLYETHELENE (HDCLPE) FILM WITH A MINIMUM THICKNESS OF 4-MIL. COST SHALL BE INCIDENTAL TO THE PIPE RELOCATION PAY ITEM.



PROFILE STA 30+00 TO STA 34+50

SCALE: (H)1" = 20' (V)1" = 4'

SCALE
SCALE: HOR 1" = 20'
VER 1" = 4'

20 0 10 20
4 0 2 4

P:\2007\076049_009 Washington Street Force Mains\Drawings\071.06049 Working Drawings\071.06049_C-100_TO_C-106.dwg C106 Jul 25,2014- 11:05am

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7934
LICENSED PROFESSIONAL ENGINEER

Record Drawings

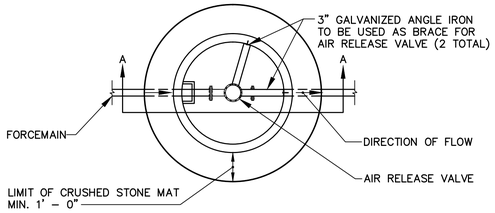
RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

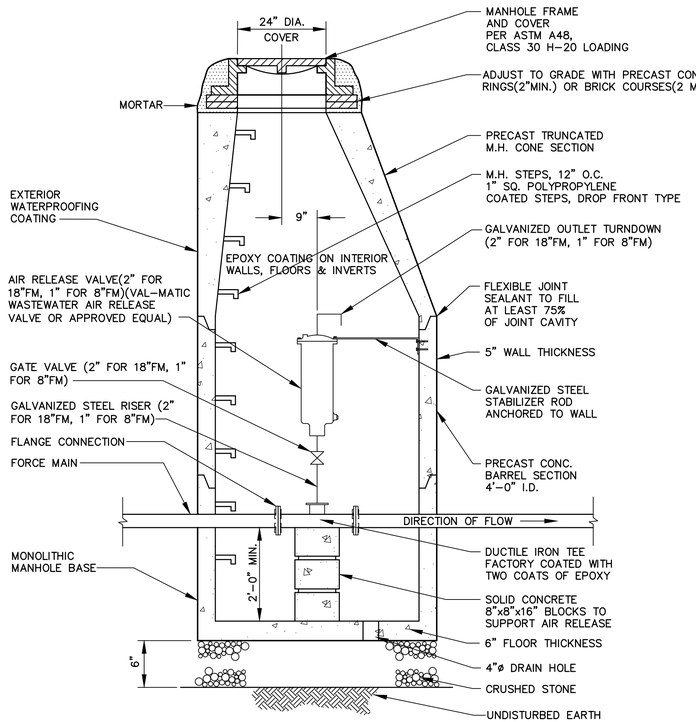
PLAN AND PROFILE STA 30+00 TO STA 34+50

No.	Revision/Issue	Date
D	RECORD DRAWINGS	2/10/14
C	ADDENDUM #1	7/28/11
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM
Drawn by: KDG
Checked by: SSJ
Approved by: SJD
Project: 071.06049.009
Date: APRIL 2011
Sheet No: C-106
Sheet 8 of 13



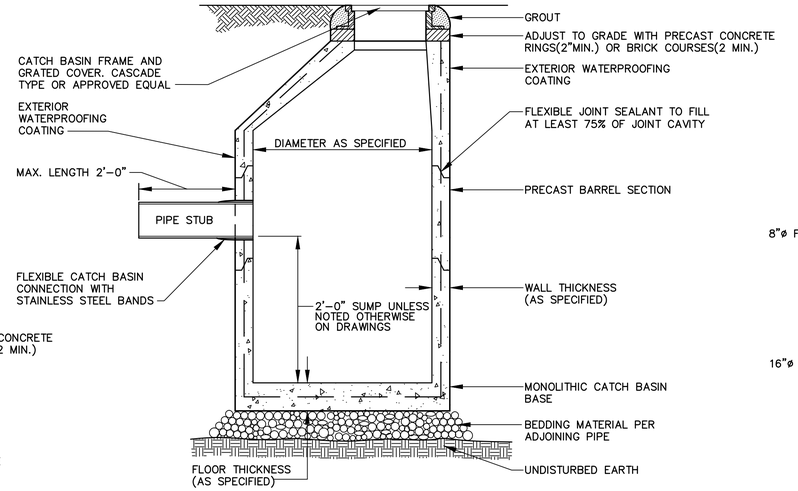
PLAN VIEW



SECTION A–A

4' DIA AIR RELEASE MANHOLE

NOT TO SCALE

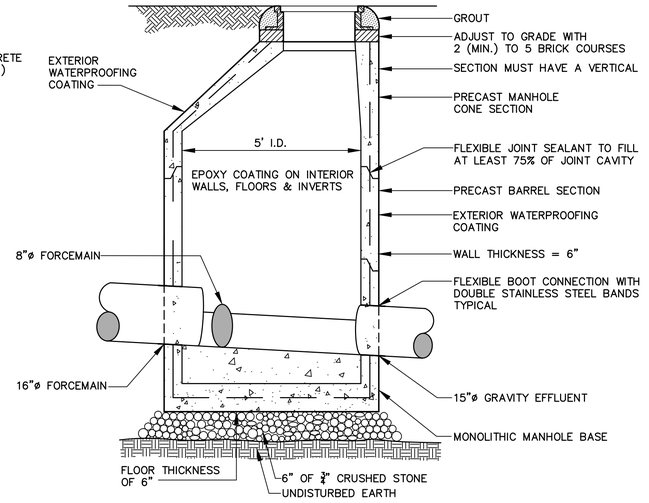


ALL MANHOLE PENETRATIONS SHALL HAVE ELASTOMERIC BOOT WITH DOUBLE STAINLESS STEEL PIPE BANDS, KOR-N-SEAL OR APPROVED EQUAL.

I.D.	WALL WIDTH	FLOOR THICKNESS
4'–0"	5"	6"
5'–0"	6"	6"
6'–0"	7"	6"

PRECAST CONCRETE CATCH BASIN/MANHOLE

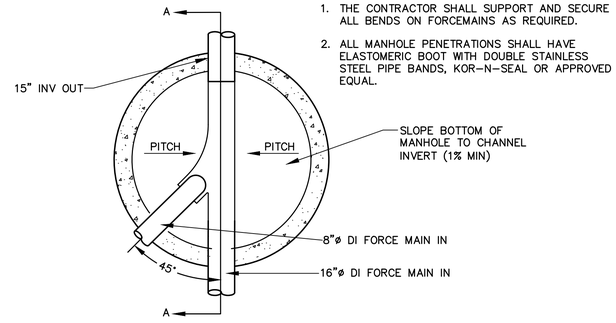
NOT TO SCALE



SECTION A–A

NOTES

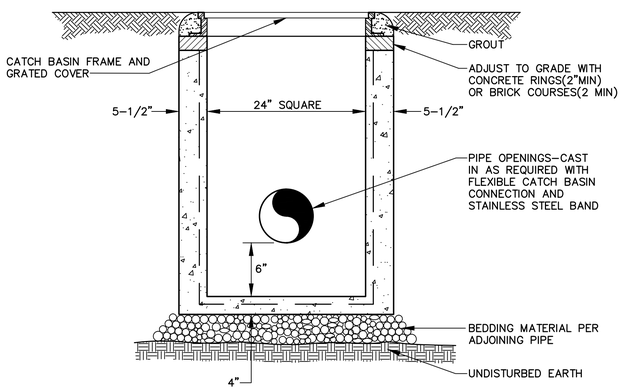
1. THE CONTRACTOR SHALL SUPPORT AND SECURE ALL BENDS ON FORCEMAINS AS REQUIRED.
2. ALL MANHOLE PENETRATIONS SHALL HAVE ELASTOMERIC BOOT WITH DOUBLE STAINLESS STEEL PIPE BANDS, KOR-N-SEAL OR APPROVED EQUAL.



PLAN VIEW

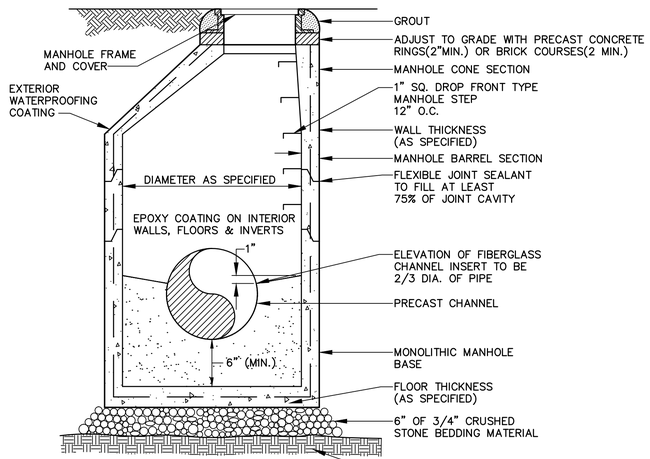
5' DIA TERMINUS SEWER MANHOLE DETAIL

NOT TO SCALE



PRECAST CONCRETE CATCH BASIN-TYPE "F"

NOT TO SCALE

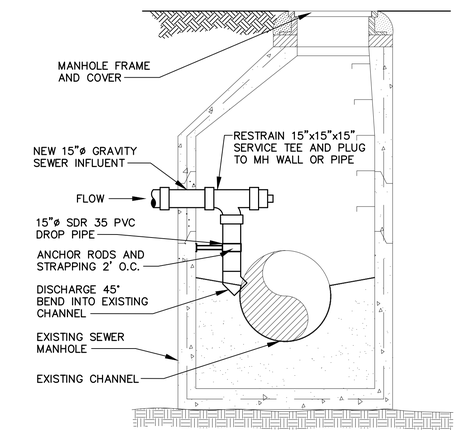


ALL MANHOLE PENETRATIONS SHALL HAVE ELASTOMERIC BOOT WITH DOUBLE STAINLESS STEEL PIPE BANDS, KOR-N-SEAL OR APPROVED EQUAL.

I.D.	WALL WIDTH	FLOOR THICKNESS
4'–0"	5"	6"
5'–0"	6"	6"
6'–0"	7"	6"

PRECAST CONCRETE SANITARY MANHOLE

NOT TO SCALE



ALL MANHOLE PENETRATIONS SHALL HAVE ELASTOMERIC BOOT WITH DOUBLE STAINLESS STEEL PIPE BANDS, KOR-N-SEAL OR APPROVED EQUAL.

DROP MANHOLE DETAIL

NOT TO SCALE

P:\2007\076049_009 Washington Street Force Maine\Drawings\071.06049 Working Drawings\071.06049_C-107_TO_C-111.dwg C-107 Jul 25,2014- 11:11am

Site:

WASHINGTON STREET FORCEMAIN REPLACEMENT

CITY OF BATH
BATH, MAINE

Prepared for:

CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7934
LICENSED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

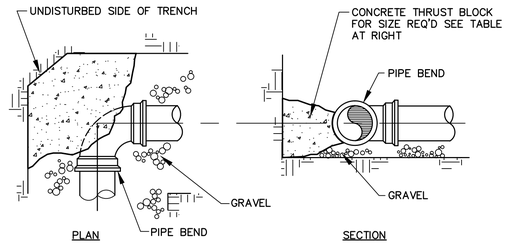
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

CONSTRUCTION DETAILS

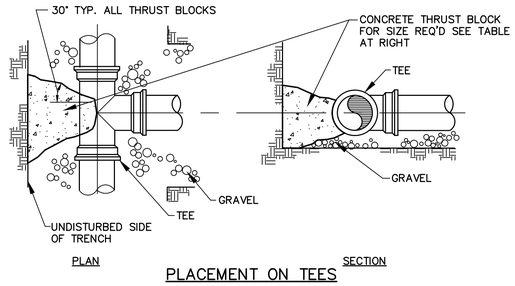
No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM | Checked by: SSJ
Drawn by: KDG | Approved by: SJD
Project: 071.06049.009 | Date: APRIL 2011

Sheet No: C-107
Sheet 9 of 13



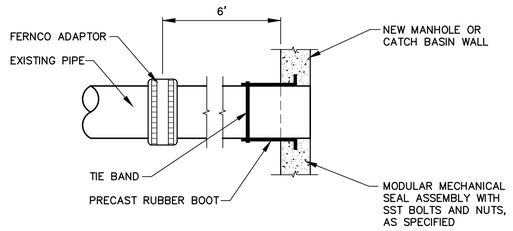
PLACEMENT ON BENDS



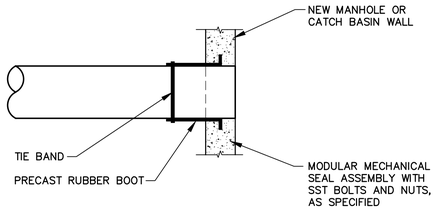
PLACEMENT ON TEES

SIZE REQUIREMENTS FOR CONCRETE THRUST BLOCKS					
		BEARING ON UNDISTURBED SOIL (SQUARE FT.)			
FITTINGS		90° BENDS	45° BENDS	TEES & PLUGS	HYDRANTS
PIPE SIZE	8"	5.0	3.0	4.0	N/A
	16"	17.0	9.0	12.0	N/A

TYPICAL THRUST BLOCK DETAIL
NOT TO SCALE

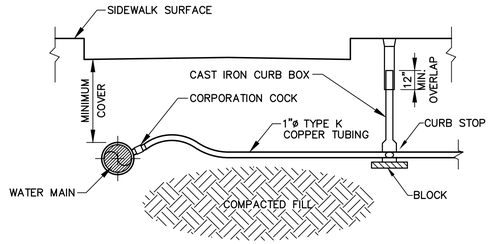


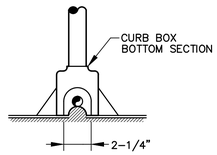
EXISTING PIPE INTO NEW STRUCTURE



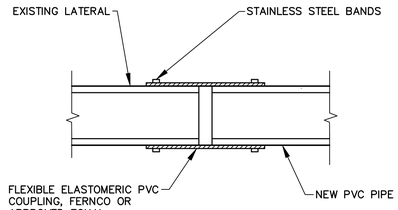
NEW PIPE INTO NEW STRUCTURE

PIPE CONNECTION DETAIL
NOT TO SCALE



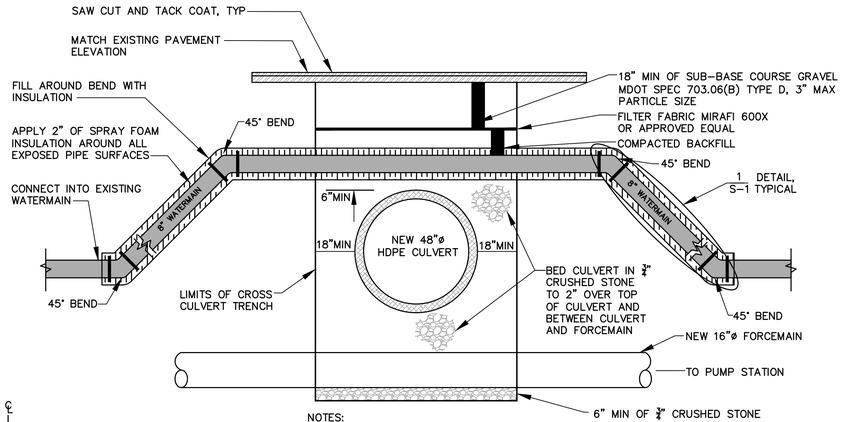


TYPICAL COPPER HOUSE SERVICE DETAIL
NOT TO SCALE



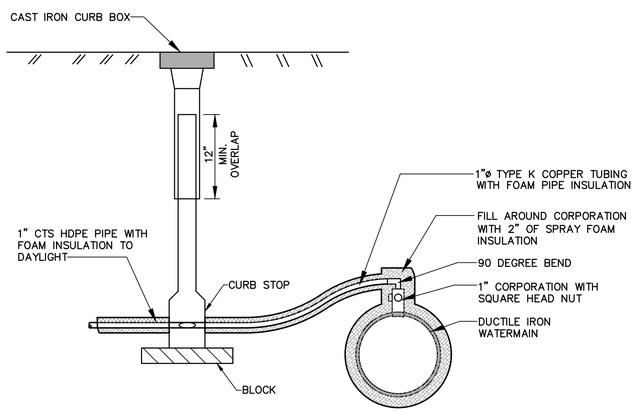
(FOR REPAIR OR REPLACEMENT)

TYPICAL SANITARY SEWER HOUSE LATERAL CONNECTION DETAIL
NOT TO SCALE

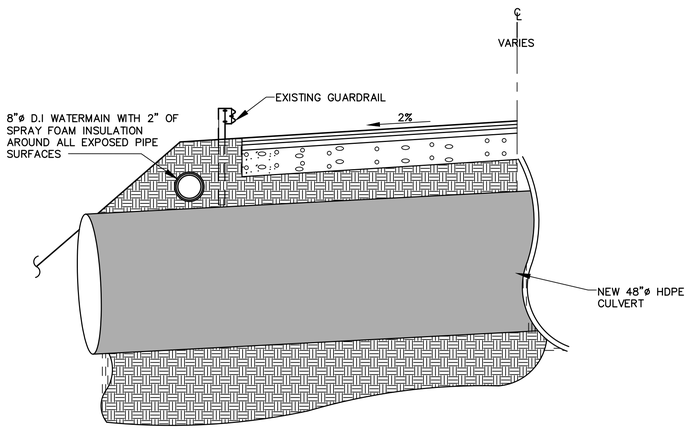


NOTES:
1. CLAY CHECK DAM ON INLET SIDE ONLY
2. WATERMAIN AND FORCEMAIN TO BE ADEQUATELY RESTRAINED AT ALL FITTINGS. STAINLESS STEEL RODS AND THRUST BLOCKS TO BE USED AS NECESSARY. TYPE/CONFIGURATION OF RESTRAINTS TO BE APPROVED BY ENGINEER AND BATH WATER DISTRICT PRIOR TO CONSTRUCTION.

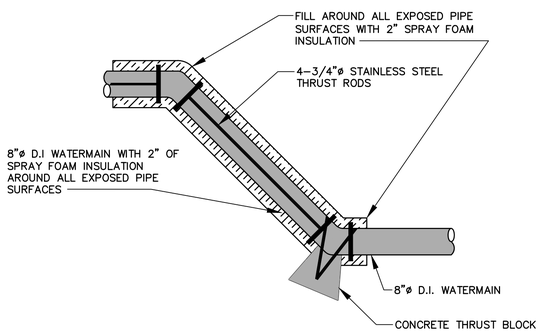
CULVERT REPLACEMENT DETAIL
NOT TO SCALE



BWD AIR RELEASE DETAIL
NOT TO SCALE



8" WATERMAIN X-SECTION
NOT TO SCALE



DETAIL 1/S-1 ALTERNATE 1
NOT TO SCALE

Site:

WASHINGTON STREET FORCEMAIN REPLACEMENT

CITY OF BATH
BATH, MAINE

Prepared for:

CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER
#7934
LICENSED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

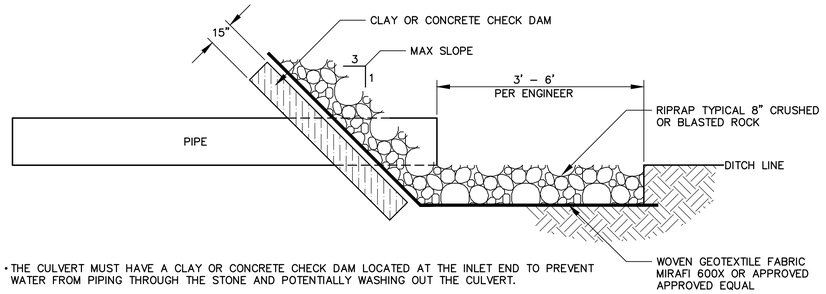
CONSTRUCTION DETAILS

No.	Revision/Issue	Date
E	RECORD DRAWINGS	2/10/14
D	FINAL WATERMAIN CROSSING	9/7/11
C	REVISED WATERMAIN CROSSING	7/19/11
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM	Checked by: SSJ
Drawn by: KDG	Approved by: SJD
Project: 071.06049.009	Date: APRIL 2011

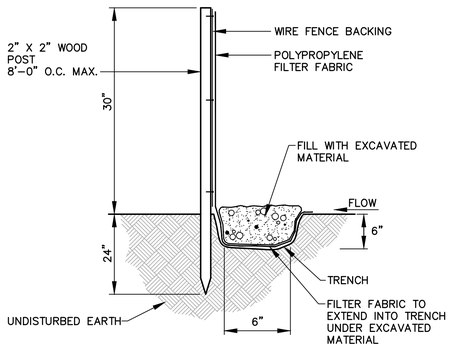
Sheet No: C-108
Sheet 10 of 13

P:\2007\076049_009 Washington Street Force Main\Drawings\071.06049 Working Drawings\071.06049_C-107_10_C-111.dwg C-108 Jul 25,2014- 11:12am

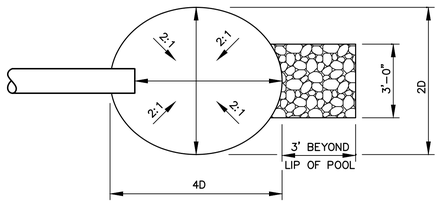


- THE CULVERT MUST HAVE A CLAY OR CONCRETE CHECK DAM LOCATED AT THE INLET END TO PREVENT WATER FROM PIPING THROUGH THE STONE AND POTENTIALLY WASHING OUT THE CULVERT.
- THICKNESS OF RIPRAP BLANKET SHALL BE NO LESS THAN 15" DEEP. CLAY/CONCRETE WATER STOP SHALL BE NO LESS THAN 15" DEEP.

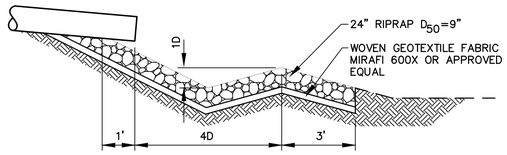
TYPICAL INSTALLATION FOR ROADWAY CROSS CULVERTS
NOT TO SCALE



EROSION CONTROL FENCE DETAIL
NOT TO SCALE



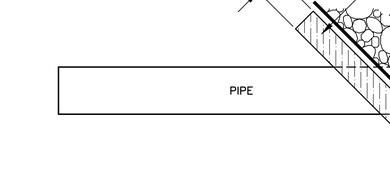
PLAN



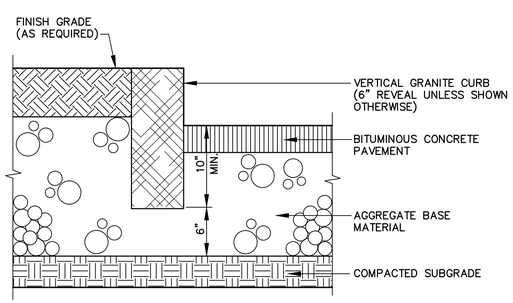
SECTION

D = DIAMETER OF PIPE

OUTLET PLUNGE POOL
NOT TO SCALE

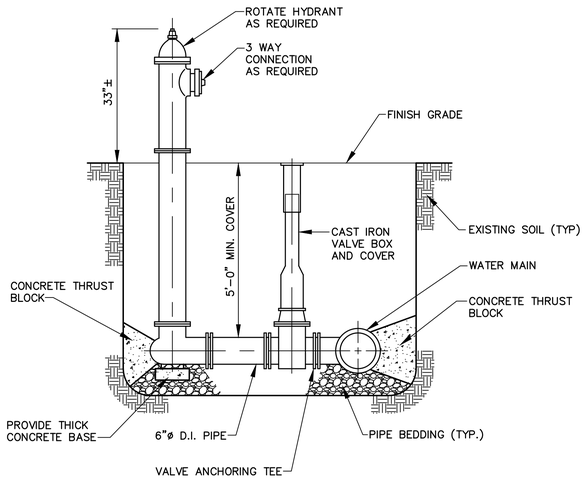


MASONRY PLUG DETAIL
NOT TO SCALE

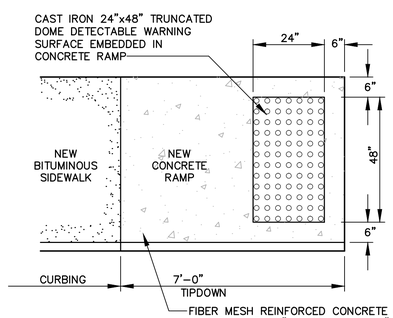


NOTE: ALL JOINTS SHALL BE BACKED WITH GEOTEXTILE FABRIC, MIRAFI 600X OR APPROVED EQUAL

VERTICAL GRANITE CURBING
NOT TO SCALE

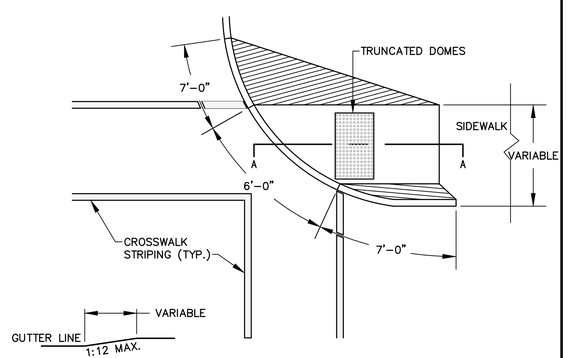


FIRE HYDRANT
NOT TO SCALE



PLAN

SIDEWALK RAMP DETAIL
NOT TO SCALE



SECTION A–A

ADA ACCESS RAMP
NOT TO SCALE

GENERAL NOTES

1. EXISTING CONDITIONS WAS PREPARED BY TITCOMB ASSOCIATES IN FEB 2011.
2. THE CONTRACTOR IS RESPONSIBLE FOR THE MEANS AND METHODS OF CONSTRUCTION AND FOR CONDITIONS AT THE SITE. THESE PLANS, PREPARED BY RANSOM ENVIRONMENTAL, DO NOT EXTEND TO OR INCLUDE SYSTEMS PERTAINING TO THE SAFETY OF THE CONSTRUCTION CONTRACTOR OR THEIR EMPLOYEES, AGENTS OR REPRESENTATIVES IN THE PERFORMANCE OF THE WORK. THE SEAL OF THE ENGINEER HEREON DOES NOT EXTEND TO ANY SUCH SAFETY SYSTEMS THAT MAY NOW OR HEREAFTER BE INCORPORATED INTO THESE PLANS. THE CONSTRUCTION CONTRACTOR SHALL PREPARE OR OBTAIN THE APPROPRIATE SAFETY SYSTEMS WHICH MAY BE REQUIRED BY THE U.S. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND/OR LOCAL REGULATIONS.
3. FIELD CHANGES. DURING CONSTRUCTION, THE CONTRACTOR MAY PROPOSE FIELD CHANGES TO THE ENGINEER FOR MINOR CONSTRUCTION–RELATED CHANGES TO THE DESIGN PLANS OR TO ACCOUNT FOR UNEXPECTED SITE CONDITIONS. FIELD CHANGES SHALL BE LIMITED TO CHANGES THAT DO NOT MATERIALLY ALTER THE VISUAL APPEARANCE OF THE PROJECT (SUCH AS BUT NOT LIMITED TO BUILDING DESIGN, LANDSCAPE DESIGN, OUTDOOR LIGHTING, ETC.) AND THAT DO NOT MATERIALLY ALTER THE APPROVED DESIGN OF THE PROJECT (SUCH AS BUT NOT LIMITED TO LAYOUT, TRAFFIC CIRCULATION, STORM WATER DRAINAGE, ETC.).
4. THE CONTRACTOR SHALL BID AND PERFORM THE WORK IN ACCORDANCE WITH ALL LOCAL, STATE AND NATIONAL CODES, SPECIFICATIONS, REGULATIONS AND STANDARDS.
5. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO FAMILIARIZE HIMSELF WITH THE SITE AND ALL EXISTING CONDITIONS SURROUNDING IT AND THEREON. THE CONTRACTOR SHALL ADVISE THE APPROPRIATE AUTHORITY OF HIS INTENTIONS AT LEAST 48 HOURS IN ADVANCE.
6. ALL WORK IS TO CONFORM TO CITY OF BATH DEPARTMENT OF PUBLIC WORKS, BATH WATER DISTRICT AND MAINE D.O.T. STANDARD HIGHWAY SPECIFICATIONS.
7. THE CONTRACTOR SHALL MAINTAIN EMERGENCY ACCESS TO ALL AREAS AFFECTED BY HIS WORK AT ALL TIMES.
8. PROPERTY LINE AND R.O.W. MONUMENTS SHALL NOT BE DISTURBED BY CONSTRUCTION. IF DISTURBED, THEY SHALL BE RESET TO THEIR ORIGINAL LOCATIONS AT THE CONTRACTOR'S EXPENSE, BY A MAINE REGISTERED LAND SURVEYOR.
9. SITE WORK SHALL BE CONSTRUCTED FROM A COMPLETE SET OF PLANS, NOT ALL FEATURES ARE DETAILED ON EVERY PLAN. THE ENGINEER IS TO BE NOTIFIED OF ANY CONFLICT WITHIN THIS PLAN SET.
10. CONSTRUCTION DEBRIS. NO CONSTRUCTION OR DEMOLITION DEBRIS, STUMPS OR OTHER WASTES GENERATED DURING SITE WORK OR BUILDING CONSTRUCTION SHALL BE DISPOSED OF ON–SITE. ALL SUCH WASTE MATERIALS SHALL BE DISPOSED OF IN A LICENSED LANDFILL OR AS OTHERWISE PERMITTED CONSISTENT WITH APPLICABLE LAWS.
11. ALL MATERIAL SCHEDULES SHOWN ON THE PLANS ARE FOR GENERAL INFORMATION ONLY. THE CONTRACTOR SHALL PREPARE HIS OWN MATERIAL SCHEDULES BASED UPON HIS PLAN REVIEW. ALL SCHEDULES SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO ORDERING MATERIALS OR PERFORMING WORK.
12. SELECT SURPLUS FILL SHALL BECOME THE PROPERTY OF THE CITY OF BATH AND SHALL BE DELIVERED TO THE BATH PUBLIC WORKS DEPARTMENT. UNSUITABLE SURPLUS FILL SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM THE SITE AND PROPERLY DISPOSED OF.
13. THE CONTRACTOR SHALL REMOVE AREAS OF EXISTING PAVEMENT ALONG THE NEW EDGE OF TRAVEL WAY THAT ARE OUTSIDE OF THE PROPOSED TEMPLATE AND SHALL RESTORE WITH 4" OF LOAM, SEED AND MULCH.
14. ALL WATER SYSTEM VALVES SHALL BE OPERATED BY BWD PERSONNEL ONLY.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RELOCATING ALL SIGNS AND SIGN POSTS AS REQUIRED. THE CONTRACTOR SHALL REPLACE ALL DAMAGED SIGNS AND SIGN POSTS THAT ARE DAMAGED DURING CONSTRUCTION AT NO COST TO THE CITY.

LAYOUT NOTES

1. WRITTEN DIMENSIONS HAVE PRECEDENCE OVER SCALED DIMENSIONS. THE CONTRACTOR SHALL USE CAUTION WHEN SCALING REPRODUCED PLANS. IN CASE OF CONFLICT BETWEEN THIS PLAN SET AND ANY OTHER DRAWINGS AND/OR SPECIFICATION, THE ENGINEER SHALL BE NOTIFIED IMMEDIATELY FOR CLARIFICATIONS.
2. OFFSETS TO CATCH BASINS AND MANHOLES ARE TO THE CENTER OF THE FRAME.
3. PIPE LENGTH EQUALS THE CENTER TO CENTER DISTANCES BETWEEN CATCH BASINS AND/OR MANHOLES MINUS ONE–HALF OF THE DIAMETER OF EACH CATCH BASIN OR MANHOLE.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING SURVEY CONTROL AND CONSTRUCTION LAYOUT TO ENSURE ROAD ALIGNMENT IS ACCURATELY CONSTRUCTED AS SHOWN

GRADING NOTES

1. VERIFY TBM ELEVATIONS PRIOR TO CONSTRUCTION.
2. TOPSOIL STRIPPED IN AREAS OF CONSTRUCTION THAT IS SUITABLE FOR REUSE AS LOAM (AND WHICH HAS BEEN APPROVED BY THE ENGINEER) SHALL BE STOCKPILED ON SITE AT A LOCATION TO BE DESIGNATED BY THE OWNER. UNSUITABLE SOIL SHALL BE SEPARATED, REMOVED AND DISPOSED OF AT AN ENGINEER–APPROVED DISPOSAL LOCATION OFF SITE AT NO ADDITIONAL COST.
3. THE CONTRACTOR SHALL ANTICIPATE THAT GROUNDWATER WILL BE ENCOUNTERED DURING CONSTRUCTION AND SHALL INCLUDE SUFFICIENT COSTS WITHIN THEIR BID TO PROVIDE DEWATERING AS NECESSARY. NO SEPARATE PAYMENT SHALL BE MADE TO THE CONTRACTOR FOR DEWATERING.

UTILITY NOTES

1. UTILITIES AS SHOWN ON THESE PLANS HAVE BEEN OBTAINED FROM VARIOUS SOURCES AND THEIR LOCATIONS ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING AND DETERMINING THE LOCATION, SIZE AND ELEVATION OF THESE UTILITIES. PRIOR TO THE START OF ANY CONSTRUCTION, THE ENGINEER SHALL BE NOTIFIED IN WRITING OF ANY UTILITIES FOUND INTERFERING WITH THE PROPOSED CONSTRUCTION AND THE PROPOSED ACTION SHALL BE AGREED TO BY THE ENGINEER BEFORE PROCEEDING WITH THE PROPOSED WORK. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACT WITH MAINE DIG SAFE AT 1–888–DIG–SAFE, AT LEAST 72 HOURS BEFORE DIGGING.
2. TEST PITS AT ALL UTILITY CROSSINGS SHALL BE COMPLETED TWO WEEKS IN ADVANCE OF THE START OF CONSTRUCTION OR ORDERING OF MATERIALS. TEST PIT INFORMATION SHALL BE PROMPTLY PROVIDED TO THE ENGINEER FOR REVIEW.
3. ALL TEST PITS SHALL BE PERFORMED BY THE CONTRACTOR PRIOR TO ORDERING ANY STRUCTURES. TEST PIT INFORMATION SHALL BE PROVIDED TO THE ENGINEER TO ALLOW ADJUSTMENTS IN DESIGN, AS NECESSARY, TO INCORPORATE NEW INFORMATION. NEW STRUCTURES SHALL NOT BE ORDERED UNTIL THE ENGINEER HAS APPROVED THE IMPACT OF EXISTING CONDITIONS OR PROVIDED REVISED DESIGN.
4. THRUST BLOCKS SHALL BE PLACED ON THE FORCE MAIN AT ALL BENDS, TEES, VALVES, CHANGES IN DIRECTION, ETC.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING WITH UTILITY COMPANIES AS REQUIRED TO PROTECT, SHORE AND BRACE ALL UTILITY POLES DURING CONSTRUCTION

EROSION CONTROL NOTES

1. APPLICATION OF TEMPORARY AND PERMANENT EROSION CONTROL MEASURES FOR THE PROJECT SHALL BE IN ACCORDANCE WITH PROCEDURES AND SPECIFICATIONS OF THE "MAINE EROSION AND SEDIMENT CONTROL HANDBOOK FOR CONSTRUCTION: BEST MANAGEMENT PRACTICES," MARCH 2003 (BMP HANDBOOK).
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR INSTALLING AND MAINTAINING ALL EROSION AND SEDIMENT CONTROL DEVICES AS SHOWN ON THE PLANS THROUGHOUT THE DURATION OF THE PROJECT IN ACCORDANCE WITH APPLICABLE MDEP STANDARDS. SILT FENCE SHALL BE INSTALLED PRIOR TO CONSTRUCTION.
3. ALL GROUND AREAS DISTURBED FOR CONSTRUCTION WILL BE GRADED, LOAMED AND SEEDED AS SOON AS POSSIBLE. PERMANENT SEED MIXTURE SHALL CONFORM TO THE SEEDING PLAN CONTAINED IN THE EROSION CONTROL NOTES.
4. PERMANENT SEEDING SHALL BE:

	LBS/1,000 S.F.
BIRDSFOOT TREFOIL	.18
CROWNVETCH	.34
CREEPING RED FESCUE OR TALL FESCUE	.46

5. MULCH SHALL BE HAY OR STRAW APPLIED AT 70–90 LBS/1,000 S.F.
6. ALL EROSION CONTROL MEASURES, SEEDING AND MULCHING SHALL BE INSPECTED WEEKLY, AFTER RAINSTORMS AND DURING RUNOFF EVENTS. ALL MEASURES SHALL BE REPAIRED OR REPLACED WHEN NO LONGER SERVICEABLE DUE TO SEDIMENT ACCUMULATION OR DAMAGE.
7. SEEDED AND MULCHED AREAS SHALL BE MAINTAINED UNTIL FINAL ACCEPTANCE OF THE WORK. SEED CATCH SHALL BE ACCEPTABLE WHEN 75 PERCENT CATCH IS ESTABLISHED. MAINTENANCE SHALL CONSIST OF PROVIDING PROTECTION AGAINST TRAFFIC AND REPAIRING ANY AREAS TO RE–ESTABLISHED THE CONDITION AND GRADE OF THE SOIL PRIOR TO SEEDING AND SHALL THEN BE REFERTILIZED, RESEEDED AND REMULCHED.
8. TEMPORARY EROSION CONTROL MEASURES SHALL BE REMOVED UPON COMPLETION OF GRADING OPERATIONS AND ESTABLISHMENT OF A 75 PERCENT CATCH OF GRASS.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING ALL EROSION AND SEDIMENT CONTROL DEVICES THROUGHOUT THE DURATION OF THE PROJECT IN ACCORDANCE WITH APPLICABLE STANDARDS. THE DETAILS PROVIDED SERVE AS A GUIDE ONLY. ADDITIONAL EROSION CONTROL MEASURES SHALL BE INSTALLED IF DEEMED NECESSARY BY ON–SITE INSPECTIONS OF THE CITY, THE ENGINEER OR THEIR REPRESENTATIVES AT NO ADDITIONAL COST TO THE OWNER.
10. ALL GROUND AREAS DISTURBED FOR CONSTRUCTION WILL BE GRADED, LOAMED AND SEEDED AS SOON AS POSSIBLE. PERMANENT SEED MIXTURE SHALL CONFORM TO THE SEEDING PLAN CONTAINED IN THE EROSION CONTROL NOTES.
11. ALL DISTURBED AREAS ARE TO RECEIVE A MINIMUM OF 6" OF TOPSOIL PRIOR TO PERMANENT SEEDING.
12. ALL EXCAVATIONS SHALL BE THOROUGHLY SECURED ON A DAILY BASIS BY THE CONTRACTOR AT THE COMPLETION OF CONSTRUCTION OPERATIONS IN THE IMMEDIATE AREA.

Site:

WASHINGTON STREET FORCEMAIN REPLACEMENT

CITY OF BATH
BATH, MAINE

Prepared for:

CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER #7034
LICENSED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

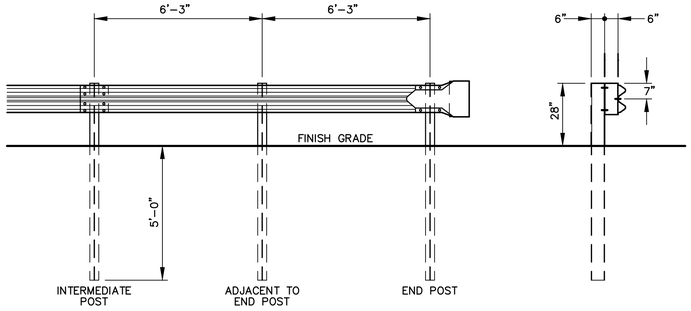
OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

CONSTRUCTION NOTES & DETAILS

No.	Revision/Issue	Date
C	RESUBMISSION DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

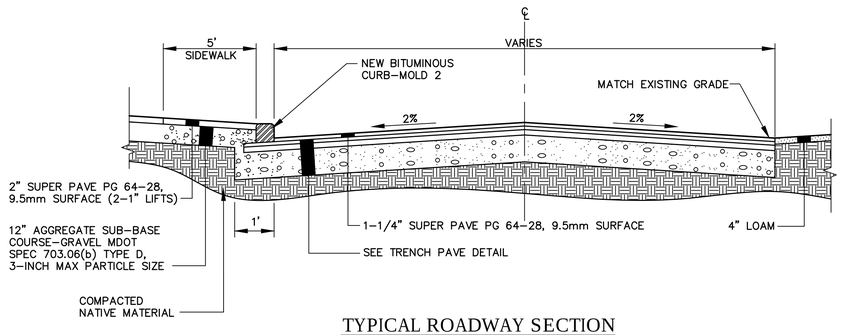
Design by: JLM	Checked by: SSJ
Drawn by: KDG	Approved by: SJD
Project: 071.06049.009	Date: APRIL 2011

Sheet No: C-109
Sheet 11 of 13



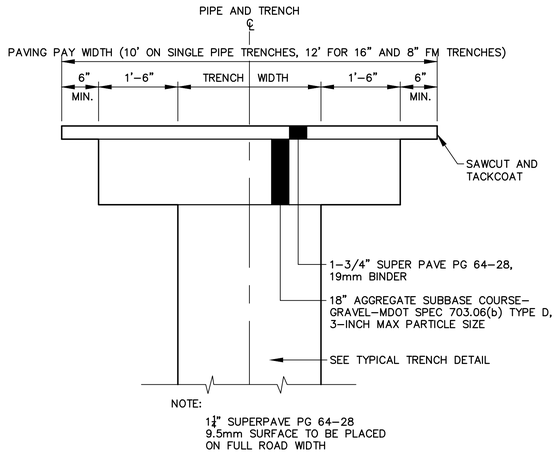
NOTES:
1. INTERMEDIATE POST SPACING SHALL BE 6'-3" UNLESS OTHERWISE SHOWN.
2. STEEL POST AND OFFSET BRACKETS FOR GUARD RAIL SHALL BE W6x8.5 OR W6x9.
3. "W" BEAM BACK UP PLATES SHALL BE PLACED BEHIND RAIL ELEMENTS AT INTERMEDIATE STEEL POSTS (NON SPLICE POSTS).
4. OFFSET BRACKET SHALL BE INSTALLED ON ALL POSTS.
5. GUARD RAIL – TERMINAL END TO BE USED ON ALL ENDS.

GUARD RAIL DETAIL
NOT TO SCALE

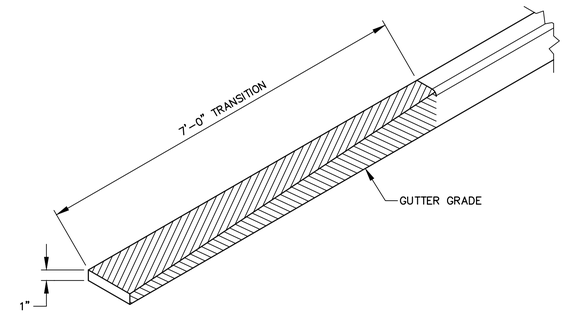


TYPICAL ROADWAY SECTION
NOT TO SCALE

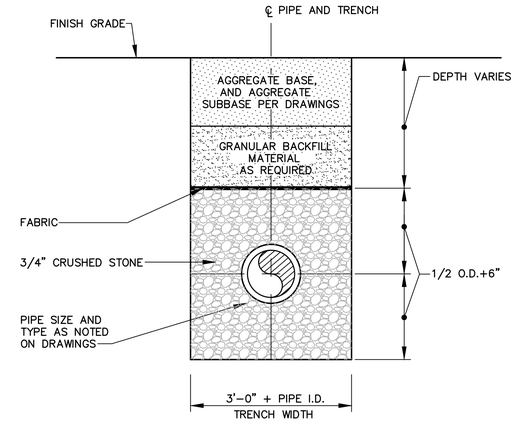
NOTE: TRENCH PAVE ACCORDING TO DETAIL AND SURFACE PAVE EXISTING WIDTH OF STREET



TYPICAL TRENCH PAVING DETAIL
NOT TO SCALE

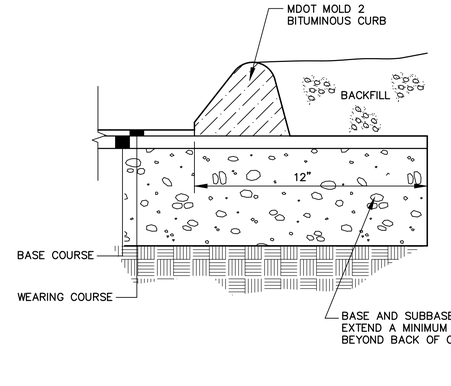


BITUMINOUS TRANSITION CURB
NOT TO SCALE

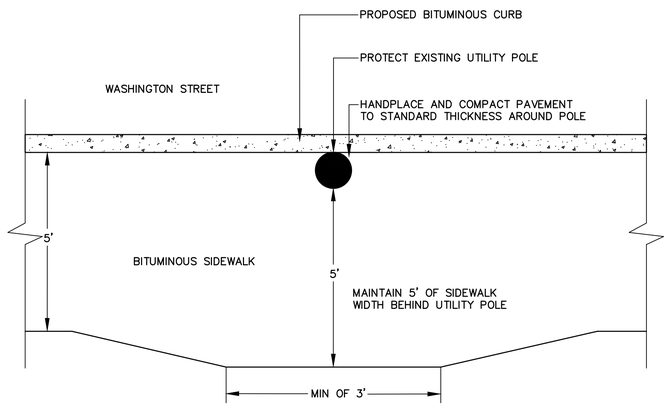


1. SAND BACKFILL AND RIGID INSULATION AS REQUIRED.
2. TYPE "B" UNDERDRAIN SHALL HAVE PERFORATIONS DOWN.
3. TYPE "C" UNDERDRAIN SHALL HAVE PERFORATIONS UP.

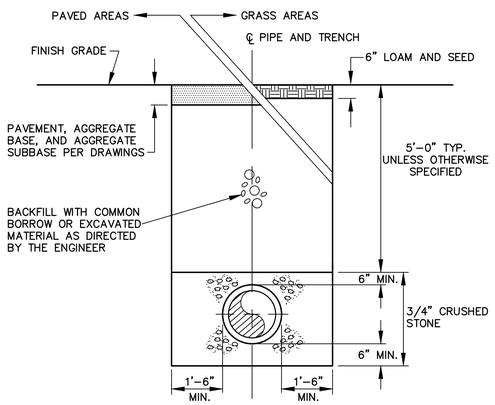
TYPICAL UNDERDRAIN TRENCH DETAIL
NOT TO SCALE



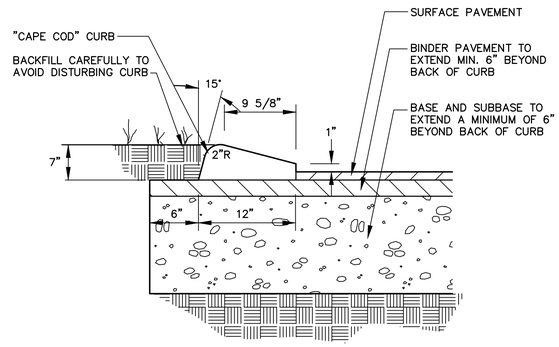
BITUMINOUS CURB-MOLD 2
NOT TO SCALE



SIDEWALK AROUND UTILITY POLE DETAIL
NOT TO SCALE



TYPICAL TRENCH - UTILITIES
NOT TO SCALE



"CAPE COD" SLOPED FACE BITUMINOUS CONCRETE CURB
NOT TO SCALE

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN DYER
#7834
REGISTERED PROFESSIONAL ENGINEER

Record Drawings

RANSOM Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

CONSTRUCTION DETAILS

No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM | Checked by: SSJ
Drawn by: KDG | Approved by: SJD
Project: 071.06049.009 | Date: APRIL 2011

Sheet No: C-110
Sheet 12 of 13

P:\2007\076049_009 Washington Street Force Main\Drawings\071.06049 Working Drawings\071.06049_C-107_10_C-111.dwg C-110 Jul 25,2014- 11:14am

SPECIFICATIONS

1. PRIOR TO CONSTRCTION, THE CONTRACTOR SHALL PROVIDE AN ELECTRICAL AND MECHANICAL PLAN FOR ALL NEW EQUIPMENT. PLAN SHALL INCLUDE, AT A MINIMUM:
   - –EQUIPMENT DETAILS/SCHEDULES
   - –CONSTRUCTION DETAILS AND SEQUENCE OF OPERATIONS
   - –CONTROL PANEL PLAN
   - –RISER & PANEL SCHEDULE PLANS, INCLUDING ELECTRICAL SEQUENCING AND CONTROL LOGIC DETAIL, AS NECESSARY
   - –CONNECTION/WIRING DIAGRAM

2. PRIOR TO SUBMITTING A BID, CONTRACTOR SHALL VISIT THE SITE AND CAREFULLY NOTE EXISTING CONDITIONS. FAILURE TO MAKE SUCH A VISIT SHALL NOT RELIEVE THE CONTRACTOR FROM THE OBLIGATION TO MAKE SUCH ADJUSTMENTS AS REQUIRED TO FURNISH A COMPLETE SYSTEM IN COMPLIANCE WITH THIS WORK SCOPE AT NO ADDITIONAL COST TO THE OWNER.

3. REMOVE EXISTING HEATING EQUIPMENT IN THE WET WELL, INCLUDING ALL CONTROLS AND WIRING BACK TO BREAKER PANEL.

4. UNIT HEATER UH–1 SHALL BE TRANE MODEL UHXA053D2B, OR APPROVED EQUAL, EXPLOSION PROOF HORIZONTAL ELECTRIC UNIT HEATER. HEATER SHALL BE SUITABLE FOR CLASS 1, DIVISION 1 LOCATIONS. UNIT CABINET SHALL BE 14 GAUGE COLD ROLLED STEEL EPOXY; HEAT EXCHANGER SHALL BE DOUBLE WALL STEEL WITH ETHYLENE GLYCOL AND WATER MIXTURE, STEEL TUBE RADIATORS WITH ALUMINUM FINS, THREE LOW WATT DENSITY IMMERSION TYPE ELECTRIC HEATING ELEMENTS, SNAP ACTION CAPILLARY TYP THERMAL CUTOUTS, 24 VOLT CONTROL CIRCUITS, STAINLESS STEEL RELIEF VALVE SET TO OPEN AT 200 PSI, HEAVY DUTY CONTACTORS BREAKING ALL LINES, CAST ALUMINUM CONTROL BOX, AND CADMIUM PLATED CIRCUIT. UNIT SHALL BE UL LISTED AND SUITABLE FOR 480 VOLT 3 PHASE SERVICE. FURNISH WITH WALL BRACKET AND REMOTE EXPLOSION PROOF THERMOSTAT.

5. MOTOR OPERATED DAMPERS SHALL BE OF ALUMINUM CONSTRUCTION WITH AIRFOIL BLADES WITH INJECTED FOAM INSULATION, END & FACE SEALS AND THERMAL BREAKS (RUSKIN MODEL CDTI–50, OR APPROVED EQUAL). FURNISH ALUMINUM BIRD SCREEN ON INSIDE FACE. DAMPER MOTORS SHALL BE BELIMO SPRING RETURN TYPE SELECTED TO MATCH THE DESIGNATED DAMPER SIZE.

6. SEQUENCE OF OPERATION:
   UH–1 SHALL BE CONTROLLED FROM ITS THERMOSTAT TO MAINTAIN A SETPOINT OF 55° F(ADJUSTABLE).

   WHEN THE EXISTING WET WELL EXHAUST FAN STARTS, MOTOR OPERATED DAMPERS D–1, D–2 AND D–3 SHALL FULLY OPEN. WHEN THE FAN STOPS, DAMPERS D–1, D–2 AND D–3 SHALL FULLY CLOSE.

7. FURNISH AND INSTALL AN EQUIPMENT LABEL ON EACH PIECE OF SCHEDULED EQUIPMENT FURNISHED IN THIS WORK SCOPE. LABELS SHALL BE BLACK PLASTIC WITH 1" HIGH WHITE ENGRAVED LETTERS.

DOOR NOTES

1. DOOR SHALL BE 1¾" THICK, FLUSH FIBERGLASS REINFORCED PLASTIC DOOR, INSULATED, AS MANUFACTURED BY SIMON DOOR COMPANY, OR EQUAL. DOOR SURFACE SHALL HAVE TEXTURED, SEMI–GLOSS, SEAMLESS GEL COAT FINISH (MIN 12 MILS). FACEPANELS SHALL BE FIBERGLASS REINFORCED POLYESTER RESIN, AND DOOR COLOR SHALL BE SELECTED BY THE OWNER.

2. DOOR FRAME SHALL BE FIBERGLASS REINFORCED PLASTIC, AS MANUFACTURED BY SIMON DOOR COMPANY, OR EQUAL. FINISH SHALL BE TEXTURED, SEAMLESS GEL COAT (MIN 12 MILS), PAINTED TO MATCH DOOR.

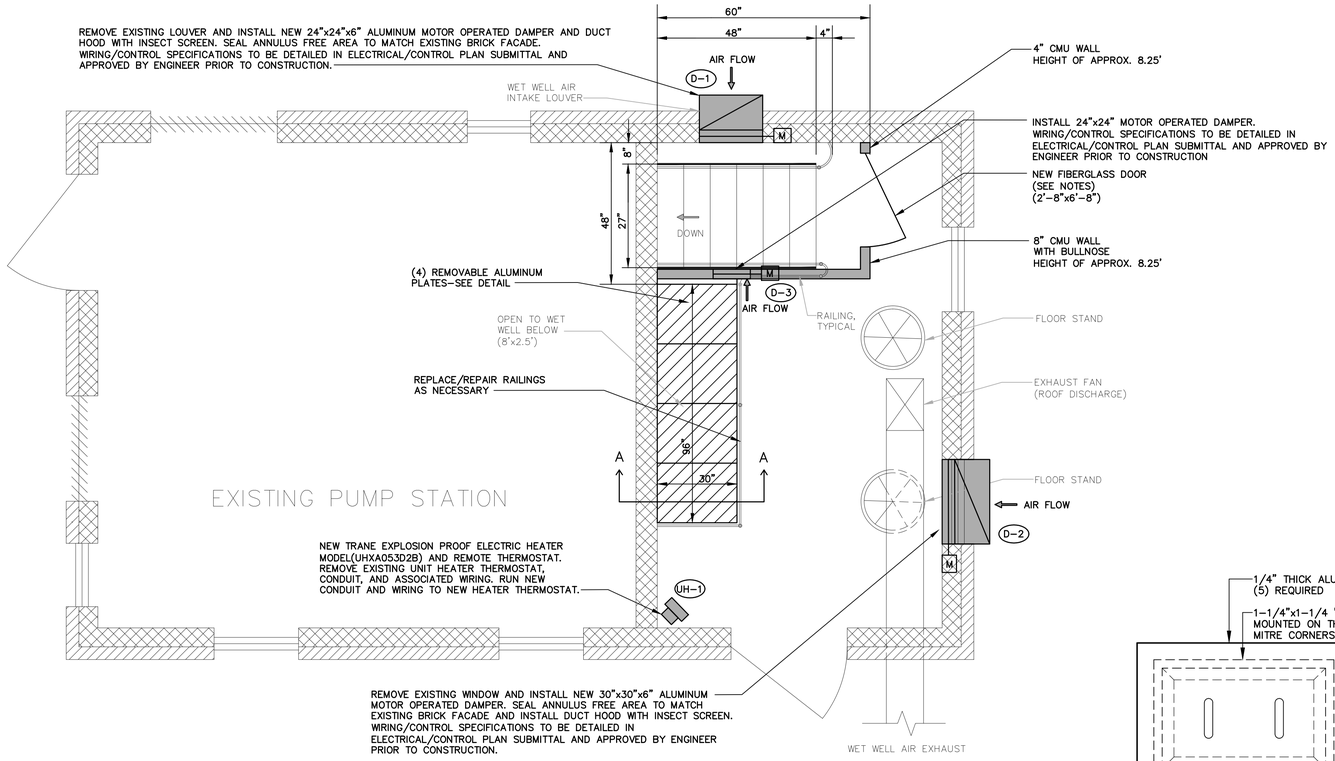
3. HINGES SHALL BE 4½" HIGH FREQUENCY STAINLESS STEEL, CONCEALED BEARING HINGES, FULL MORTISE.

4. LOCK SET SHALL BE LEVER TYPE, STAINLESS STEEL, MEETING ANSI A156.13.

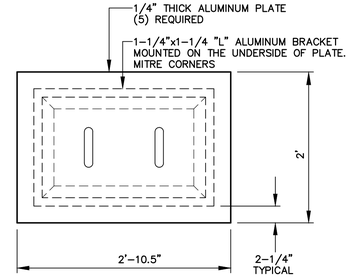
5. PROVIDE TEMPORARY TUMBLER FOR PROJECT AT COMPLETION OF PROJECT PROVIDE TUMBLER KEYED TO MASTER KEY.

6. THRESHOLD SHALL BE ALUMINUM WITH TAPERED WATER STOP. FULL WEATHER STRIPPING SHALL BE PROVIDED.

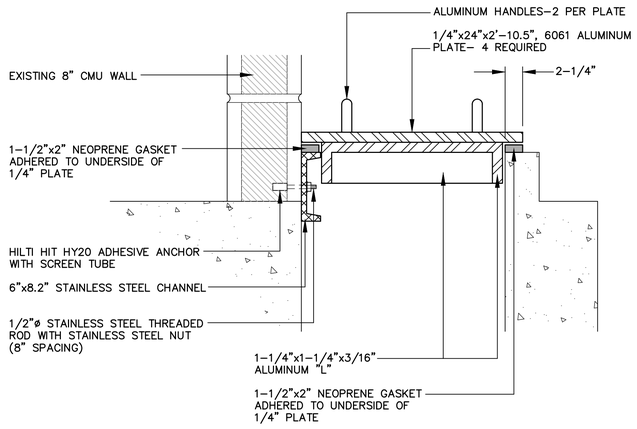
7. CLOSERS SHALL BE NORTON 7700 SERIES BOTHLEAFS WITH HOLD OPEN FUNCTION.



PUMP STATION STRUCTURAL/MECHANICAL MODIFICATIONS
NOT TO SCALE



REMOVABLE ALUMINUM PLATE DETAIL
NOT TO SCALE



SECTION AA
NOT TO SCALE

Site:
WASHINGTON STREET FORCEMAIN REPLACEMENT
CITY OF BATH
BATH, MAINE

Prepared for:
CITY OF BATH
55 FRONT STREET
BATH, MAINE

STATE OF MAINE
STEPHEN J. DYER #7934
LICENSED PROFESSIONAL ENGINEER

Record Drawings

RANSOM
Environmental Consultants, Inc.
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2891
Fax (207) 772-3248
www.ransomenv.com

OAK ENGINEERS
400 Commercial Street, Suite 404
Portland, ME 04101
Tel. (207) 772-2004
Fax (207) 772-3248
www.oakengineers.com

PUMP STATION DETAILS

No.	Revision/Issue	Date
C	RECORD DRAWINGS	2/10/14
B	ISSUED FOR BIDDING	7/19/11
A	ISSUED FOR CLIENT REVIEW	7/11/11

Design by: JLM	Checked by: SSJ
Drawn by: KDG	Approved by: SJD
Project: 071.06049.009	Date: APRIL 2011

Sheet No: C-111
Sheet 13 of 13

APPENDIX E
Permits

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, NEW ENGLAND DISTRICT
NEW ENGLAND DISTRICT OFFICE
696 VIRGINIA ROAD
CONCORD MASSACHUETTS 01742-2751

April 14, 2025

Regulatory Division
Maine Section
NAE-2024-01752

Mr. Chris Wallace
City of Bath
450 Oak Grove Ave
Bath, ME 04530
Via Email: cwallace@CityofBath.com

Dear Mr. Wallace:

This letter is in response to the application you submitted to the U.S. Army Corps of Engineers (USACE), New England District for a Department of the Army general permit verification. We have assigned this project file number NAE-2024-01752, which you should reference in all correspondence with this office.

A review of the information provided indicates the proposed work includes the placement and maintenance of fill within 64 square feet (SF.) of wetlands and temporarily impact 29,000 SF. (trench and back fill) of wetlands to replace an existing sewer main located in the town of Bath, Maine. The linear project starts at the intersection of Harward Street and Washington Street (43.93512, -69.814843) and goes to the railroad track south of Office Drive (43.923170, -69.822260) in Bath, Sagadahoc County, Maine. The work is shown on the enclosed plans titled WRIGHT-PIERCE HARWARD STREET BATH, SAGADAHOC COUNTY, MAINE" and "CITY OF BATH, MAINE HARWARD STREET PUMP STATION AND SEWER INERCEPTOR UPGRADES", on 15 sheets, and dated "NOVEMBER 2023", "11/15/2024", and "11/18/2024".

Based on the information you have provided we verify that the activity is authorized under General Permit 6 of the federal permit known as the Maine General Permits (GPs). If the extent of the project area and/or nature of the authorized impacts to waters are modified, a revised application must be submitted to this office for written approval before work is initiated. You can find a copy of these permits at: https://www.nae.usace.army.mil/Missions/Regulatory/State-General-Permits/

Any deviation from the terms and conditions of the permit, or your submitted plans, may subject the permittee to the enforcement provisions of our regulations. Therefore, in the event changes to this project are contemplated, it is recommended you

coordinate with this office prior to proceeding with the work. This office must approve any changes before you undertake them. You must perform this work in compliance with the terms and conditions of the GPs listed above.

This verification is valid until October 14, 2025. You must commence or be under contract to commence the work authorized herein by October 14, 2025 and complete the work by October 14, 2026. If not, you must contact this office to determine the need for further authorization before beginning or continuing the activity. It is recommended that you contact this office before this authorization expires to discuss if permit reissuance is a possibility.

This GP verification and any associated authorizations does not preclude the necessity to obtain any other federal, state, or local permits, licenses, and/or certifications, which may be required.

If you have any questions related to this verification or have issues accessing documents referenced in this letter, please contact Amanda Sayles, Project Manager at (978) 318-8486, or by email at Amanda.L.Sayles@usace.army.mil. This agency continually strives to improve our customer service. To better serve you, please complete the Customer Service Survey located at: https://regulatory.ops.usace.army.mil/customer-service-survey/.

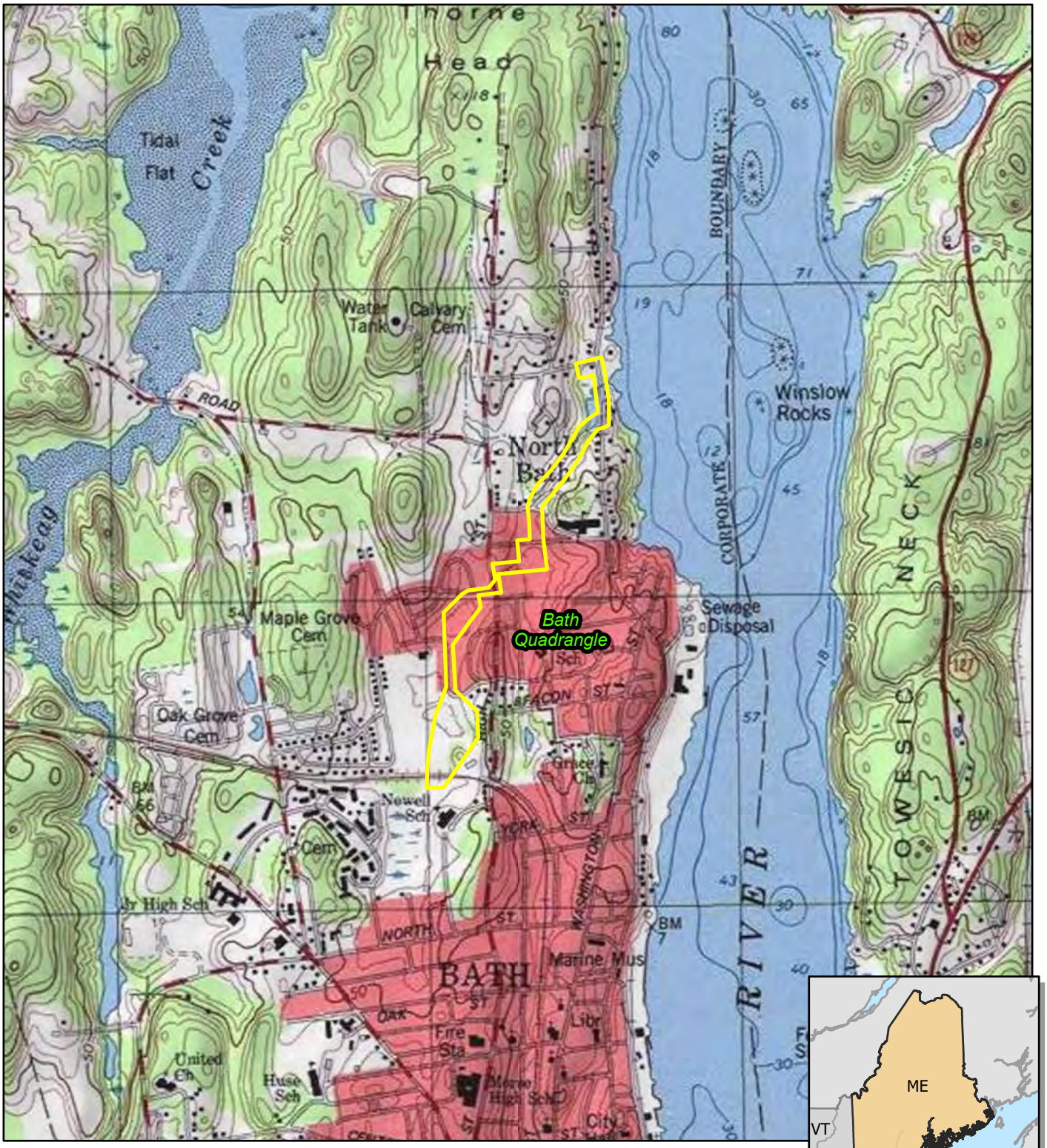
Sincerely,

Amanda Sayles

For: Peter D. Olmstead
Chief, Maine Section
Regulatory Division

Enclosures

Cc (w/enclosures):
Ms. Maeve Carlson, Wright-Pierce, Maeve.Carlson@wright-pierce.com



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

1" = 1,500'
1:18,000

0 1,000 2,000 FEET

WRIGHT-PIERCE
Engineering a Better Environment

Flycatcher
LAND + SCIENCE + PEOPLE

PROJECT:

WRIGHT-PIERCE
HARWARD STREET
BATH, SAGADAHOC COUNTY, MAINE

LEGEND:

SURVEY AREA
USGS 7.5-MINUTE QUADRANGLE BOUNDARY

DRAWN BY:	G. BOZEK
CHECKED BY:	R. THURRELL
MONTH:	NOVEMBER
YEAR:	2023
PROJ. NO.:	23Y-005
CLIENT:	WRIGHT-PIERCE

FIGURE 1 - SITE LOCATION MAP

Path: C:\Flycatcher\Projects\WrightPierce\23Y-005_HARWARD_ST_BATH\5_PRO\23Y-005_HARWARD_ST_BATH.aprx

LAST SAVED BY: DANIEL.METZ 11/18/2024 4:02 PM



KEY PLAN
SCALE: 1"=150'

IMPACT CALCULATIONS SUMMARY:

ARMY CORPS:
Temporary: 28,999.77 SF
Permanent: 64 SF

MAINE DEP:
Temporary: 25,478.82 SF
Permanent:
New FM - 2,614 SF
Old FM- 970.95 SF

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD: D.METZ
CHECKED:
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

KEY PLAN

DRAWING
C-02

J:\ENGW\EBATH\21119-HARWARDINFGSWMM-MODEL_DRAWINGS\CIV\21119-CS-KEYPLAN-PERMIT.DWG | 21119-CS-KeyPlan | 1:2.5849 | ---- | 11/18/2024 4:26:40 PM | DANIEL.METZ

LAST SAVED BY: DANIELMETZ 11/13/2024 11:10 AM

GENERAL NOTES

1. THE OWNER WILL BE RESPONSIBLE FOR OBTAINING THE PERMITS LISTED IN THE SUPPLEMENTARY OR SPECIAL CONDITIONS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO BE FAMILIAR WITH THE APPLICABLE PROVISIONS OF EACH PERMIT AS THEY APPLY TO THE WORK PRIOR TO BIDDING AND ABIDE BY THOSE PROVISIONS DURING CONSTRUCTION . COPIES OF ALL OBTAINED PERMITS ARE AVAILABLE FOR REVIEW FROM THE OWNER. ALL OTHER PERMITS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
2. THE OWNER SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY RIGHTS OF WAY AND EASEMENTS. THE CONTRACTOR SHALL VERIFY THAT THE NECESSARY EASEMENTS HAVE BEEN SECURED BY THE OWNER. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO BE FAMILIAR WITH THE APPLICABLE PROVISIONS OF EACH EASEMENT AS THEY APPLY TO THE WORK PRIOR TO BIDDING AND ABIDE BY THOSE PROVISIONS DURING CONSTRUCTION . COPIES OF ALL RIGHTS-OF-WAY AND EASEMENTS ARE AVAILABLE FOR REVIEW FROM THE OWNER.
3. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING TRAFFIC FLOW AT ALL TIMES. CONTRACTOR SHALL INSTALL AND MAINTAIN TRAFFIC CONTROL SIGNS IN ACCORDANCE WITH THE MUTCD AND ALL STATE AND LOCAL REGULATIONS. THE CONTRACTOR IS REQUIRED TO SUBMIT A TRAFFIC CONTROL PLAN TO THE OWNER PRIOR TO COMMENCING CONSTRUCTION.
4. CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).
5. CONTRACTOR SHALL COMPLY WITH THE COORDINATION REQUIREMENTS AND RELATED COSTS, IF ANY, AS SPECIFIED IN SPECIFICATION SECTION 01050.
6. CONTRACTOR SHALL NOTE THAT, IN GENERAL, ALL EXISTING CONDITION INFORMATION ON THE DRAWINGS ARE SHOWN WITH A LIGHTER LINE WEIGHT AND WITH A SLANTED TYPE TEXT.
7. ALL EXISTING SEWER AND STORM DRAIN LINES ENCOUNTERED DURING CONSTRUCTION ARE TO REMAIN IN SERVICE. ANY EXISTING SEWERS, STORM DRAIN LINES OR CULVERTS DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER, EXCEPT WHEN IN DIRECT CONFLICT WITH THE NEW SEWER OR WHEN NOT SHOWN OR INDICATED.
8. ALL STRUCTURES AND PIPELINES LOCATED ADJACENT TO TRENCH EXCAVATION SHALL BE PROTECTED AND FIRMLY SUPPORTED BY THE CONTRACTOR UNTIL THE TRENCH IS BACKFILLED. INJURY TO ANY SUCH STRUCTURES CAUSED BY OR RESULTING FROM THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE . ALL UTILITIES REQUIRING REPAIR, RELOCATION OR ADJUSTMENT AS A RESULT OF THE PROJECT SHALL BE COORDINATED THROUGH THE RESPECTIVE UTILITY.
9. IN THOSE INSTANCES WHERE POWER OR TELEPHONE POLE SUPPORT IS REQUIRED, THE CONTRACTOR SHALL PROVIDE A MINIMUM 48-HOUR NOTICE TO THE RESPECTIVE UTILITY POLE OWNER. NO ADDITIONAL PAYMENT WILL BE PROVIDED FOR TEMPORARY BRACING OF UTILITIES.
10. ALL TEST PITS SHALL BE EXCAVATED PRIOR TO CONSTRUCTION LAYOUT AND RESULTS REPORTED TO THE ENGINEER FOR REVIEW FOR CONFORMANCE WITH THE PLANS. TESTS PITS ARE REQUIRED WHERE SHOWN ON THE DRAWINGS AND AS DIRECTED BY THE ENGINEER.

EXISTING SITE CONDITIONS

1. THE LOCATIONS OF UNDERGROUND UTILITIES AND STRUCTURES, AS SHOWN ON THE DRAWINGS, ARE APPROXIMATE AND MAY NOT BE COMPLETE. NO GUARANTEE IS MADE THAT UTILITIES OR STRUCTURES WILL BE ENCOUNTERED WHERE SHOWN, OR THAT ALL UNDERGROUND UTILITIES AND STRUCTURES ARE SHOWN. ALL LOCATIONS AND SIZES OF EXISTING UTILITIES AND STRUCTURES SHALL BE VERIFIED IN THE FIELD WITH TEST PITS AS REQUIRED PRIOR TO BEGINNING CONSTRUCTION OF NEW FACILITIES OR PIPING THAT MAY BE AFFECTED. THE CONTRACTOR WILL REALIGN NEW PIPE LOCATIONS AS REQUIRED TO CONFORM TO EXISTING LINES AND AS APPROVED BY THE ENGINEER.
2. BELOW GRADE UTILITY INFORMATION IS BASED ON INFORMATION PROVIDED BY EACH UTILITY. LOCATION OF PUBLIC UTILITIES SHOWN IS ONLY APPROXIMATE AND MAY NOT BE COMPLETE. PRIVATE UNDERGROUND UTILITIES SUCH AS, BUT NOT LIMITED TO, SEWER LINES, WATER LINES AND BURIED ELECTRICAL SERVICE ENTRANCES ARE NOT SHOWN. THE CONTRACTOR SHALL ASCERTAIN THE LOCATION AND SIZE OF EXISTING UTILITIES IN THE FIELD WITH THE RESPECTIVE UTILITY COMPANY REPRESENTATIVE PRIOR TO COMMENCING WORK. REFER TO SPECIFICATION SECTION 01050. ADDITIONAL TEST PITS, BEYOND THOSE SHOWN, MAY BE REQUIRED. UTILITY CONTACTS ARE AS FOLLOWS:

BATH PUBLIC WORKS:
LEE LEINER
207-443-8357

CENTRAL MAINE POWER COMPANY
800-565-3181

GWI, INC.:
207-286-8686

DIG SAFE:
1-888-DIG-SAFE

BATH WATER DISTRICT:
NATHAN BODGE
207-443-2391

3. HAZARDOUS MATERIALS HAVE BEEN DETECTED IN THE AREA OF WORK AT 1090 HIGH STREET. THE HAZARDOUS MATERIALS HAVE BEEN DETERMINED TO BE BELOW THE APPROPRIATE THRESHOLD FOR CONSTRUCTION WORK AND EXCAVATION. REFER TO SPECIFICATION SECTION 02080A. THERE ARE NO OTHER HAZARDOUS ENVIRONMENTAL CONDITIONS WITHIN THE AREA OF WORK. IF THE PRESENCE OF HAZARDOUS ENVIRONMENTAL CONDITIONS ARE DISCOVERED, THE CONTRACTOR SHALL NOTIFY THE OWNER AND THE ENGINEER IMMEDIATELY. ALL ACTIVITIES, HANDLING AND DISPOSAL OF HAZARDOUS ENVIRONMENTAL CONDITIONS AND MATERIALS SHALL BE IN ACCORDANCE WITH OSHA, FEDERAL, STATE, AND LOCAL REGULATIONS.

SITE DEMOLITION

1. REFER TO THE EXISTING SITE PLAN, FOR ADDITIONAL INFORMATION REGARDING EXISTING FACILITIES. REFER TO THE LAYOUT DRAWING FOR LIMITS OF WORK.
2. REFER TO SPECIFICATION SECTION 01010A, WHICH CONTAINS INFORMATION ON CONSTRAINTS OF CONSTRUCTION SEQUENCING.
3. DEMOLISH/REMOVE EXISTING PIPING AS REQUIRED FOR CONSTRUCTION OF NEW FACILITIES. ALL PIPING, EQUIPMENT AND MATERIALS TO BE DEMOLISHED AND/OR REMOVED FROM SERVICE SHALL BE COORDINATED WITH THE OWNER AND ENGINEER BEFORE COMMENCING THAT WORK. EXISTING PIPING THAT NEEDS TO BE REMOVED TO CONSTRUCT THE NEW FACILITIES, BUT IS TO REMAIN, SHALL BE REINSTALLED/REPLACED AS NEEDED. EXISTING PIPES AND CONDUIT DESIGNATED AS "ABANDONED" MAY BE REMOVED IF THE CONTRACTOR SO CHOOSES. IF ABANDONED PIPE CONFLICTS WITH NEW SITE PIPING OR FACILITIES, THEN A PORTION OF THE ABANDONED PIPE SHALL BE REMOVED, AND THE NEW ENDS OF ABANDONED PIPE CAPPED OR PLUGGED WITH CONCRETE.
4. SEVERING OF EXISTING UTILITIES FOR ABANDONMENT, OR REMOVAL OF A SEGMENT FROM SERVICE, SHALL BE PERFORMED IN SUCH A MANNER AS TO ALLOW THE REMAINING ACTIVE SEGMENT TO CONTINUE IN ITS INTENDED SERVICE. CAP ACTIVE SEGMENTS WITH APPROPRIATE FITTINGS, JOINT RESTRAINT, ETC. TO ENSURE THEIR INTEGRITY. PLUG ENDS OF ABANDONED PIPE SEGMENTS WITH CONCRETE UNLESS SPECIAL CIRCUMSTANCES DICTATE PLUGGING ABANDONED PIPES WITH BLIND FLANGES, RESTRAINED MECHANICAL JOINT PLUGS, ETC. AS APPROPRIATE.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING AND DISPOSING OF ALL DEMOLISHED PIPING, EQUIPMENT AND MATERIALS. DISPOSAL SHALL BE IN ACCORDANCE WITH ALL STATE AND LOCAL REGULATIONS. THE OWNER RESERVES THE RIGHT TO RETAIN ANY SUCH PIPING, EQUIPMENT AND MATERIALS DESIGNATED FOR DEMOLITION. SUCH MATERIALS TO BE RETAINED SHALL BE PROPERLY STORED IN AN ON-SITE LOCATION. COORDINATE LOCATION AND MATERIALS TO BE SALVAGED WITH THE OWNER/ENGINEER. REFER TO SPECIFICATION SECTION 02050A.
6. THE CONTRACTOR SHALL KEEP A RECORD OF DEMOLITION AS PART OF THE PROJECT RECORD DOCUMENTS IN ACCORDANCE WITH SPECIFICATION SECTION 01720.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE APPROPRIATE DISPOSAL OF FLOWS RESULTING FROM PRECIPITATION AND GROUNDWATER DEWATERING OPERATIONS.
8. COORDINATE WITH THE OWNER REGARDING RELOCATION OF EXISTING PARK EQUIPMENT AND STORAGE/SALVAGE OF DEMOLISHED EQUIPMENT.

SITE CLEARING, GRUBBING AND GRADING

1. STRIPPING OF TOPSOIL (LOAM) SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02115. REFER TO THE LAYOUT AND GRADING DRAWINGS FOR LIMIT OF WORK AND STRIPPING.
2. CONTRACTOR SHALL MINIMIZE CLEARING OPERATIONS. CLEARING AND GRUBBING SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02110. CLEARING LIMITS SHALL BE AS INDICATED ON THE DRAWINGS, BUT AT ALL TIMES WITHIN EXISTING ROAD RIGHTS-OF-WAY AND PROPERTY LINES ON STATE OR COUNTY-OWNED PROPERTY OR EASEMENTS. ALL CLEARING AND GRUBBING MATERIAL SHALL BE THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF AT A SITE PROVIDED BY THE CONTRACTOR IN COMPLIANCE WITH ALL STATE AND LOCAL LAWS.
3. THE CONTRACTOR SHALL FOLLOW ALL ENDANGERED SPECIES ACT 4(D) RULES REGARDING THE NORTHERN LONG EARED BAT. THIS INCLUDES AVOIDANCE OF TREE REMOVAL DURING THE MONTHS OF JUNE AND JULY. CONTRACTOR SHALL PLAN ACCORDINGLY.
4. CONTRACTOR SHALL PROVIDE PROPER EROSION CONTROL AND DRAINAGE MEASURES IN ALL AREAS OF WORK, AND CONFINE SOIL SEDIMENT TO WITHIN THE LIMITS OF EXCAVATION AND GRADING. PRIOR TO BEGINNING EXCAVATION WORK, EROSION CONTROL FENCE SHALL BE INSTALLED AT THE DOWN GRADIENT PERIMETER OF THE ACTUAL LIMITS OF GRUBBING AND/OR GRADING, AND AS SHOWN ON THE DRAWINGS. EROSION CONTROL MEASURES SHOWN ON THE DRAWINGS ARE A MINIMUM, CONTRACTOR SHALL TAKE ALL OTHER NECESSARY MEASURES. EROSION CONTROL FENCE SHALL ALSO BE INSTALLED AT THE DOWN GRADIENT PERIMETER OF THE TOPSOIL STOCKPILES. ALL DISTURBED EARTH SURFACES SHALL BE STABILIZED IN THE SHORTEST PRACTICAL TIME AND TEMPORARY EROSION CONTROL DEVICES SHALL BE EMPLOYED UNTIL SUCH TIME AS ADEQUATE SOIL STABILIZATION HAS BEEN ACHIEVED. TEMPORARY STORAGE OF EXCAVATED MATERIAL SHALL BE STABILIZED IN A MANNER THAT WILL MINIMIZE EROSION. ALL INSTALLED EROSION CONTROL FACILITIES SHALL BE REMOVED AT THE END OF THE PROJECT. REFER TO SPECIFICATION SECTION 02270.
5. ALL STORM DRAINAGE INLETS SHALL BE PROTECTED BY HAY BALE FILTERS TO PREVENT ENTRY OF SEDIMENT FROM RUNOFF WATERS DURING CONSTRUCTION. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL AND DISPOSAL OF ALL COLLECTED SEDIMENT, AND THAT WHICH COLLECTS IN THE STORM DRAIN SYSTEM. REFER TO THE CIVIL DETAIL DRAWINGS.
6. CONTRACTOR SHALL CONTROL DUST ON THE CONSTRUCTION SITE TO A REASONABLE LIMIT, AS DETERMINED BY THE ENGINEER, AND AS OUTLINED IN SPECIFICATION SECTION 01562.
7. CONTRACTOR SHALL NOT TRACK OR SPILL EARTH, DEBRIS OR OTHER CONSTRUCTION MATERIAL ON PUBLIC OR PRIVATE STREETS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE IMMEDIATE ASSOCIATED CLEAN UP.
8. ALL CATCH BASINS, MANHOLES, VALVE PITS, VALVE BOXES AND OTHER BURIED FACILITIES WITH SURFACE ACCESS SHALL BE ADJUSTED TO MATCH FINAL GRADES, UNLESS OTHERWISE INDICATED.
9. THE CONTRACTOR SHALL NOT HAVE ANY RIGHT OF PROPERTY IN ANY MATERIALS TAKEN FROM ANY EXCAVATION. SUITABLE EXCAVATED MATERIAL MAY BE INCORPORATED IN THE PROJECT, WITH EXCESS MATERIAL DISPOSED OF AT A LOCATION PROVIDED BY THE CONTRACTOR. THESE PROVISIONS SHALL IN NO WAY RELIEVE THE CONTRACTOR OF OBLIGATIONS TO PROPERLY DISPOSE OF AND REPLACE ANY MATERIAL DETERMINED BY THE ENGINEER TO BE UNSUITABLE FOR BACKFILLING. THE CONTRACTOR SHALL DISPOSE OF UNSUITABLE AND EXCESS MATERIAL IN ACCORDANCE WITH THE APPLICABLE SECTIONS OF THE CONTRACT DOCUMENTS.
10. CONTRACTOR SHALL REMOVE AND REPLACE, OR REPAIR, ALL CURBS, SIDEWALKS, PAVEMENT AND OTHER ITEMS DAMAGED BY CONSTRUCTION ACTIVITIES TO AT LEAST THEIR ORIGINAL CONDITION, TO THE SATISFACTION OF THE OWNER AND ENGINEER.
11. WHERE EXISTING PAVEMENT IS REMOVED AND REPLACED, MATCH EXISTING GRADES TO THE EXTENT POSSIBLE. COORDINATE FINE GRADING WITH THE ENGINEER.
12. ALL ROAD AND DRIVE CROSS SLOPES SHALL PITCH 1/4-INCH PER FOOT MINIMUM. ALL PAVED SURFACES SHALL PITCH 1% UNLESS OTHERWISE NOTED. REFER TO THE CIVIL DETAIL DRAWINGS.
13. ALL NON-ROADWAY AREAS THAT ARE EXCAVATED, FILLED, OR OTHERWISE DISTURBED BY THE CONTRACTOR SHALL BE LOAMED, GRADED, LIMED, FERTILIZED, SEEDED AND MULCHED, UNLESS OTHERWISE NOTED. THE TOP 4-INCHES OF SOIL SHALL BE LOAM . REFER TO SPECIFICATION SECTION 02485, LANDSCAPING/LOAM AND SEED.

CIVIL SITE LAYOUT

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THIS PROVIDED LAYOUT INFORMATION THROUGHOUT THE COURSE OF CONSTRUCTION. REPORT ANY LAYOUT DISCREPANCIES IMMEDIATELY TO THE ENGINEER.
2. IN GENERAL, THE GIVEN STRUCTURE LOCATIONS ARE TO THE OUTSIDE FACE OF THE STRUCTURE FOUNDATION WALL, NOT FOOTINGS. RADII SHOWN FOR ROADS ARE TO EDGE OF PAVEMENT.
3. THE LOCATIONS AND LIMITS OF ALL ON-SITE WORK AND STORAGE AREAS SHALL BE REVIEWED/COORDINATED WITH, AND ACCEPTABLE TO, THE OWNER AND ENGINEER. THE CONTRACTOR SHALL LIMIT ACTIVITIES TO THESE AREAS.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RE-ESTABLISHING AND RESETTING ALL EXISTING PROPERTY MONUMENTATION DISTURBED BY CONSTRUCTION. THIS WORK SHALL BE DONE BY A LAND SURVEYOR REGISTERED IN THE STATE OF MAINE, AT NO ADDITIONAL COST TO THE OWNER.
5. WRITTEN DIMENSIONS SHALL PREVAIL. DO NOT SCALE DISTANCES FROM THE DRAWINGS. REPORT ANY DISCREPANCIES IMMEDIATELY TO THE ENGINEER.
6. ALL ELEVATIONS REFER TO THE NAVD88 DATUM. ORIENTATION IS GRID NORTH ON THE NAD83 MAINE WEST STATE PLANE COORDINATE SYSTEM. PROJECT BENCH MARK IS SHOWN ON THE DRAWINGS. CONTRACTOR SHALL VERIFY BENCHMARK ELEVATIONS PRIOR TO USING IN CONSTRUCTION.
7. EXISTING CONDITIONS SITE PLAN DEVELOPED FROM SURVEY DRAWING PREPARED DOUCET SURVEY, DATED 03/05/2024, AND EXISTING RECORD DRAWING INFORMATION.

CIVIL SITE PIPING

1. TRENCH INSULATION SHALL BE USED WHERE DEPTH OF COVER IS LESS THAN 5-FEET. REFER TO THE CIVIL DETAIL DRAWINGS FOR THE TRENCH INSULATION DETAIL.
2. TRENCH INSULATION SHALL BE USED WHEN THERE IS LESS THAN 2-FEET BETWEEN THE SEWER OR FORCE MAIN AND A CULVERT. REFER TO THE CIVIL DETAIL DRAWINGS FOR THE TRENCH INSULATION DETAIL.
3. REFER TO SPECIFICATION SECTION 02200 FOR PIPE AND STRUCTURE BEDDING AND BACKFILL REQUIREMENTS.
4. COMPACTION TESTS WILL BE PERFORMED IN ACCORDANCE WITH SPECIFICATION SECTION 02200. ANY SETTLEMENT OCCURRING WITHIN ONE-YEAR OF FINAL COMPLETION OF THE WORK SHALL BE CORRECTED BY THE CONTRACTOR AT NO ADDITIONAL COST.
5. OPEN TRENCHES IN THE ROADWAY MUST BE BACKFILLED AT THE END OF THE WORKDAY. OPEN TRENCHES OUTSIDE OF THE WAY MAY BE LEFT OPEN IF THE CONTRACTOR PROVIDES ADEQUATELY SAFE BARRICADING AND LIGHTS.
6. WHERE NEW PIPING IS TO BE CONNECTED TO EXISTING PIPING, THE CONTRACTOR SHALL FURNISH AND INSTALL ALL ADAPTERS, FITTINGS, AND ADDITIONAL PIPE AS REQUIRED TO COMPLETE THE CONNECTION. CONTRACTOR SHALL VERIFY LOCATION, ELEVATION, ORIENTATION AND MATERIAL OF CONSTRUCTION. TEST PITS SHALL BE USED AS REQUIRED .
7. ALL EXISTING UTILITIES ENCOUNTERED DURING CONSTRUCTION ARE TO REMAIN IN SERVICE UNLESS OTHERWISE NOTED ON THE CIVIL EXISTING CONDITIONS AND DEMOLITION PLAN. ANY EXISTING UTILITIES DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
8. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL AND DISPOSAL OF ALL DEMOLITION MATERIALS IN ACCORDANCE WITH SPECIFICATION SECTION 02050.
9. LOCATION OF EXISTING SEWER LATERALS SHOWN ARE APPROXIMATE BASED ON CCTV INSPECTIONS WHERE AVAILABLE. CONTRACTOR SHALL LOCATE EXISTING SEWER LATERALS AND SUBMIT PROPOSED ROUTING OF EXISTING SEWER LATERALS TO NEW SEWER MAIN FOR REVIEW BY THE ENGINEER AS NECESSARY.

CIVIL ABBREVIATIONS

&	AND
Ø, DIA	DIAMETER
#, NO	NUMBER
AC	ASBESTOS CEMENT
APP'D	APPROVED
BR	BRICK
BLDG	BUILDING
CB	CATCH BASIN
CEN	CENTER
CFS	CUBIC FEET PER SECOND
CI	CAST IRON
CIPP	CURED-IN-PLACE-PIPE
CL	CENTERLINE
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
CONC	CONCRETE
COR	CORNER
CY	CUBIC YARD
DEMO	DEMOLITION
DMH	DRAIN MANHOLE
DI	DUCTILE IRON
DR	DRAIN
DWG	DRAWING
EL	ELEVATION
EMH	ELECTRIC MANHOLE
FM	FORCE MAIN
FT	FEET
G	GAS
HDPE	HIGH DENSITY POLYETHYLENE
HYD	HYDRANT
IN	INCH
INF	INFLUENT
INV	INVERT
LBS	POUNDS
LF	LINEAR FOOT
LSCAPE	LANDSCAPE
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MW	MONITORING WELL
N	NORTH
NGVD	NATIONAL GEODETIC VERTICAL DATUM
N/A	NOT AVAILABLE/APPLICABLE
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
OUT	OUTFALL
PC	PERFORATED CLAY
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PS	PRIMARY SLUDGE
PT	POINT OF TANGENCY
PVC	POLYVINYL CHLORIDE
RCP	REINFORCED CONCRETE PIPE
RD	ROOF DRAIN
REQ'D	REQUIRED
S	SLOPE, SEWER
SD	STORM DRAIN
SF	SQUARE FEET
SMH	SANITARY SEWER MANHOLE
SQ	SQUARE
STA	STATION
T, XFMR	TRANSFORMER
TBM	TEMPORARY BENCH MARK
THK	THICKNESS
TOS	TOP OF STRUCTURE
TYP	TYPICAL
UD	UNDERDRAIN
UG	UNDERGROUND
UGE	UNDERGROUND ELECTRIC
VC	VITRIFIED CLAY
VF	VERTICAL FOOT
W/	WITH
W	POTABLE WATER

LEGEND

EXISTING		PROPOSED
	PROPERTY/ROW LINE	
	SETBACK LINE	
	EASEMENT LINE	
	CENTERLINE	
	EDGE OF PAVEMENT	
	CURBING	
	EDGE OF GRAVEL	
122	CONTOUR	123
	BUILDING	
	STONEWALL	
	TREELINE	
	CHAIN LINK FENCE	
	STOCKADE FENCE	
	BARB WIRE FENCE	
	RETAINING WALL	
	GUARDRAIL	
8"	SEWER	8"S
4"	SEWER FORCE MAIN	4"FM
4"	GAS	4"G
8"	WATER	8"W
15"	STORM DRAIN	15"SD
6"	UNDERDRAIN	6"UD
12" CMP	CULVERT	12" CMP
UGE	UNDERGROUND ELECTRIC	UGE
OHE	OVERHEAD ELECTRIC	OHE
UGT	UNDERGROUND TELEPHONE	UGT
UGV	UNDERGROUND CABLE TV	UGV
	IRON PIPE/REBAR	●
	DRILLHOLE	●
	MONUMENT	■
	SURVEY CONTROL POINT	
124.6	SPOT ELEVATION	134.5
SMH	SEWER MANHOLE	●SMH
DMH	DRAINAGE MANHOLE	●DMH
CB CB CB	CATCH BASIN	●CB ■CB
EMH	ELECTRIC MANHOLE	■EMH
TMH	TELEPHONE MANHOLE	■TMH
	SHUTOFF VALVE	
	WATER SERVICE SHUTOFF	
	YARD HYDRANT	
	HYDRANT	
	GAS SERVICE SHUTOFF	
	GAS GATE VALVE	
	UTILITY POLE	
	UTILITY POLE W/ GUY	
	UTILITY POLE W/ LIGHT	
	LIGHT POLE	
	BOLLARD	
	FLAGPOLE	
	CONIFEROUS TREE	
	DECIDUOUS TREE	
	SHRUB	
	WETLAND FLAG	
	EDGE OF WATER	
	STREAM	
	EDGE OF WETLANDS	
	FLOODPLAIN	
	WETLANDS	
	DRAINAGE FLOW	
	DRAINAGE SWALE	
	PAVEMENT MARKINGS	
	SIGN	
MB	MAILBOX	
	TEMPORARY BENCH MARK	
TP	TEST PIT	
B	TEST BORING	
P	TEST PROBE	
MW	MONITORING WELL	
	LIMIT OF WORK	
	SILT FENCE	
	RIPRAP	
	RAILROAD	
	MATCHLINE	
	ROCK OUTCROP	
EXX	PIPING TO ABANDON	

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD: D.METZ
CHECKED:
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

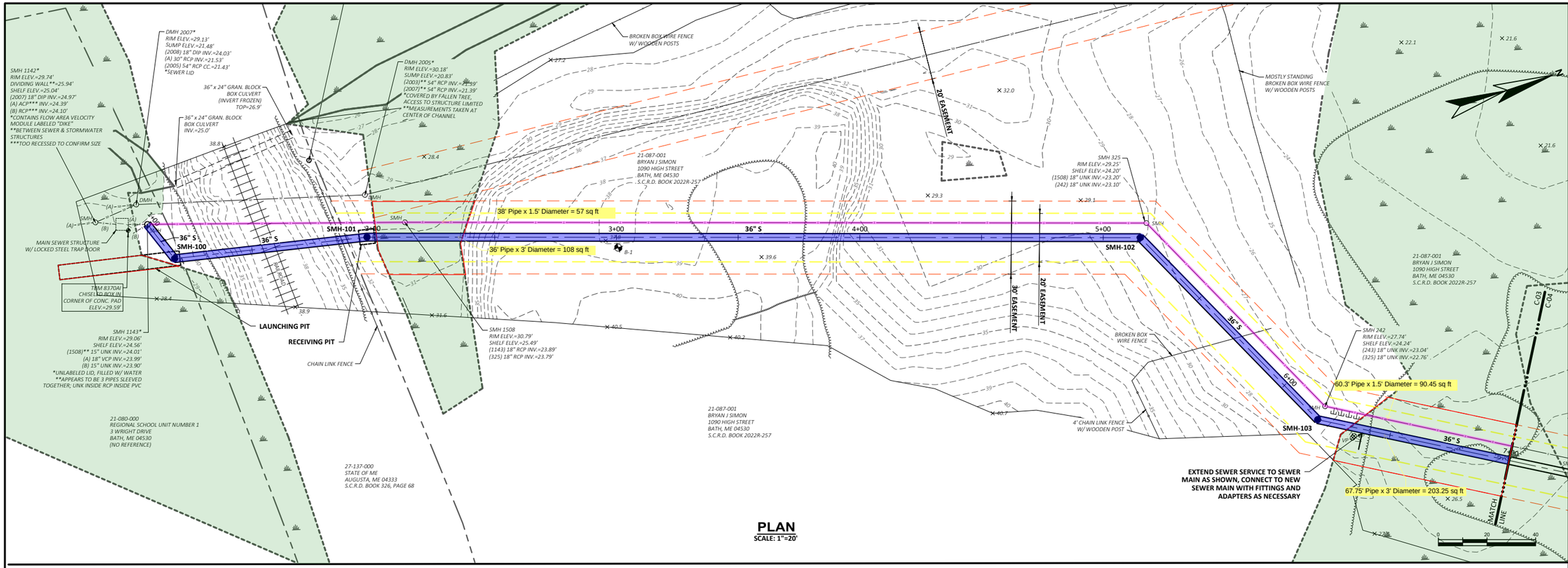
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

GENERAL NOTES, LEGEND AND ABBREVIATIONS

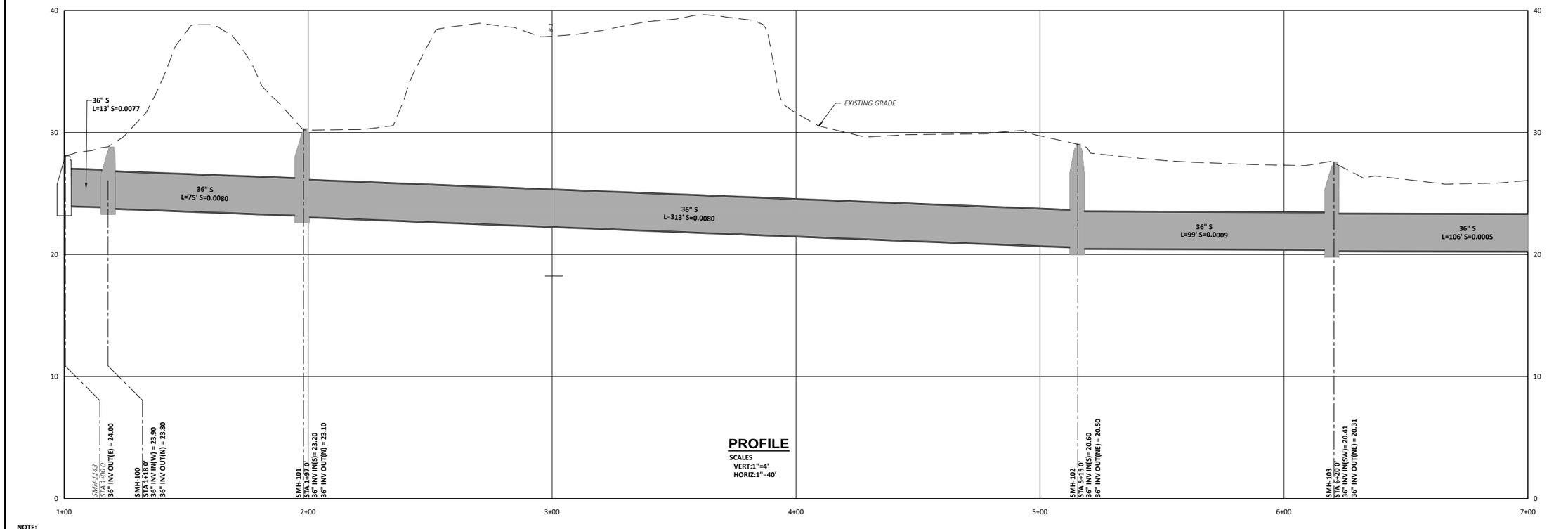
DRAWING
C-01

J:\ENG\WL\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVIL\21119-CS-NOTESLEGENDABBREV.DWG | 21119-CS-NotesLegendAbbrev | 2.5BB | ---- | 11/15/2024 10:59:04 AM | DANIELMETZ

LAST SAVED BY: DANIEL.METZ 11/12/2024 3:37 PM



PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO. 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

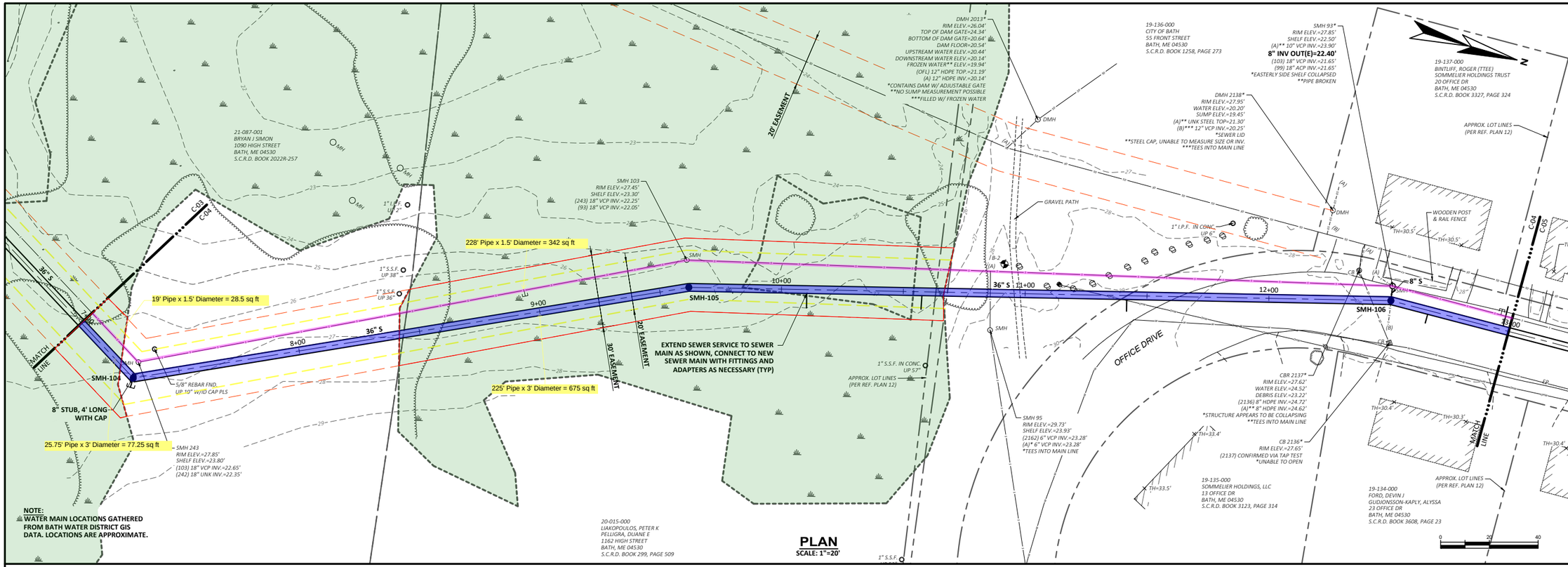
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 1+00 TO STA. 7+00

DRAWING
C-03

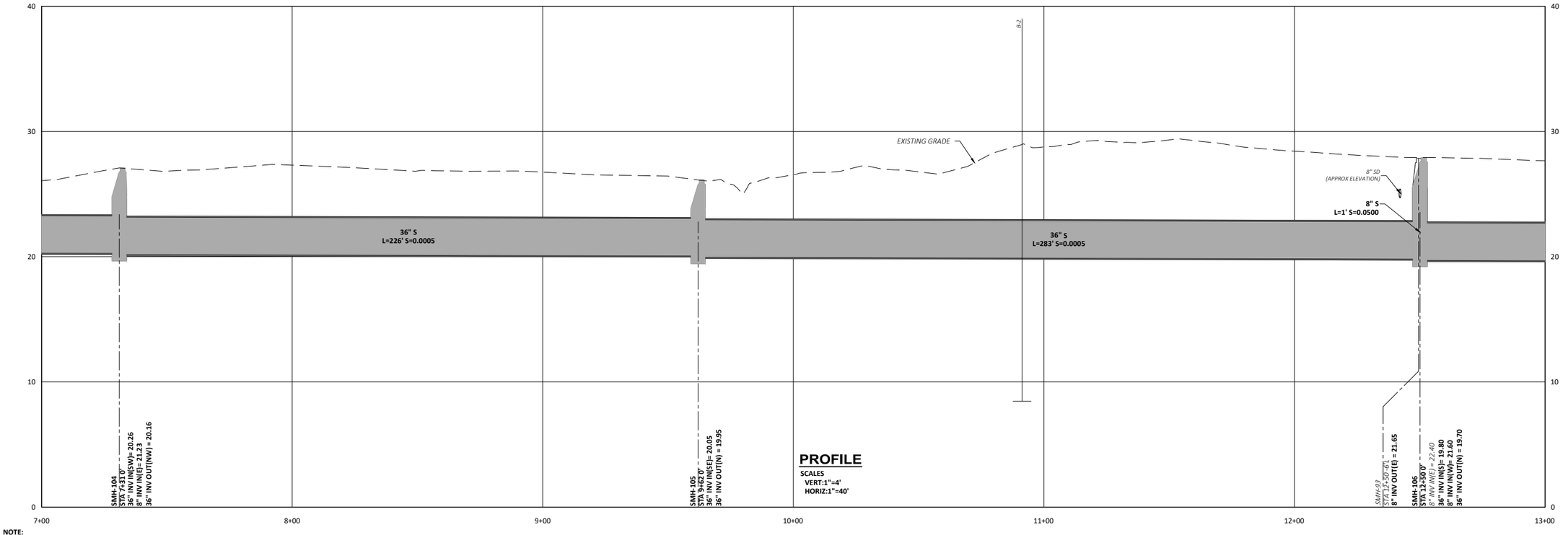
J:\ENG\WEL\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVC-002 21119-CS-PLANANDPROFILE1.DWG | 21119-CS-PlanandProfile1 | 12.5849 | --- | 11/15/2024 11:00:26 AM | DANIELMETZ

LAST SAVED BY: DANIEL.METZ 11/13/2024 9:04 AM



NOTE:
WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.

PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

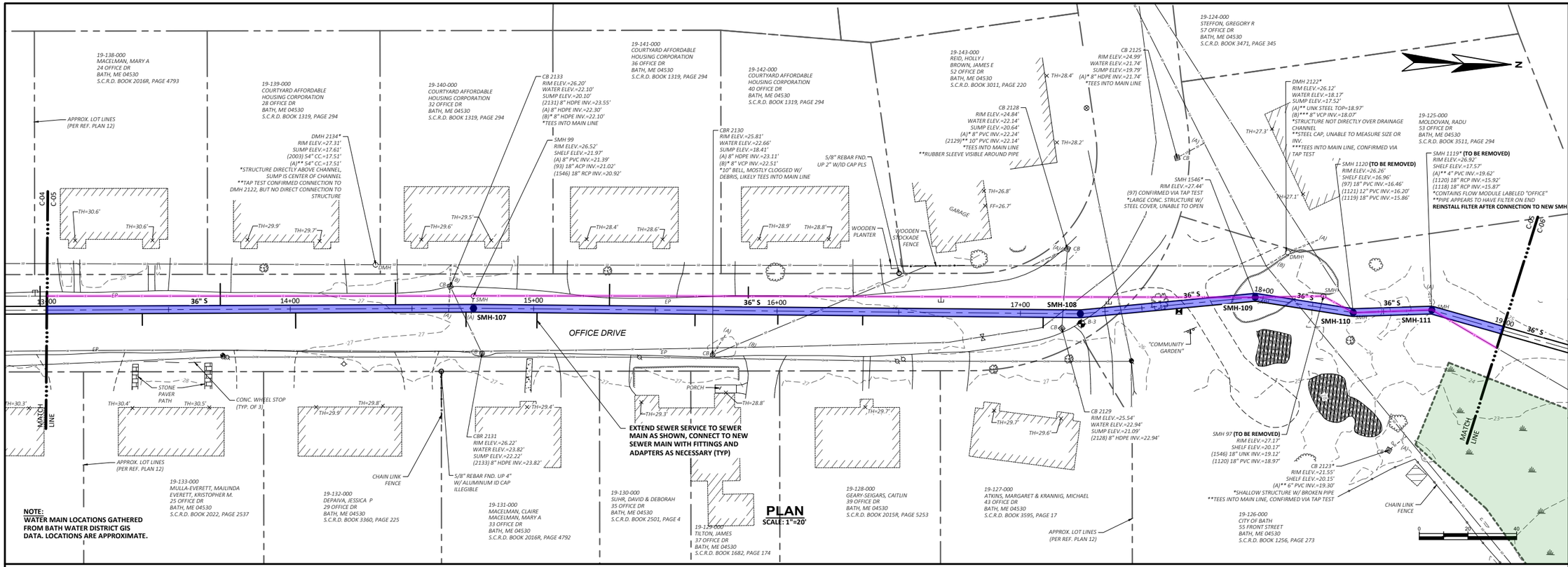
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 7+00 TO STA. 13+00

DRAWING
C-04

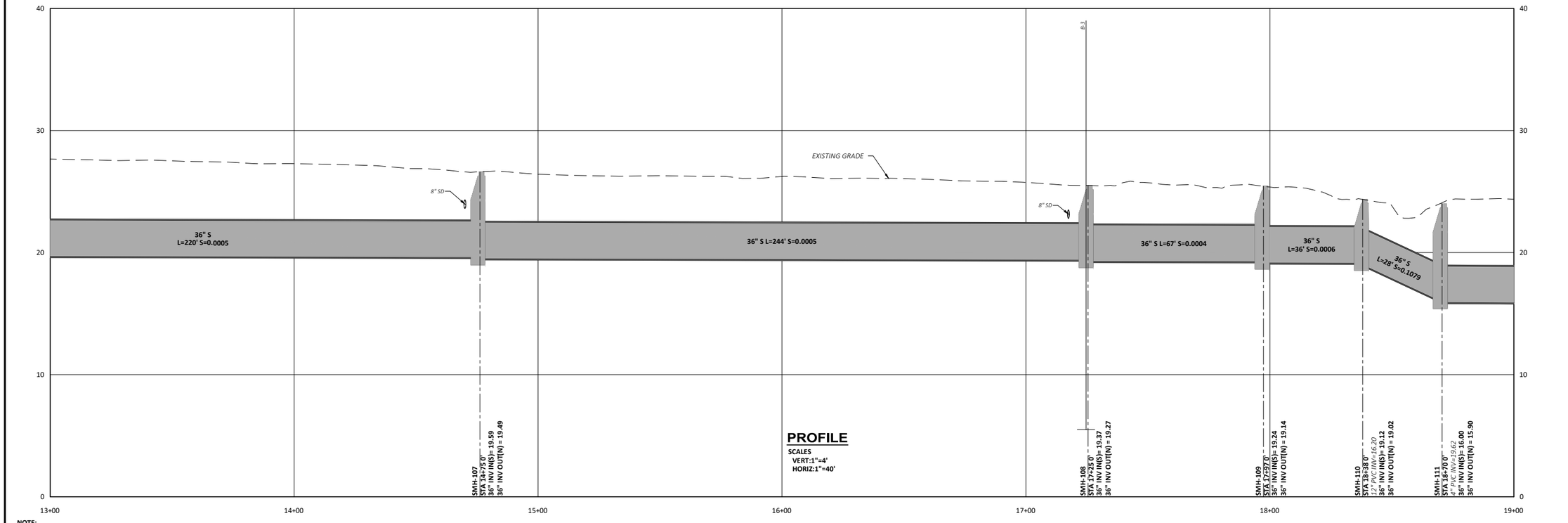
J:\ENGM\BATH\21119-HARWARD\INFOSWMM-MODEL_DRAWINGS\CIV\21119-CS-PLANANDPROFILE.DWG | 21119-CS-PlanandProfile! | 12.5849 | — | 11/15/2024 11:01:16 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/13/2024 10:13 AM



NOTE:
WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.

PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

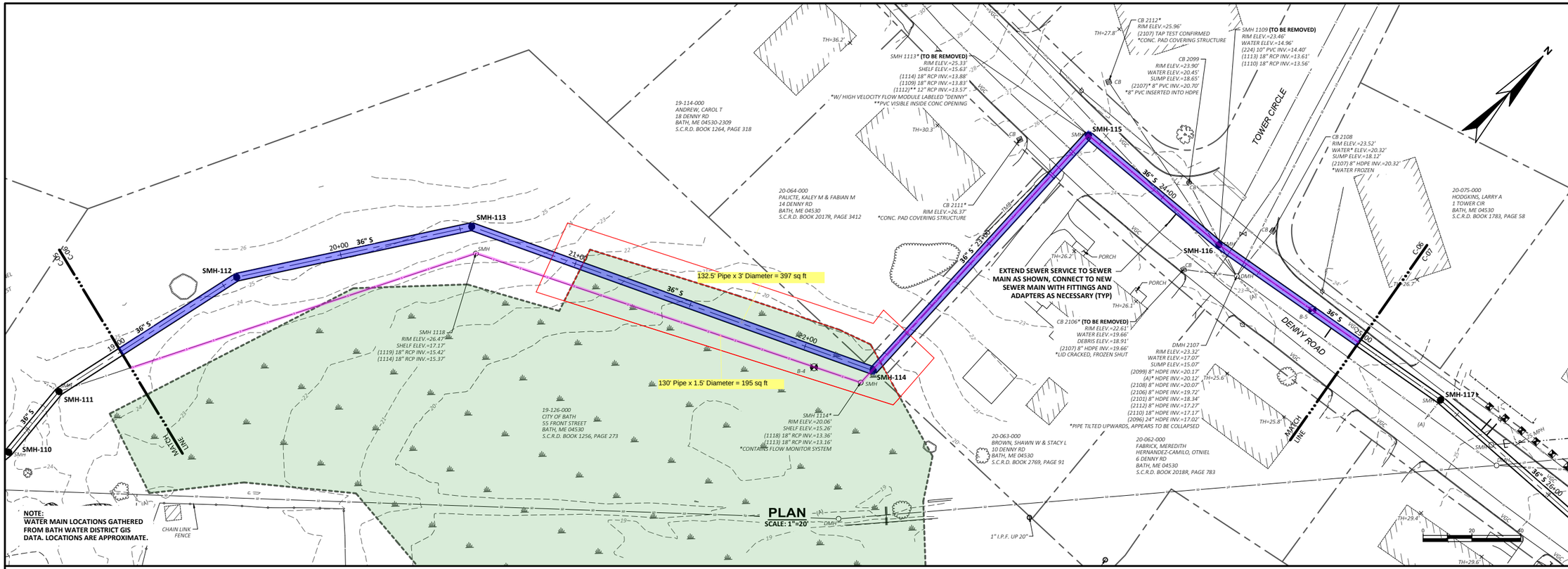
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 13+00 TO STA. 19+00

DRAWING
C-05

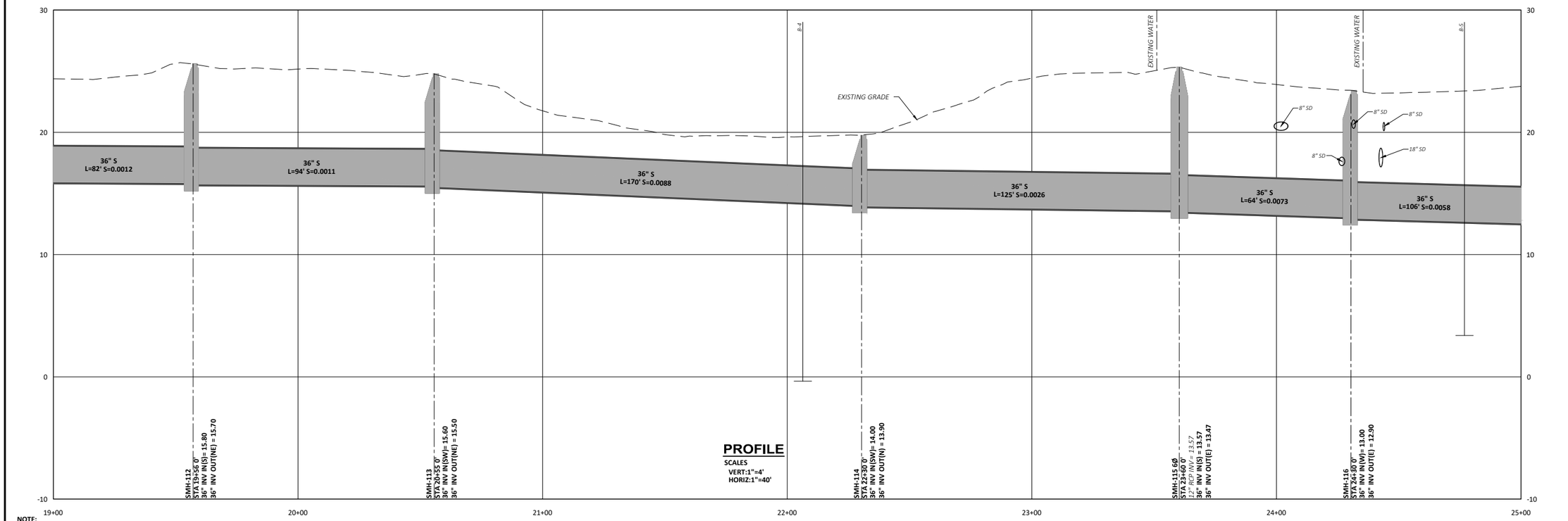
I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIV\21119-CS-PLANANDPROFILEIII.DWG | 21119-CS-PlanandProfileIII | 12.5849 | --- | 11/15/2024 11:01:48 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/15/2024 11:14 AM



NOTE:
WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.

PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

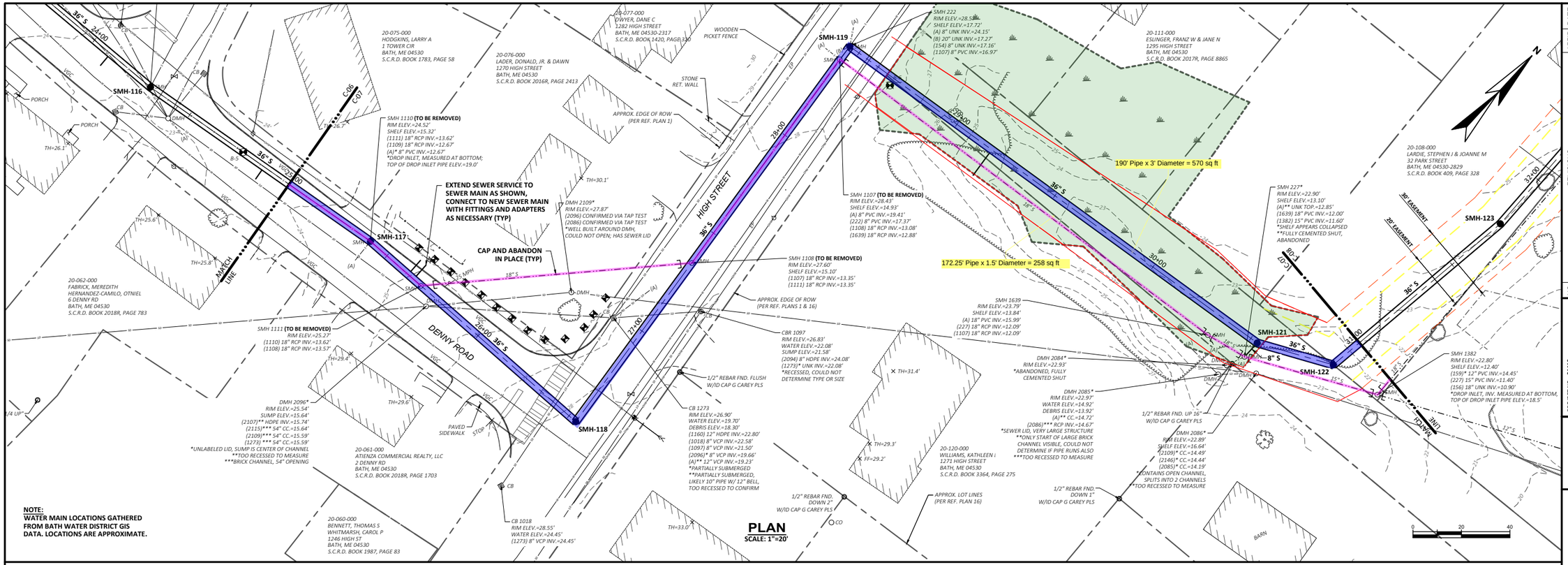
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 19+00 TO STA. 25+00

DRAWING
C-06

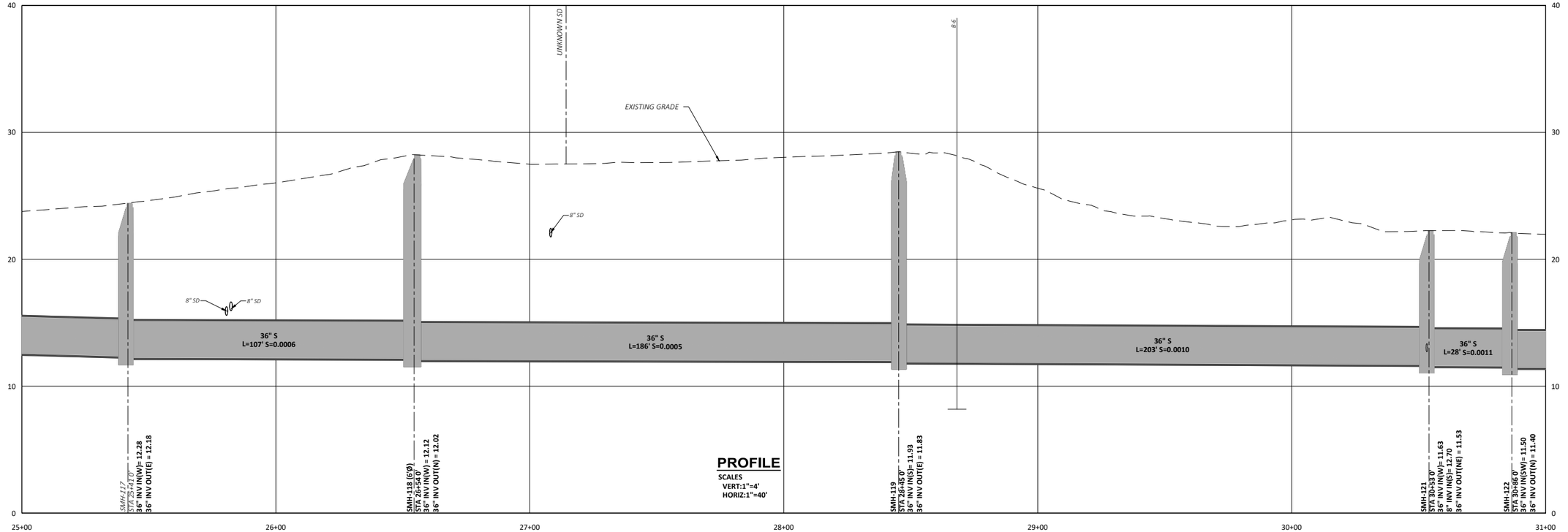
I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVIL\21119-CS-PLANANDPROFILEIV.DWG | 21119-CS-PlanandProfileIV | 1:2.5849 | --- | 11/15/2024 11:16:51 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/15/2024 10:54 AM



NOTE:
WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.

PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO. 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD: D.METZ
CHECKED:
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

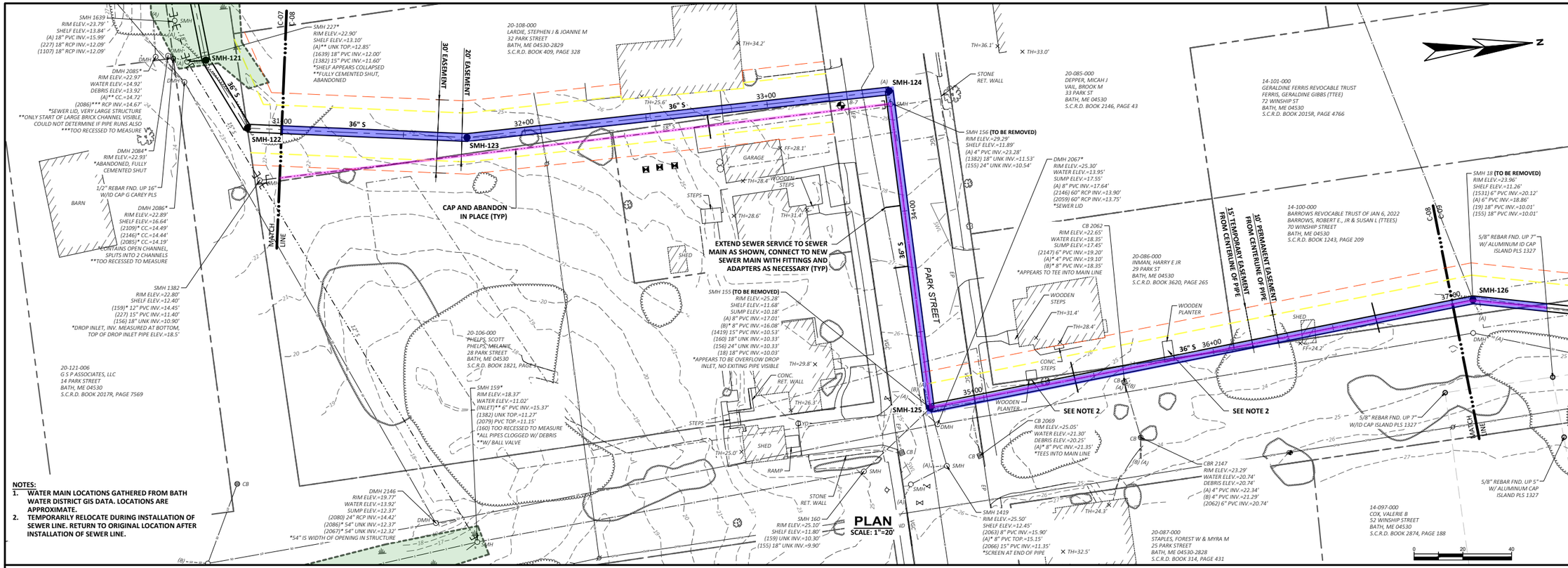
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 25+00 TO STA. 31+00

DRAWING
C-07

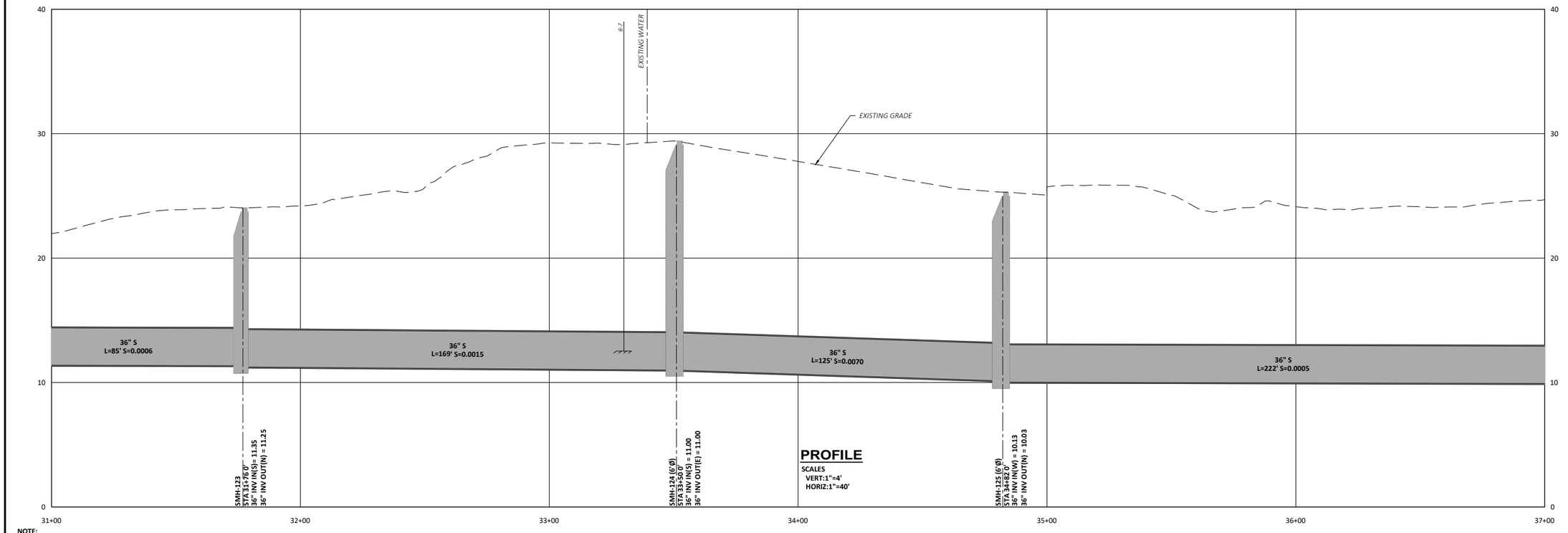
I:\ENG\ME\BATH\21119-HARWARD\INFO\SWMM-MODEL_DRAWINGS\CIVL-006 21119-CS-PLANANDPROFILEV.DWG | 21119-CS-PLANANDPROFILEV | 1:2.5849 | — | 11/15/2024 11:02:44 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/15/2024 10:54 AM



NOTES:

1. **WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.**
2. **TEMPORARILY RELOCATE DURING INSTALLATION OF SEWER LINE. RETURN TO ORIGINAL LOCATION AFTER INSTALLATION OF SEWER LINE.**



NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	DATE	APP'D	REVISIONS
1			
2			
3			
4			
5			

PROJECT NO. 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

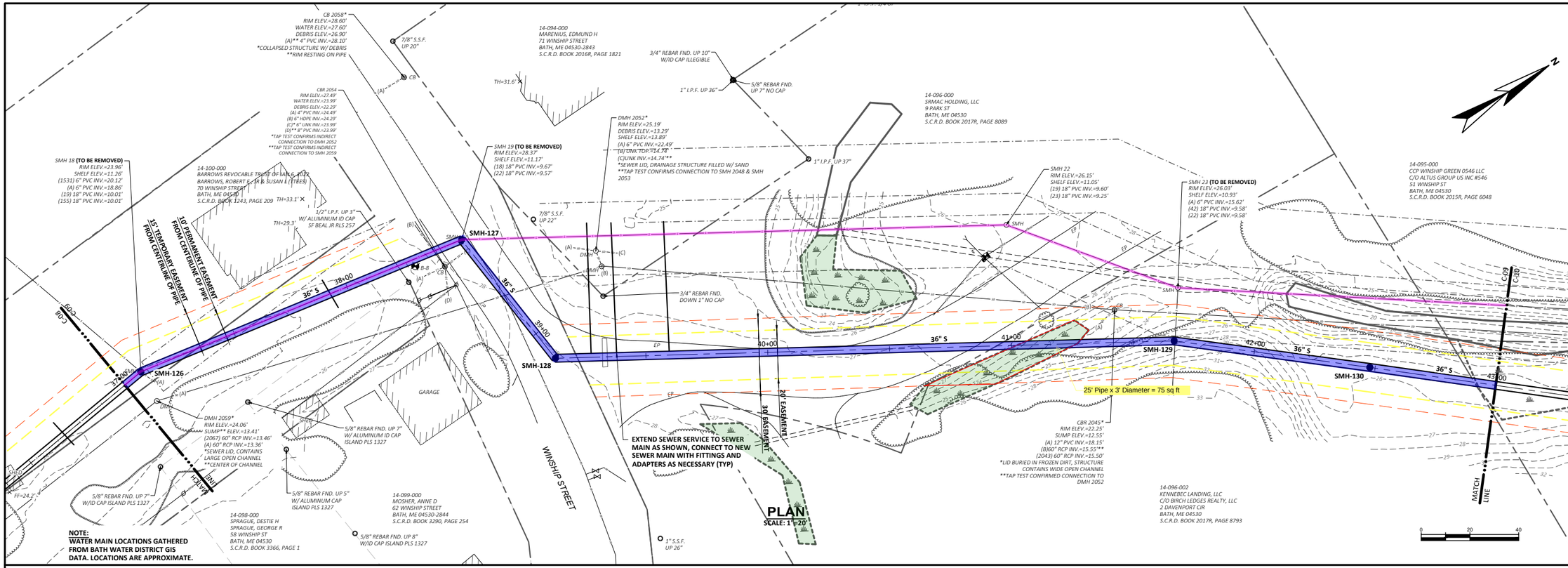
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 31+00 TO STA. 37+00

DRAWING
C-08

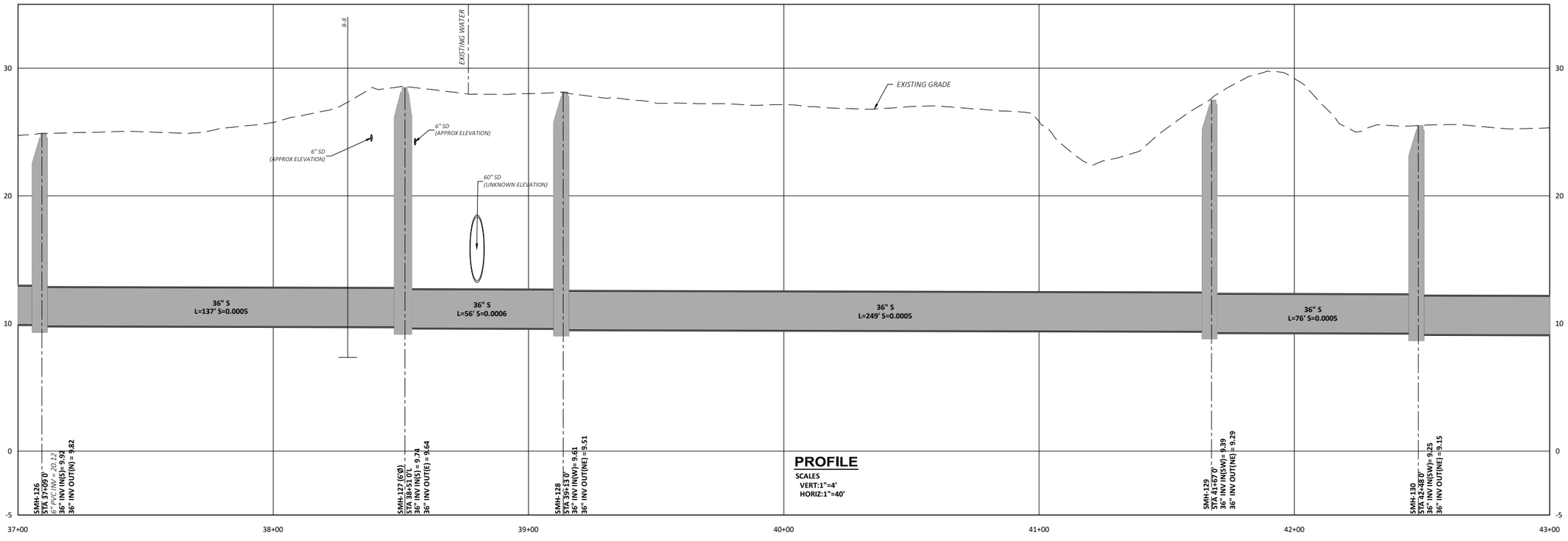
I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVIL\21119-CS-PLANANDPROFILEVI.DWG | 21119-CS-PlanandProfileVI | 1:2.5869 | --- | 11/15/2024 11:03:10 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/13/2024 1:01 PM



NOTE:
WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.

PLAN
SCALE: 1" =20'



NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

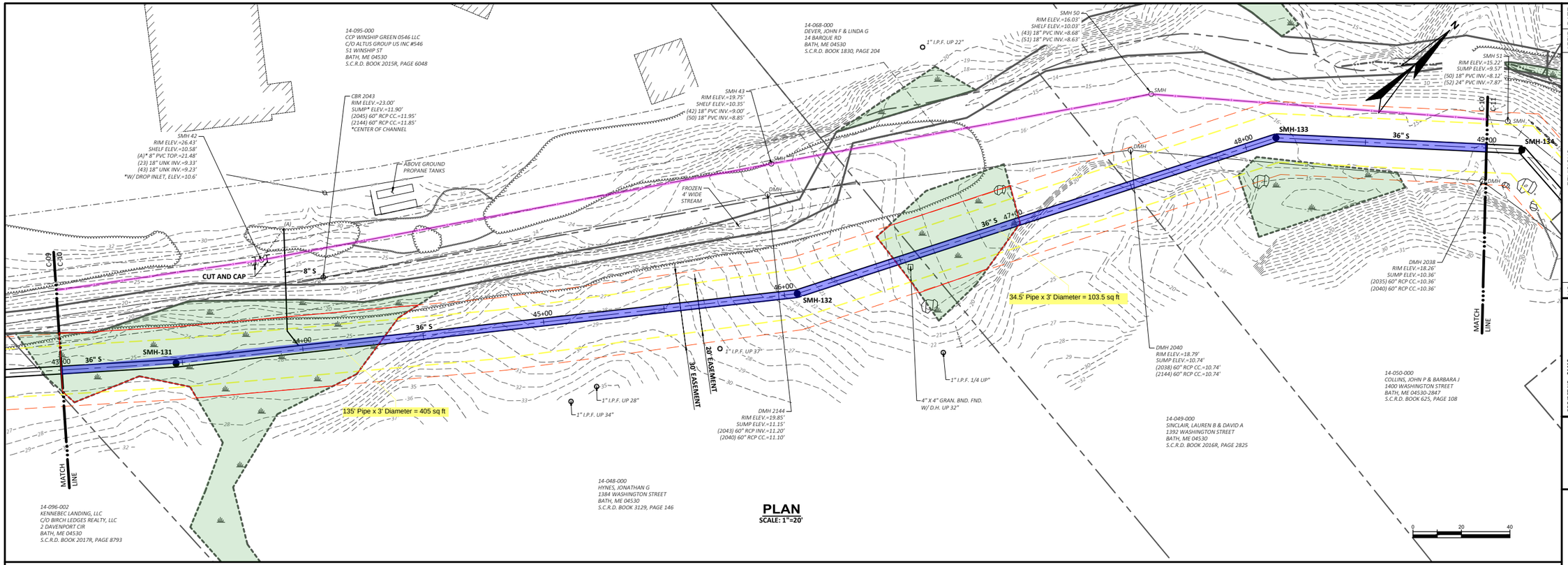
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 37+00 TO STA. 43+00

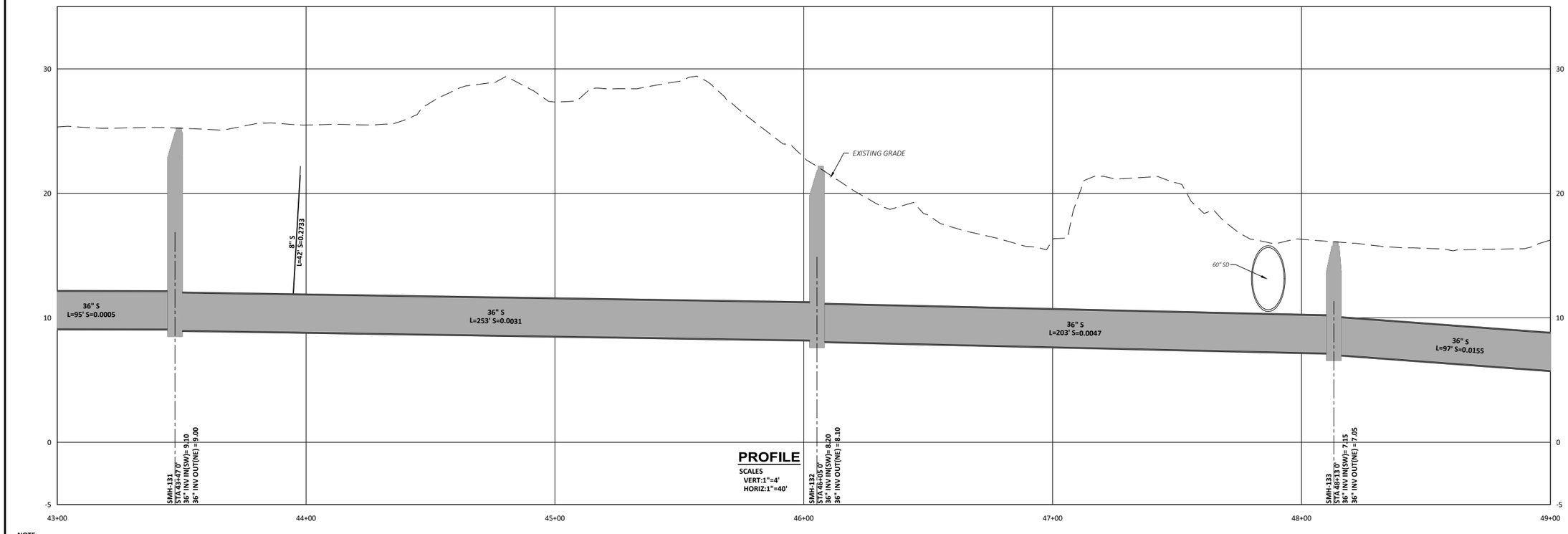
DRAWING
C-09

I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIV\21119-CS-PLANANDPROFILEVII.DWG | 21119-CS-PlanandProfileVII | 12.5849 | — | 11/15/2024 11:26:57 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/15/2024 8:54 AM



PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	DATE	APP'D	REVISIONS
1			
2			
3			
4			
5			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

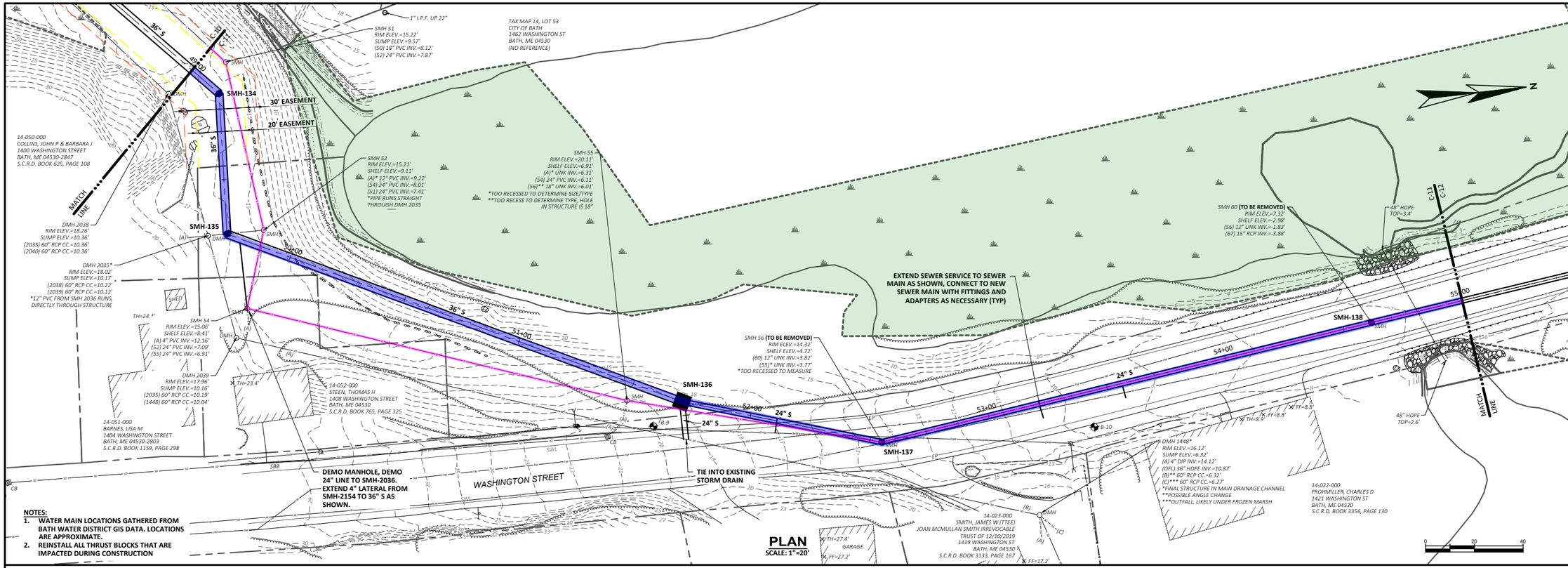
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 43+00 TO STA. 49+00

DRAWING
C-10

I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVIL\21119-CS-PLANANDPROFILEVIII.DWG | 21119-CS-PlanandProfileVIII | 12.5849 | --- | 11/15/2024 11:03:59 AM | DANIEL.METZ

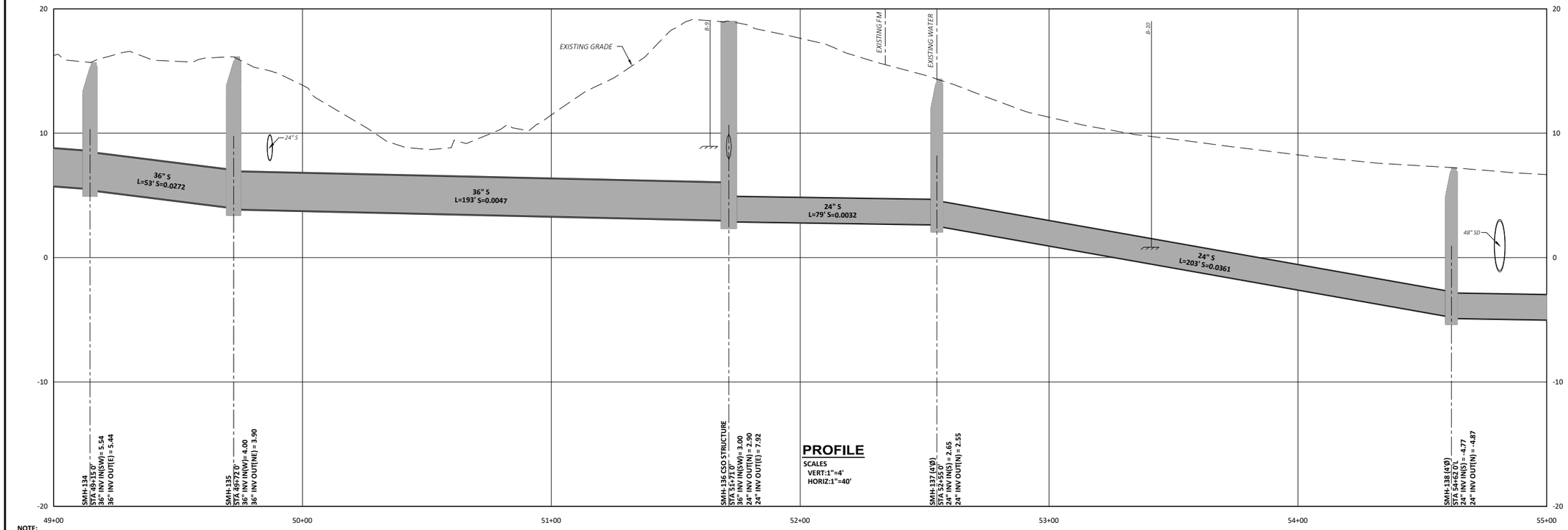
LAST SAVED BY: DANIEL.METZ 11/15/2024 8:44 AM



NOTES:

1. **WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.**
2. **REINSTALL ALL THRUST BLOCKS THAT ARE IMPACTED DURING CONSTRUCTION**

PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	DATE	REVISIONS	APP'D
1			
2			
3			
4			
5			
6			

PROJECT NO. 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD: D.METZ
CHECKED:
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

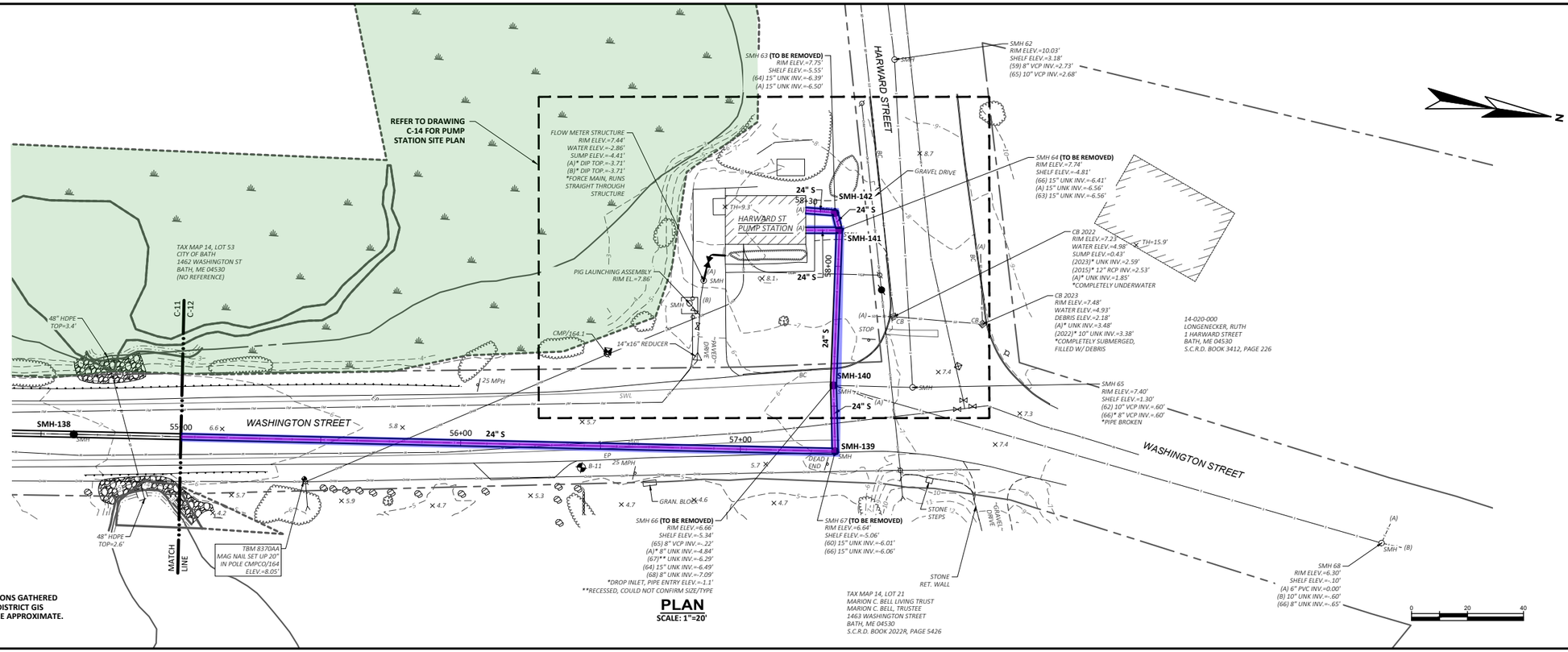
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 49+00 TO STA. 55+00

DRAWING
C-11

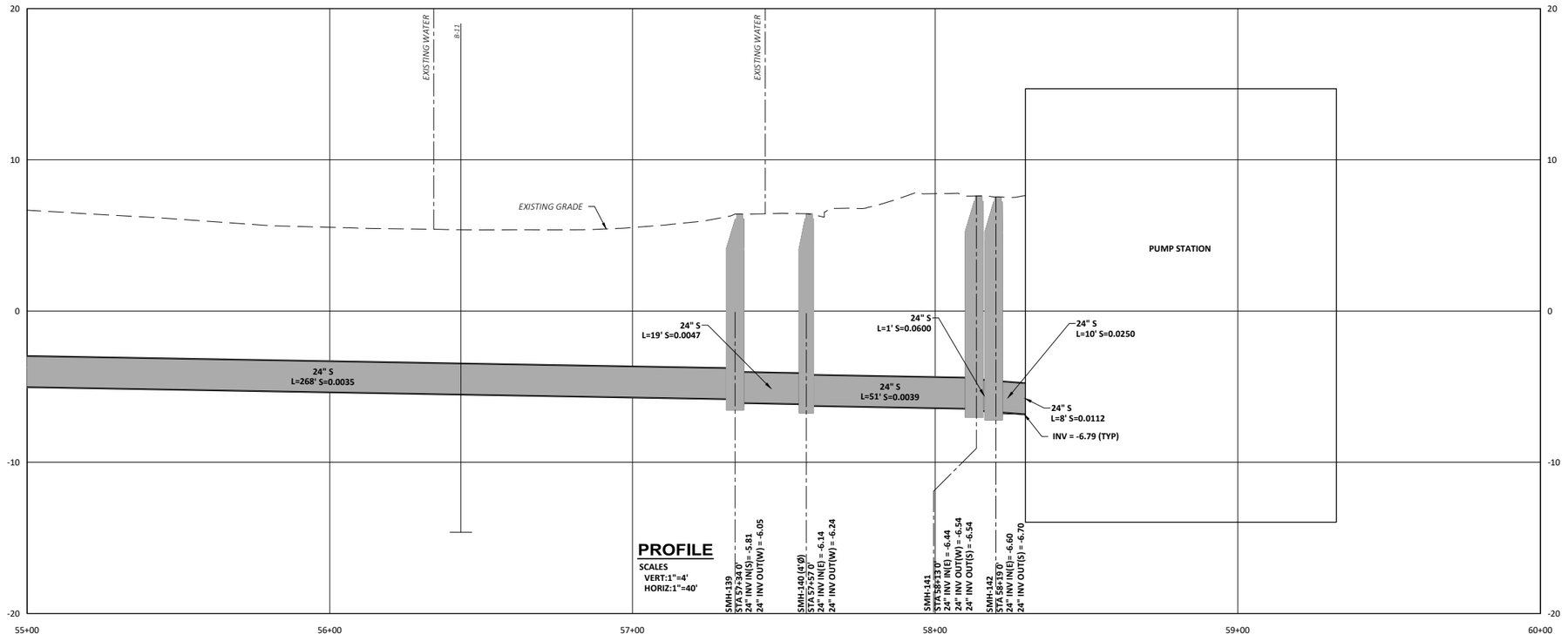
I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVIL\21119-CS-PLANANDPROFILEIX.DWG | 21119-CS-PlanandProfileIX | 1:2.5849 | --- | 11/15/2024 11:33:33 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/15/2024 10:16 AM



NOTE:
WATER MAIN LOCATIONS GATHERED FROM BATH WATER DISTRICT GIS DATA. LOCATIONS ARE APPROXIMATE.

PLAN
SCALE: 1"=20'



PROFILE
SCALES
VERT:1"=4'
HORIZ:1"=40'

NOTE:
ALL MANHOLES TO BE 5' DIAMETER UNLESS NOTED OTHERWISE.

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

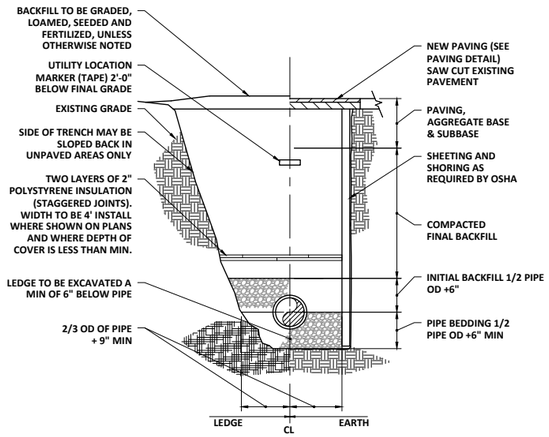
CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

PLAN AND PROFILE
STA. 55+00 TO END

DRAWING
C-12

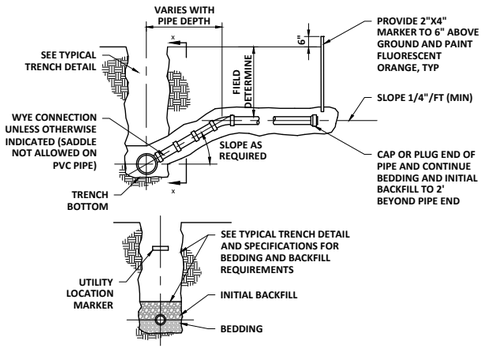
I:\ENGWE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIVIL\21119-CS-PLANANDPROFILEX.DWG | 21119-CS-PlanandProfilex | 1:2.5840 | ---- | 11/15/2024 11:04:59 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/14/2024 1:34 PM



NOTES:
1. ALL EXCAVATION MUST MEET OSHA STANDARDS.
2. INSTALL 3 FOOT LONG IMPERVIOUS MATERIAL DAM IN BEDDING/INITIAL BACKFILL MATERIAL EVERY 100' AND WHERE SHOWN ON PLANS TO PREVENT TRENCH GROUNDWATER FROM BEING CHANNELED ALONG BEDDING/INITIAL BACKFILL.
3. SEE SPECIFICATIONS FOR BEDDING AND BACKFILL REQUIREMENTS.
4. SEE SPECIFICATIONS FOR PAYMENT LIMITS ON UNIT PRICE WORK.

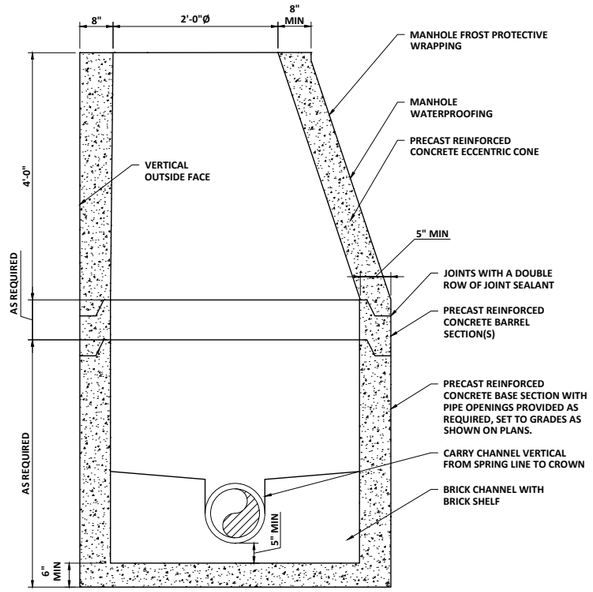
PIPE TRENCH
SCALE: "NTS"



SECTION X-X

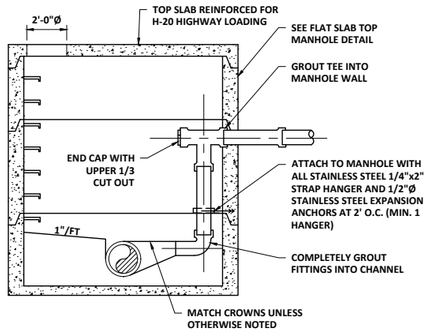
NOTES:
1. ALL SERVICE CONNECTIONS TO BE 6"Ø UNLESS OTHERWISE SHOWN ON THE PLANS.
2. USE CHIMNEY DETAIL WHERE SERVICE CONNECTION ENTERS SEWER AT GREATER THAN 60° TO THE HORIZONTAL.
3. EXTEND SERVICE 4'(MIN) BEYOND LIMIT OF SIDEWALK.

SEWER SERVICE CONNECTION
SCALE: "NTS"



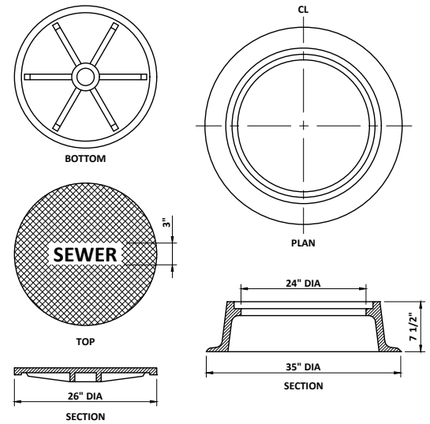
NOTES:
1. MANHOLE CHANNELS REQUIRING A CHANGE IN DIRECTION ARE TO BE BUILT ON A SMOOTH CURVE OF THE LONGEST POSSIBLE RADIUS. IF SIDE PIPES ENTER CHANNEL, SHAPE TO RECEIVE ADDED SIDE FLOW.
2. USE A FLAT SLAB TOP MANHOLE WHEN THE HEIGHT DIFFERENCE BETWEEN THE HIGHEST INVERT AND RIM IS LESS THAN 6'-0" AND WHEN MANHOLE DIAMETER IS GREATER THAN 4'-0".

TYPICAL 4-FT MANHOLE
SCALE: "NTS"

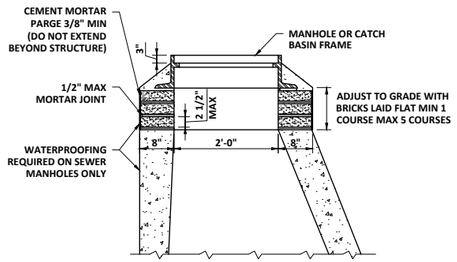


NOTE:
FOR MANHOLES WITH 8" TO 12"Ø DROP PIPE, USE 5'Ø OR AS INDICATED. FOR MANHOLES WITH TWO OR MORE DROP PIPES, USE 6'Ø, OR AS INDICATED.

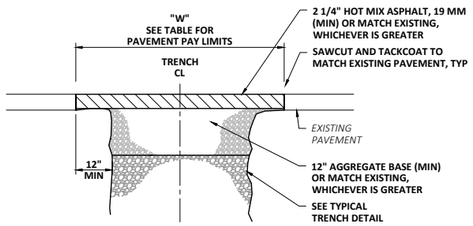
INSIDE DROP MANHOLE WITH PVC PIPE
SCALE: NTS



MANHOLE STANDARD COVER AND FRAME
SCALE: "NTS"



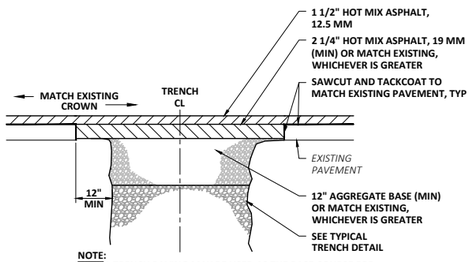
MANHOLE AND CATCH BASIN FRAME INSTALLATION
SCALE: NTS



PAVEMENT PAY LIMITS	
PIPE I.D.	"W" (FOR 0' - 10' DEEP)
< 6"	6'-0"
6" - 15"	7'-0"
16" - 21"	8'-0"

"W" SHALL BE INCREASED BY 1'-0" FOR TRENCHES 10' - 15', AND BY 2'-0" FOR TRENCHES 15' - 20' DEEP.

INITIAL TRENCH PAVING (WITH OVERLAY)
SCALE: NTS



NOTE:
INITIAL TRENCH PAVING MAY BE USED AS THE BASE COURSE FOR FINAL PAVING IF IN GOOD REPAIR.

FINAL TRENCH PAVING (WITH OVERLAY)
SCALE: NTS

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.WEBB
CAD:
CHECKED: D.METZ
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

DETAILS I

DRAWING
C-15

I:\ENGWE\BATH\21119-HARWARD\INFOSWMM-MODEL_DRAWINGS\CIV\21119-CS-DETAILS.DWG | 21119-CS-Detail | 12.5849 | --- | 11/15/2024 11:05:34 AM | DANIEL.METZ

LAST SAVED BY: DANIEL.METZ 11/14/2024 1:25 PM

EROSION AND SEDIMENTATION CONTROL NOTES

THIS PLAN HAS BEEN DEVELOPED AS A STRATEGY TO CONTROL SOIL EROSION AND SEDIMENTATION DURING AND AFTER CONSTRUCTION. THIS PLAN IS BASED ON THE STANDARDS AND SPECIFICATIONS FOR EROSION PREVENTION IN DEVELOPING AREAS IN ACCORDANCE WITH OCTOBER 2016 REVISION TO THE 2003 MAINE EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPS) MANUAL FOR DESIGNERS AND ENGINEERS, OR LATEST EDITION. EROSION CONTROL MIX SHALL BE AS SPECIFIED IN THIS CITATION, PAGE 40.

THE PROPOSED LOCATIONS OF SILTATION AND EROSION CONTROL STRUCTURES ARE SHOWN ON THE SITE PLAN.

1. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE DONE IN ACCORDANCE WITH 2016 REVISION TO THE 2003 MAINE EROSION AND SEDIMENT CONTROL FIELD GUIDE FOR CONTRACTORS, OR LATEST EDITION. ALL TEMPORARY MEASURES SHALL NOT BE REMOVED UNTIL SITE IS FULLY STABILIZED.
2. IN AREAS ADJACENT TO NATURAL RESOURCES, LOCATIONS TO BE VEGETATED IN THEIR FINISH CONDITION SHALL BE STABILIZED WITH MULCH WITHIN 7 DAYS OF MOST RECENT DISTURBANCE.
3. AREAS THAT WILL NOT RECEIVE FINAL GRADING FOR UP TO ONE YEAR SHALL BE STABILIZED WITH MULCH WITHIN 7 DAYS OF MOST RECENT DISTURBANCE.
4. THOSE AREAS UNDERGOING ACTUAL CONSTRUCTION WILL BE MAINTAINED IN AN UNTREATED OR UNVEGETATED CONDITION FOR THE MINIMUM TIME REQUIRED. IN GENERAL AREAS TO BE VEGETATED SHALL BE PERMANENTLY STABILIZED WITHIN 15 DAYS OF FINAL GRADING AND TEMPORARILY STABILIZED WITHIN 30 DAYS OF INITIAL DISTURBANCE OF THE SOIL.
5. SEDIMENT BARRIERS (SILT FENCE, STONE CHECK DAMS, ETC.) SHOULD BE INSTALLED PRIOR TO ANY SOIL DISTURBANCE OF UPGRADIENT DRAINAGE AREAS. SEDIMENT BARRIERS SHALL BE INSTALLED DOWNGRADIENT OF STOCKPILES, AND STORMWATER SHALL BE PREVENTED FROM RUNNING ONTO THE STOCKPILES. PLASTIC SHEETING OR OTHER MATERIAL, WOVEN OR NON-WOVEN GEOTEXTILE FABRIC, MAY BE USED TO COVER STOCKPILES.
6. INSTALL SILT FENCE AT TOE OF SLOPES TO FILTER SILT FROM RUNOFF. SEE SILT FENCE DETAIL FOR PROPER INSTALLATION. SILT FENCE WILL REMAIN IN PLACE PER NOTE #5.
7. ALL EROSION CONTROL STRUCTURES WILL BE INSPECTED, REPLACED AND/OR REPAIRED EVERY 7 DAYS AND IMMEDIATELY FOLLOWING ANY SIGNIFICANT RAINFALL OR SNOW MELT OR WHEN NO LONGER SERVICEABLE DUE TO SEDIMENT ACCUMULATION OR DECOMPOSURE. IF REPAIRS ARE IDENTIFIED, THEY SHALL BEGIN NO LATER THAN THE END OF THE FOLLOWING WORK DAY AND BE COMPLETE WITHIN 7 DAYS FROM INSPECTION. SEDIMENT DEPOSITS MUST BE REMOVED WHEN THEY REACH APPROXIMATELY ONE HALF THE HEIGHT OF THE BARRIER. SEDIMENT CONTROL DEVICES SHALL REMAIN IN PLACE AND BE MAINTAINED BY THE CONTRACTOR UNTIL AREAS UPSLOPE ARE PERMANENTLY STABILIZED.
8. NO SLOPES, EITHER PERMANENT OR TEMPORARY, SHALL BE STEEPER THAN TWO HORIZONTAL TO ONE VERTICAL (2 TO 1) UNLESS STABILIZED WITH RIPRAP OR OTHER STRUCTURAL MEANS. NO SLOPES IN EXCESS OF 1.5H:1V SHALL BE ALLOWED UNLESS STAMPED BY A PROFESSIONAL ENGINEER.
9. IF FINAL SEEDING AND SODDING IS NOT EXPECTED PRIOR TO THE ANTICIPATED DATE OF THE FIRST KILLING FROST, USE TEMPORARY ANNUAL RYEGRASS SEEDING AND MULCHING ON ROUGH GRADED SUBSOIL TO PROTECT THE SITE AND DELAY PERMANENT LOAMING, FINE GRADING, AND SEEDING OR SODDING UNTIL SPRING.
10. WHEN FEASIBLE, TEMPORARY SEEDING OF DISTURBED AREAS THAT HAVE NOT BEEN FINISH GRADED SHALL BE COMPLETED 30 DAYS PRIOR TO THE FIRST KILLING FROST.
11. DURING THE CONSTRUCTION PHASE, INTERCEPTED SEDIMENT WILL BE RETURNED TO THE SITE AND REGRADED ONTO OPEN AREAS. POST SEEDING SEDIMENT, IF ANY, WILL BE DISPOSED OF IN AN ACCEPTABLE MANNER.
12. REVEGETATION MEASURES WILL COMMENCE UPON COMPLETION OF CONSTRUCTION EXCEPT AS NOTED ABOVE. ALL DISTURBED AREAS NOT OTHERWISE STABILIZED WILL BE GRADED, SMOOTHED, AND REVEGETATED.
13. ALL TEMPORARY EROSION CONTROL MEASURES SHALL BE REMOVED ONCE THE SITE IS STABILIZED.
14. EXCAVATION AND EARTHWORK SHALL BE DONE SUCH THAT NO MORE THAN 1 ACRE OF THE SITE IS WITHOUT STABILIZATION AT ANY ONE TIME.
15. EXPOSED AREA SHOULD BE LIMITED SUCH THAT THE AREA CAN BE MULCHED IN ONE DAY PRIOR TO ANY SNOW EVENT.
16. STABILIZATION SCHEDULE BEFORE WINTER:

SEPTEMBER 1:	ALL SLOPES GREATER THAN 15% MUST BE SEEDED AND MULCHED. ALL GRASS-LINED DITCHES AND CHANNELS MUST BE CONSTRUCTED AND STABILIZED.
SEPTEMBER 15	ALL DISTURBED AREAS MUST BE SEEDED AND MULCHED. ALL SLOPES MUST BE STABILIZED, SEEDED AND MULCHED. SLOPES 3:1 OR GREATER TO BE STABILIZED WITH EROSION CONTROL MATTING AND SEEDED. ALL DISTURBED AREAS TO BE PROTECTED WITH AN ANNUAL GRASS MUST BE SEEDED AT A SEEDING RATE OF 3 POUNDS PER 1,000 SQUARE FEET AND MULCHED.
OCTOBER 1	ALL DISTURBED AREAS TO BE PROTECTED WITH WINTER RYE MUST BE APPLIED AT A RATE OF 3LB PER 1000 SQUARE FEET, AND WITH HAY APPLIED AT A RATE OF 75LB PER 1000 SQUARE FEET OR WITH AN EROSION CONTROL BLANKET.
OCTOBER 15:	SOIL MUST BE SEEDED WITH WINTER RYE AND PROTECTED WITH EROSION CONTROL BLANKET IF NOT YET STABILIZED.
NOVEMBER 1:	AREA SHOULD BE STABILIZED IF RYE HAS NOT GROWN THREE INCHES AND DOES NOT HAVE 75% COVERAGE.
NOVEMBER 15	ALL STONE-LINED DITCHES AND CHANNELS MUST BE CONSTRUCTED AND STABILIZED. SLOPES THAT ARE COVERED WITH RIPRAP MUST BE CONSTRUCTED BY THAT DATE.
DECEMBER 1	ALL DISTURBED AREAS WHERE THE GROWTH OF VEGETATION FAILS TO BE AT LEAST THREE INCHES TALL OR AT LEAST 75% OF THE DISTURBED SOIL IS COVERED BY VEGETATION, MUST BE PROTECTED FOR OVER-WINTER.

17. MULCH MAY REQUIRE ANCHORING TO ENSURE THAT MULCH REMAINS IN-PLACE. MULCH NETTING, CRIMPING, OR PUNCHING ARE ACCEPTABLE METHODS. MULCH NETTING SHALL BE TENAX RADIX EROSION CONTROL NETS OR APPROVED EQUAL, AND SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER REQUIREMENTS.
18. SPILL PREVENTION: CONTROLS MUST BE USED TO PREVENT POLLUTANTS FROM BEING DISCHARGED FROM MATERIALS AND EQUIPMENT ON-SITE, INCLUDING STORAGE PRACTICES TO MINIMIZE EXPOSURE OF THE MATERIALS TO STORMWATER, AND APPROPRIATE SPILL PREVENTION, CONTAINMENT, AND RESPONSE PLANNING AND IMPLEMENTATION.
19. GROUNDWATER PROTECTION: DURING CONSTRUCTION, LIQUID PETROLEUM PRODUCTS AND OTHER HAZARDOUS MATERIALS WITH THE POTENTIAL TO CONTAMINATE GROUNDWATER MAY NOT BE STORED OR HANDLED IN AREAS OF THE SITE DRAINING TO AN INFILTRATION AREA. AN "INFILTRATION AREA" IS ANY AREA OF THE SITE THAT BY DESIGN OR AS A RESULT OF SOILS, TOPOGRAPHY AND OTHER RELEVANT FACTORS, ACCUMULATES RUNOFF THAT INFILTRATES INTO THE SOIL. DIKES, BERMS, SUMPS, AND OTHER FORMS OF SECONDARY CONTAINMENT THAT PREVENT DISCHARGE TO GROUNDWATER MAY BE USED TO ISOLATE PORTIONS OF THE SITE FOR THE PURPOSES OF STORAGE AND HANDLING OF THESE MATERIALS.
20. MINIMIZE THE EXPOSURE OF CONSTRUCTION DEBRIS, BUILDING AND LANDSCAPING MATERIALS, TRASH, FERTILIZERS, PESTICIDES, HERBICIDES, DETERGENTS, SANITARY WASTE AND OTHER MATERIALS TO PRECIPITATION AND STORMWATER RUNOFF. THESE MATERIALS MUST BE PREVENTED FROM BECOMING A POLLUTANT SOURCE.
21. EXCAVATION DE-WATERING IS THE REMOVAL OF WATER FROM TRENCHES, FOUNDATIONS, COFFER DAMS, PONDS, AND OTHER AREAS WITHIN THE CONSTRUCTION AREA THAT RETAIN WATER AFTER EXCAVATION. IN MOST CASES THE COLLECTED WATER IS HEAVILY SILTED AND HINDERS CORRECT AND SAFE CONSTRUCTION PRACTICES. THE COLLECTED WATER REMOVED FROM THE PONDED AREA, EITHER THROUGH GRAVITY OR PUMPING, MUST BE SPREAD THROUGH NATURAL WOODED BUFFERS OR REMOVED TO AREAS THAT ARE SPECIFICALLY DESIGNED TO COLLECT THE MAXIMUM AMOUNT OF SEDIMENT POSSIBLE, LIKE A COFFERDAM SEDIMENTATION BASIN. AVOID ALLOWING THE WATER TO FLOW OVER DISTURBED AREAS OF THE SITE. EQUIVALENT MEASURES MAY BE TAKEN IF APPROVED BY THE DEPARTMENT.
22. AUTHORIZED NON-STORMWATER DISCHARGES: IDENTIFY AND PREVENT CONTAMINATION BY NON-STORMWATER DISCHARGES. WHERE ALLOWED NON-STORMWATER DISCHARGES EXIST, THEY MUST BE IDENTIFIED AND STEPS SHOULD BE TAKEN TO ENSURE THE IMPLEMENTATION OF APPOPRIATE POLLUTION PREVENTION MEASURES FOR THE NON-STORMWATER COMPONENT(S) OF THE DISCHARGE. AUTHORIZED NON-STORMWATER DISCHARGES ARE:
    - A. DISCHARGES FROM FIREFIGHTING ACTIVITY;
    - B. FIRE HYDRANT FLUSHINGS;
    - C. VEHICLE WASHWATER IF DETERGENTS ARE NOT USED AND WASHING IS LIMITED TO THE EXTERIOR OF VEHICLES (ENGINE, UNDERCARRIAGE AND TRANSMISSION WASHING IS PROHIBITED);
    - D. DUST CONTROL RUNOFF IN ACCORDANCE WITH SPECIFICATIONS AND ANY APPLICABLE PERMIT CONDITIONS;
    - E. ROUTINE EXTERNAL BUILDING WASHDOWN, NOT INCLUDING SURFACE PAINT REMOVAL, THAT DOES NOT INVOLVE DETERGENTS;
    - F. PAVEMENT WASHWATER (WHERE SPILLS/LEAKS OF TOXIC OR HAZARDOUS MATERIALS HAVE NOT OCCURRED, UNLESS ALL SPILLED MATERIAL HAD BEEN REMOVED) IF DETERGENTS ARE NOT USED;
    - G. UNCONTAMINATED AIR CONDITIONING OR COMPRESSOR CONDENSATE;
    - H. UNCONTAMINATED GROUNDWATER OR SPRING WATER;
    - I. FOUNDATION OR FOOTER DRAIN-WATER WHERE FLOWS ARE NOT CONTAMINATED;
    - J. UNCONTAMINATED EXCAVATION DEWATERING;
    - K. POTABLE WATER SOURCES INCLUDING WATERLINE FLUSHINGS; AND
    - L. LANDSCAPE IRRIGATION.
24. UNAUTHORIZED NON-STORMWATER DISCHARGES: THE MAINEDEP'S APPROVAL UNDER THIS CHAPTER DOES NOT AUTHORIZE A DISCHARGE THAT IS MIXED WITH A SOURCE OF NON-STORMWATER, OTHER THAN THOSE DISCHARGES IN COMPLIANCE WITH APPENDIX C (6). SPECIFICALLY, THE DEPARTMENT'S APPROVAL DOES NOT AUTHORIZE DISCHARGES OF THE FOLLOWING:
    - A. WASTEWATER FROM THE WASHOUT OR CLEANOUT OF CONCRETE, STUCCO, PAINT, FORM RELEASE OILS, CURING COMPOUNDS OR OTHER CONSTRUCTION MATERIALS;
    - B. FUELS, OILS OR OTHER POLLUTANTS USED IN VEHICLE AND EQUIPMENT OPERATION AND MAINTENANCE;
    - C. SOAPS, SOLVENTS, OR DETERGENTS USED IN VEHICLE AND EQUIPMENT WASHING; AND
    - D. TOXIC OR HAZARDOUS SUBSTANCES FROM A SPILL OR OTHER RELEASE.

EROSION CONTROL - WINTER CONSTRUCTION

1. WINTER CONSTRUCTION PERIOD DEFINED: NOVEMBER 1 THROUGH APRIL 15.
2. CONTINUATION OF EARTHWORK OPERATIONS ON ADDITIONAL AREAS SHALL NOT BEGIN UNTIL THE EXPOSED SOIL SURFACE ON THE AREA BEING WORKED HAS BEEN STABILIZED SUCH THAT NO LARGER AREA OF THE SITE IS WITHOUT EROSION CONTROL PROTECTION AS LISTED IN ITEM 2 ABOVE.
3. AN AREA SHALL BE CONSIDERED TO HAVE BEEN STABILIZED WHEN EXPOSED SURFACES HAVE BEEN EITHER MULCHED WITH STRAW AT A RATE OF 100 LB. PER 1,000 SQUARE FEET (WITH OR WITHOUT SEEDING) OR DORMANT SEEDED, MULCHED AND ADEQUATELY ANCHORED BY AN APPROVED ANCHORING TECHNIQUE. IN ALL CASES, MULCH SHALL BE APPLIED SUCH THAT SOIL SURFACE IS NOT VISIBLE THROUGH THE MULCH. OVERWINTER HAY MULCH SHOULD BE APPLIED AT A RATE OF 150 LB. PER 1,000 SQUARE FEET. MULCH SHOULD BE ANCHORED WITH NETTING OR TACKIFIER TO PREVENT MOVEMENT BEFORE FREEZING.
4. BETWEEN THE DATES OF OCTOBER 15 AND APRIL 1ST, LOAM OR SEED WILL NOT BE REQUIRED. DURING PERIODS OF ABOVE-FREEZING TEMPERATURES, THE SLOPES SHALL BE FINE GRADED AND EITHER PROTECTED WITH MULCH OR TEMPORARILY SEEDED AND MULCHED UNTIL SUCH TIME AS THE FINAL TREATMENT CAN BE APPLIED. IF THE DATE IS AFTER NOVEMBER 1ST AND IF THE EXPOSED AREA HAS BEEN LOAMED, FINAL GRADED AND IS SMOOTH, THEN THE AREA MUST BE STABILIZED WITH MULCH. IF CONSTRUCTION CONTINUES DURING FREEZING WEATHER, ALL EXPOSED AREAS SHALL BE GRADED BEFORE FREEZING AND THE SURFACE TEMPORARILY PROTECTED FROM EROSION BY THE APPLICATION OF MULCH. SLOPES SHALL NOT BE LEFT EXPOSED OVER THE WINTER OR ANY OTHER EXTENDED TIME OF WORK SUSPENSION UNLESS TREATED IN THE ABOVE MANNER. UNTIL SUCH TIME AS WEATHER CONDITIONS ALLOW DITCHES TO BE FINISHED WITH THE PERMANENT SURFACE TREATMENT, EROSION SHALL BE CONTROLLED BY THE INSTALLATION OF BALES OF HAY OR STONE CHECK DAMS IN ACCORDANCE WITH THE STANDARD DETAILS.
5. THE APPLICATION OF MULCH TO FINE GRADED AREAS WILL BE STABILIZED AS FOLLOWS:
    - A. BETWEEN THE DATES OF NOVEMBER 1ST AND APRIL 15TH ALL MULCH SHALL BE ANCHORED BY EITHER PEG LINE, MULCH NETTING, ASPHALT EMULSION, CHEMICAL TACK OR WOOD CELLULOSE FIBER.
    - B. MULCH NETTING SHALL BE USED TO ANCHOR MULCH IN ALL DRAINAGE WAYS WITH A SLOPE GREATER THAN 3% FOR SLOPES EXPOSED TO DIRECT WINDS AND FOR ALL OTHER SLOPES GRATER THAN 8%. THIS SHALL BE IN ADDITION TO EROSION CONTROL MATTING-DITCHES DETAIL.
    - C. MULCH NETTING SHALL BE USED TO ANCHOR MULCH IN ALL AREAS WITH SLOPES GREATER THAN 15%. AFTER OCTOBER 1ST, THE SAME APPLIES FOR ALL SLOPES GREATER THAN 8%.
6. AFTER NOVEMBER 1ST THE CONTRACTOR SHALL APPLY MULCH AND ANCHORING ON ALL BARE EARTH AT THE END OF EACH WORKING DAY.
7. DURING WINTER CONSTRUCTION PERIODS ALL SNOW SHALL BE REMOVED FROM AREAS OF MULCHING PRIOR TO PLACEMENT.
8. THE INSPECTION FREQUENCY FOR AREAS BEING WORKED ON DURING WINTER CONSTRUCTION SHALL BE AFTER EACH RAINFALL, SNOWSTORM, OR THAWING, AND AT LEAST ONCE A WEEK.
    - A. CONTRACTOR SHALL NOT BE REQUIRED TO INSPECT AREAS OF THE SITE THAT ARE NOT VISIBLE DUE TO SNOW IF THOSE AREAS ARE NOT BEING ACTIVELY CONSTRUCTED, HAVE BEEN INSPECTED AND PROPERLY REPAIRED PRIOR TO THE SNOW EVENT.

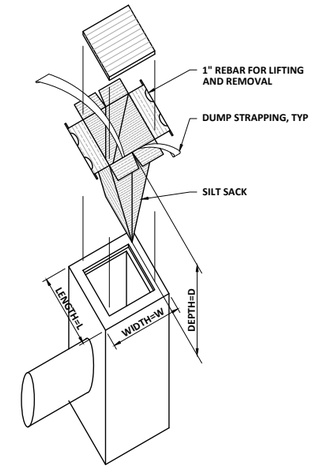
EROSION CONTROL - WETLAND NOTES

1. WETLANDS AND SURFACE WATERS (EXCEPTING THOSE WHICH ARE TO BE FILLED IN ACCORDANCE WITH STATE AND FEDERAL REGULATIONS) WILL BE PROTECTED WITH SILT FENCE INSTALLED AT THE EDGE OF THE WETLAND OR THE BOUNDARY OF WETLAND DISTURBANCE.
2. IF THE WORK INCLUDES CROSSING OF WETLANDS AND/OR STREAMS, THE CONTRACTOR SHALL TAKE SPECIAL PRECAUTIONS WORKING IN THESE AREAS.
3. ANY WETLAND CROSSING WORK SHALL BE COMPLETED BETWEEN THE PERIOD OF MAY 1 AND SEPTEMBER 30.
4. ALL EROSION CONTROL MEASURES SHALL BE IN PLACE PRIOR TO COMMENCING CONSTRUCTION WITHIN OR ADJACENT TO WETLAND AREAS. ALL TEMPORARY MEASURES SHALL NOT BE REMOVED UNTIL SITE IS FULLY STABILIZED.
5. WETLAND VEGETATIVE LAYERS SHALL BE REMOVED AND SALVAGED FOR RESTORATION OF THE DISTURBED AREAS.
6. STORAGE AREAS FOR WETLAND MATERIALS SHALL BE PROPERLY PROTECTED AGAINST EROSION.
7. SEEDING OF THE DISTURBED AREAS WITHIN WETLAND AREAS SHALL UTILIZE MIXTURES APPROPRIATE FOR WETLAND AREAS AS OUTLINED IN THE SPECIFICATIONS.

INSPECTIONS

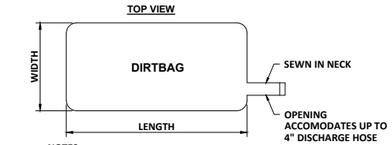
REGULAR INSPECTIONS OF ALL EROSION AND SEDIMENTATION CONTROLS SHALL BE MADE AT LEAST WEEKLY AND PRIOR TO AND FOLLOWING STORM EVENTS. MINIMUM INSPECTIONS SHALL BE MADE AS LISTED IN THE TABLE BELOW. SEE INSPECTIONS, MAINTENANCE AND HOUSEKEEPING PLAN FOR ADDITIONAL INFORMATION.

INSPECTED ITEM	EXAMPLE REPAIR INDICATORS
MULCHED SURFACES	THIN MULCH OR INADEQUATE APPLICATION. WIND MOVEMENT
SEEDED SURFACES	POOR SEED GERMINATION. LOSS OF MULCH. DEVELOPMENT OF RIVULETS.
SEDIMENT BARRIER	SEDIMENT BUILD-UP TO ONE HALF THE HEIGHT OF THE BARRIER. UNDERMINING OF THE BARRIER. SUPPORTING STAKES LOOSE, TOPPLED OR UNMARKED. BREAKS IN BARRIER.
PERIMETER DIVERSION	DISCHARGE IS TO STABILIZED AREA. EROSION OR BREAKS IN BARRIER. SUPPORTING STAKES LOOSE, TOPPLED OR UNMARKED.
CATCH BASIN PROTECTION	SEDIMENT BUILD-UP AND STRUCTURE BLOCKAGES. SLOW FLOW/PONDING WATER. BREAKS IN FABRIC OR VOIDS IN BARRIER.
DEWATERING FILTER	BREAKS IN FABRIC OR SUPPORTING STRUCTURE. SLOW FLOW, INDICATING HIGH SEDIMENT BUILD-UP.
CONSTRUCTION ENTRANCE	SEDIMENTATION OF ROADWAYS. OFF-SITE DUST COMPLAINTS.
STOCKPILE	BALLOONING OR BLOWOUTS, RUNOFF AND EROSION

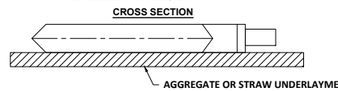


NOTE:
INSTALL SILT SACK PER MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS. EMPTY OR REMOVE SEDIMENT FROM SILT SACK WHEN RESTRAINT CORD IS NO LONGER VISIBLE. CLEAN, RINSE, AND REPLACE AS NEEDED.

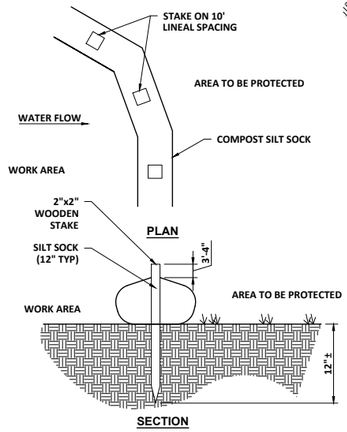
SILT SACK CATCH BASIN INLET
SCALE: NTS



NOTES:
1. DIRTBAG TO BE PLACED ON AGGREGATE OR STRAW.
2. SEAMS MUST BE HIGH STRENGTH DOUBLE STITCHED "J" SEAMS.
3. SEAM MUST BE TESTED UNDER ASTM D-4884. ACF TEST RESULTS AVAILABLE UPON REQUEST.

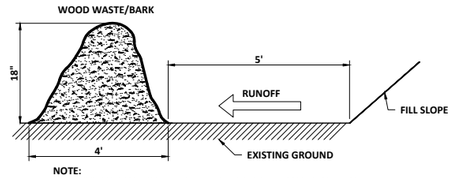


DIRT BAG
SCALE: "NTS"



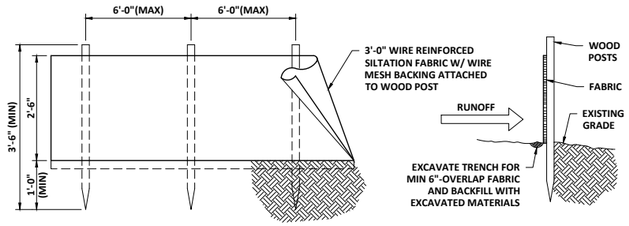
NOTES:
1. ALL MATERIAL TO MEET SPECIFICATIONS
2. SILT SOCK COMPOST/SOIL/ROCK/SEED FILL TO MEET APPLICATION REQUIREMENTS
3. SILT SOCK DEPICTED IS FOR MINIMUM SLOPES. GREATER SLOPES MAY REQUIRE LARGER SOCKS PER THE ENGINEER
4. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY ENGINEER.

COMPOST SILT SOCK
SCALE: NTS

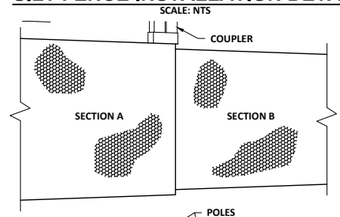


NOTE:
1. EROSION CONTROL MIX SHALL BE AS SPECIFIED ON PAGE 45 OF THE OCTOBER 2016 REVISION TO THE 2003 MAINE EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES (BMPS) MANUAL FOR DESIGNERS AND ENGINEERS, OR LATEST EDITION.

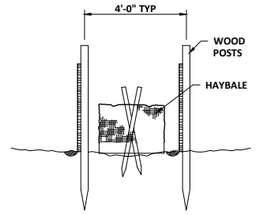
EROSION CONTROL MIX BERM
SCALE: "NTS"



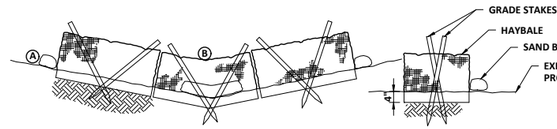
SILT FENCE INSTALLATION DETAIL
SCALE: NTS



JOINING SILT FENCE SECTIONS
SCALE: "NTS"



COMBINATION SILT FENCE AND HAY BALE BARRIER
SCALE: NTS



EROSION CHECK TO BE BALES OF HAY SECURED TO THE GROUND WITH TWO 4' LONG GRADE STAKES FOR EACH BALE. SAND BAG AS REQUIRED, PLACE SUFFICIENT BALES TO ESTABLISH ELEVATIONS AT (A) AT LEAST 6 INCHES ABOVE OVERFLOW AT (B)

HAY BALE CHECK DAM
SCALE: "NTS"

NO	REVISIONS	APP'D	DATE
1			
2			
3			
4			
5			
6			

PROJECT NO: 21119
DESIGNED: A.GRAHAM
CAD COORD: A.NESBIT
CAD: D.METZ
CHECKED:
DATE:
APPROVED:
DATE:
SUBMISSION: 30% DESIGN REVIEW

WRIGHT-PIERCE
207.725.8721 | www.wright-pierce.com
11 BOWDOIN MILL ISLAND, SUITE 140, TOPSHAM, ME 04086

CITY OF BATH, MAINE
HARWARD STREET PUMP STATION
AND SEWER INTERCEPTOR UPGRADES

EROSION CONTROL NOTES AND DETAILS

DRAWING
C-17

J:\ENG\WE\BATH\21119-HARWARDINFOSWMM-MODEL_DRAWINGS\CIV\21119-CS-EROSIONCONTROLNOTESANDDETAILS.DWG | 21119-CS-ErosionControlNotesandDetails | 12.5849 | --- | 11/15/2024 11:05:44 AM | DANIEL.METZ

Work-Start Notification Form

File Number: NAE-2024-01752 State: Maine County: Sagadahoc

Permittee: City of Bath, Mr. Chris Wallace
Date Verification Issued: 4/14/2025
Project Manager: Amanda Sayles

At least two weeks prior to commencing the activity authorized by this permit, sign this certification and return it to the following address:

US ARMY CORPS OF ENGINEERS
New England District
Attn: Amanda Sayles
442 Civic Center Drive
Augusta, Maine 04330
or
Amanda.L.Sayles@usace.army.mil
(978) 318-8486

Please note that your permitted activity is subject to a compliance inspection by a U. S. Army Corps of Engineers (USACE) representative. Failure to comply with any terms or conditions of this authorization may result in the USACE suspending, modifying or revoking the authorization and/or issuing a Class I administrative penalty, or initiating other appropriate legal action.

The people (e.g. contractor) listed below will do the work, and they understand the permit's conditions and limitations.

Contractor Name/Contractor Firm: _____
Business Address: _____
_____
Contractor Phone and Email: _____

Proposed Construction Dates: Start: _____ Finish: _____

_____ _____
Signature of Permittee Date

U.S. Army Corps of Engineers (USACE)

CERTIFICATION OF COMPLIANCE WITH DEPARTMENT OF THE ARMY PERMIT

For use of this form, see Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act of 1899, and Section 103 of the Marine Protection, Research, and Sanctuaries Act; the proponent agency is CECW-COR.

Form Approved - OMB No. 0710-0003 Expires 2027-10-31

The Agency Disclosure Notice (ADN)

The Public reporting burden for this collection of information, 0710-0003, is estimated to average 10 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or burden reduction suggestions to the Department of Defense, Washington Headquarters Services, at whs.mc-alex.esd.mbx.dd-dod-information-collections@mail.mil. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PURPOSE: This form is used by recipients of U.S. Army Corps of Engineer Regulatory permits to certify compliance with the permit terms and conditions.

Your permitted activity is subject to a compliance inspection by a U.S. Army Corps of Engineers representative. If you fail to comply with this permit, you are subject to permit suspension, modification, or revocation.

Upon completion of the activity authorized by this permit and any mitigation required by the permit, sign this certification and return it to the U.S. Army Corps of Engineers, New England District, Regulatory Office.

The certification can be submitted by email at Amanda.L.Sayles @usace.army.mil or by mail at the below address:

U.S. Army Corps of Engineers
New England District Office
Street Address: 442 Civic Center Drive
City: Augusta State: Maine Zip Code: 04330

COMPLETED BY THE CORPS

Corps Action Number: NAE-2024-01752

Permit Type: General Permit

General Permit Number and Name (*if applicable*):

Name of Permittee: Mr. Chris Wallace

Project Name: City of Bath Sewer Updates

Project Location (*physical address*): Harward Street to Office Drive
Bath, Maine

PERMITTEE'S CERTIFICATION

Date Work Started:

Date Work Completed:

Enclose photographs showing the completed project (*if available*).

I _____ hereby certify that the work authorized by the above referenced permit has been completed in accordance with all of the permit terms and conditions, and that any required compensatory mitigation has been completed in accordance with the permit conditions.

Name	Date	Signature

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

UNDERGROUND PIPE CROSSING LICENSE

This **License**, made in duplicate this 24th day of June, 2024 by and between the STATE OF MAINE, DEPARTMENT OF TRANSPORTATION (hereinafter called **Department**) and CITY OF BATH, Maine (hereinafter called "**Licensee**").

WITNESSETH:

WHEREAS, **Licensee** herein acknowledges that the term **Department**, wherever used in this License shall include not only the Maine Department of Transportation, but also any OPERATOR licensed by the Department of Transportation to provide rail service over the **Department's** Rockland Branch rail line, which currently is Midcoast Railservice, Inc. (MCRI); and,

WHEREAS, **Licensee** desires to construct, maintain and use three 36-inch diameter sewer pipes and three 18-inch storm drains located under the property and tracks of **Department** (hereinafter called "Construction"), such Construction to conform to the location and data shown on the attached hereto and designated as Exhibit "A," it is mutually agreed as follows:

1. Permit for Underground Crossings

Department hereby permits **Licensee** to construct, maintain and use three 36-inch sewer pipes and three 18-inch storm drains located at GPS 43.923103 N, -69.821107 W (railroad milepost 37.02) under the property and tracks of **Department**, shown on Exhibit A and located in the City of Bath.

2. Specifications

(a) **Licensee** shall, at its sole expense, at all times during the term of this License, maintain the Construction in accordance with the design indicated on the aforesaid approved plan.

(b) If any particular specifications conflict with any statutes or with any order, rules, or regulations of any competent public authority having jurisdiction in the matter, then such statutes, orders, rules, or regulations shall prevail, but in all remaining specifications shall govern.

3. Maintenance

(a) Should emergency work be necessary, **Licensee** shall make every effort to notify **Department** that such work is to be done.

(b) If **Licensee** shall fail to properly maintain its Construction or if the Construction interferes with drainage or other uses of **Department**'s property, then **Department** may order changes in the Construction at **Licensee**'s expense or may (but shall have no obligation to do so) make such repairs to the Construction of **Licensee** as may be immediately necessary for the safety of trains and property of **Department**. **Department** shall promptly notify **Licensee** of the making of such repairs. **Department** shall not incur any liability as a result of performing such repairs and the provisions of Paragraph 6 shall apply.

(c) **Licensee** agrees to pay to **Department** the cost of such repairs on or before the fifteenth day of the month next succeeding that in which a bill therefore is rendered.

4. Use

Licensee shall use the Construction solely for municipal purposes and shall make no change in the Construction without first obtaining, in writing, the approval of **Department**. **Licensee** shall be solely responsible for acquiring and complying with federal, state or local permits required for its intended use.

5. Protection of Other Utilities

Licensee shall protect the power, communication, signal and other utility lines on, over, or under the property of **Department** from damage of any kind by or because of the Construction, maintenance, or use of said Construction, and shall construct, maintain and use said Construction in such a manner as will not damage or injuriously affect the use of power, communication, signal or other utility uses of **Department** or other companies which may have under contract the right to maintain such utilities on the property of **Department**.

6. Liability and Risk

(a) **Licensee** and **Department** agree that all cost or expense resulting from any and all loss of life or property, or injury or damage to the person or property of any person, firm or corporation (including the parties hereto and their respective officers, agents and employees), and any and all claims, demands or actions for such loss, injury or damage, caused by or growing out of the presence or use, or the Construction, maintenance, renewal, change, relocation or removal of the Construction, shall be borne by **Licensee**.

(b) **Licensee** assumes all risk of loss or damage to **Licensee's** property, inclusive of free or unused materials, supplies and equipment, however caused, resulting directly or indirectly, by reason of the installation, maintenance, use, existence or removal of the Construction, and hereby

releases **Department** from any and all liability on account of such loss or damage caused by **Licensee**.

7. Changes or Relocation

Licensee shall, at its sole expense, within 30 days after receipt of written notice from **Department**, make such changes in the Construction, including relocation, as may be required by **Department**, if such changes or relocation shall, in the judgment of **Department**, be needed for the better development, or use of the property of **Department**, of if such changes or relocation shall, in the judgment of **Department**, be needed to protect its requirements, or contractual obligations, or if such change or relocation is required, directly or indirectly by statute or by any order of any competent public authority having jurisdiction in the matter. Provided, however, that the term "contractual obligation" used in this paragraph shall not be construed as including obligations similar hereto, entered into subsequent to the date hereof.

8. Discontinuance

Licensee shall, at its sole expense, upon termination of this License, or upon the abandonment or discontinuance of use of the Construction, promptly remove its property from the premises of **Department** and restore such premises disturbed by the Construction to a condition satisfactory to **Department**.

9. Cost of Changes

If **Licensee** fails to change or relocate the Construction within five days after the expiration of notice given as provided in Paragraph 7, or remove its property as provided in Paragraph 8, **Department** may, without further notice, in case of abandonment, remove, and in case of necessary alteration, change or relocate the Construction and render bills for the cost of such removal, change or relocation to **Licensee** which bills **Licensee** agrees to pay on or before the fifteenth of the month next succeeding that in which such bill is rendered.

10. Waiver

It is expressly understood and agreed that any waiver on the part of **Department** of any term, provision or covenant of this License shall not constitute a precedent, nor bind **Department** to a waiver of any similar or succeeding breach of same or any other terms, provisions or covenants of this License.

11. Execution Official Act Only

(a) The individuals executing this License on behalf of **Department** do so only in their official capacity and none of the covenants herein contained are to be held or construed as their individual acts or acts for which they may be individually liable in any way. In exercising the rights granted hereunder, **Licensee** shall not be deemed to be acting as an officer, agent, or employee of the State of Maine.

(b) No warranty of title to any property is given hereunder, and the permission herein given to **Licensee** is subject to all encumbrances, conditions and reservations upon or under which **Department** holds its property. The rights of **Licensee** are limited solely to the License herein granted and **Licensee** shall not acquire by virtue of this License or otherwise any easement or other greater interest in the property of **Department**.

12. Insurance

Licensee shall carry insurance coverage in an amount not less than $1,000,000.00 for both personal injury and property damage occurring as a result of Licensee's activities and presence on, and its use, alteration and occupation of any of the Department's property. This coverage shall apply to any and all claims or causes of action resulting in death, bodily injury or property damage and shall be applicable to all such claims brought by any person or arising out of any single occurrence or in the aggregate. Licensee shall provide proof of the above-described insurance upon request by the Department. Failure to maintain this required insurance coverage shall result in the automatic termination of this License.

13. Fees and Rental

LICENSEE shall pay to **Department** a one-time administrative fee of One Hundred Dollars ($100.00) for the preparation cost of this License and a fee of One Hundred Fifty Dollars ($150.00) per year to cover the cost of inspections and/or maintenance, to be paid annually on or before the anniversary date of this **License**. The **Department** reserves the right to review the rental rate in advance of the annual anniversary date of this License.

14. Notification

All communications and notices required or permitted under this License shall be in writing and shall be deemed sufficiently served if served in hand or by certified mail addressed as follows or such other address as they may designate in writing from time to time:

TO DEPARTMENT:

State of Maine
Department of Transportation
#16 State House Station
Augusta, Maine 04333-0016

Attention: Director, Office of Freight & Business Logistics

TO LICENSEE:

City of Bath - Sewers
55 Front Street
Bath, Maine 04530

15. Cancellation

The permit herein given shall terminate upon 30 days written notice of intention to terminate given by either **Department** or **Licensee** at any time to the other party.

16. Successors

This License shall inure to the benefit of and be binding upon the parties hereto, their successors or assigns, provided that **Licensee** shall not transfer, assign or permit the use of the permit hereby granted by any person or corporation without the prior consent and agreement, in writing, of **Department**.

17. Survival

Any covenants and representations contained herein, and any obligations which by their nature can be or are to be performed after the termination of this license, shall survive such termination.

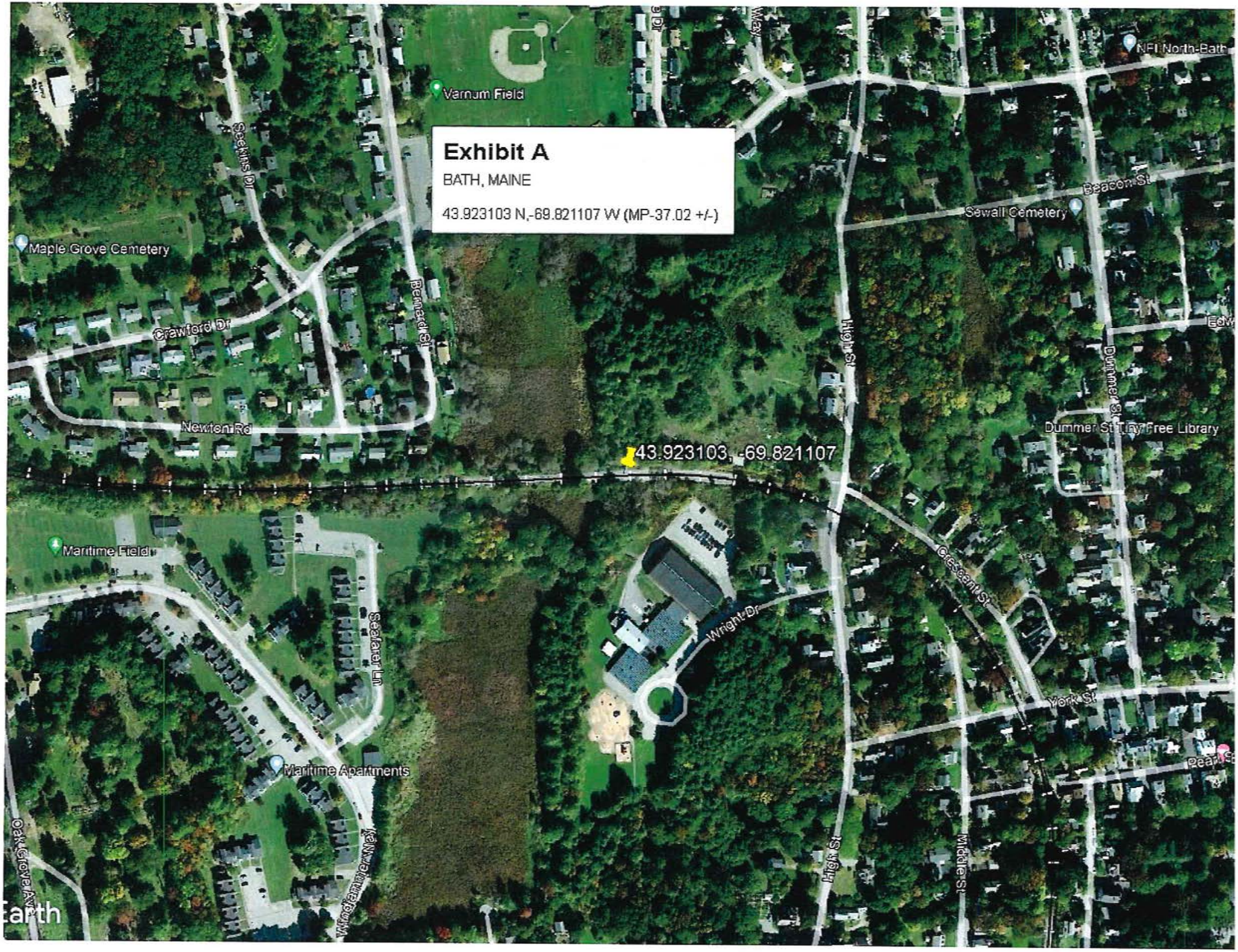
IN WITNESS WHEREOF, the parties have executed this license on the date first written above.

STATE OF MAINE DEPARTMENT
OF TRANSPORTATION

By: _____
Nathan Moulton, Director
Office of Freight & Business Logistics

LICENSEE

By: _____
Printed Name: MARC MEYERS
Title: CITY MANAGER


Exhibit A
BATH, MAINE
43.923103 N,-69.821107 W (MP-37.02 +/-)
Varnum Field
Maple Grove Cemetery
Crawford Dr
Newton Rd
Bernard St
Seekins Dr
43.923103, -69.821107
Sewall Cemetery
Beacon St
High St
Dummer St
Dummer St Tiny Free Library
Maritime Field
Seafarer Ln
Maritime Apartments
Wright Dr
Crescent St
York St
Middle St
Oak Grove Ave
Kennebec River
NEI North-Bath

Maine Municipal Association
Property & Casualty Pool

60 Community Drive
Augusta, Maine 04330

MEMBER COVERAGE CERTIFICATE

Named Member: City of Bath Certificate No. P23020PC2023
Mailing Address: 55 Front St, Bath, ME, 04530-2588

* * * * * * * * * * * * * * * *

Coverage Period: 07/01/2023 to 07/01/2024 at 12:01 A.M. prevailing time at Augusta, Maine.

This Member Coverage Certificate is comprised of the General Declarations and Limits and Section I-Common Certificate Terms and Conditions, Section II-Property Coverage, Section III-Liability Coverage, Section IV-Uninsured Motorist and Section V-Crime Coverage, and further includes any Forms and Endorsements made a part hereof.

General Declarations and Limits

IN RETURN FOR THE PAYMENT OF THE ANNUAL CONTRIBUTION, AND SUBJECT TO ALL THE TERMS, CONDITIONS AND EXCLUSIONS CONTAINED HEREIN, AS WELL AS TO THE MEMBERSHIP AGREEMENT, WE AGREE WITH YOU TO PROVIDE THE COVERAGE AS STATED IN THIS CERTIFICATE. THE COVERAGE AFFORDED IS ONLY WITH RESPECT TO SUCH OF THE FOLLOWING COVERAGES AS ARE INDICATED BY SPECIFIC CONTRIBUTIONS, OR INDICATED AS COVERED WITHOUT ADDITIONAL CONTRIBUTION. THE LIMIT OF THE POOL'S LIABILITY AGAINST EACH SUCH COVERAGE SHALL BE SUBJECT TO ALL THE TERMS AND CONDITIONS AS STATED HEREIN, AND SHALL ONLY BE FOR THOSE AMOUNTS IN EXCESS OF THE DEDUCTIBLE FOR EACH SUCH COVERAGE. THIS CERTIFICATE SHALL SERVE AS THE STATEMENT OF COVERAGE PROVIDED BY THE MAINE MUNICIPAL ASSOCIATION PROPERTY & CASUALTY POOL REQUIRED BY 30A M.R.S.A. § 2255(1)(A).

PROPERTY COVERAGE	LIMITS (unless modified by Extensions)	DEDUCTIBLE	CONTRIBUTIONS
Building & Personal Property	Per Schedule	Per Schedule	$28,580
Mobile Equipment	Per Schedule	Per Schedule	$9,574
Electronic Data Processing	$245,156	Per Schedule	$809
Valuable Papers and Records	$100,000	$1,000	Included
Accounts Receivable	$100,000	$1,000	Included
Transit	$100,000	$1,000	Included
Extra Expense	$100,000	$1,000	Included
Loss of Rent	$100,000	$1,000	Included
Loss of Business Income	$100,000	$1,000	Included
Fine Arts	$1,230,000	$1,000	$1,770
Flood	Per Extension	Per Schedule	Included
Earthquake	Per Extension	Per Schedule	Included
Forest Fire Suppression Coverage	$50,000	$500	$0
Automobile Physical Damage	Per Schedule	Per Schedule	$21,680
Equipment Breakdown	Per Extension	$1,000	$5,143

Named Member: City of Bath Certificate No. P23020PC2023

* *

UNINSURED MOTORISTS	LIMITS	DEDUCTIBLE	CONTRIBUTIONS
Uninsured/Underinsured Motorists	$400,000	$0	Included

CRIME COVERAGE	LIMITS	DEDUCTIBLE	CONTRIBUTIONS
Employee Dishonesty/Faithful Performance Forgery, Alteration, Theft, Disappearance & Destruction	$1,000,000	$5,000	$1,977

The following bonds, if provided under the Faithful Performance Of Duty Extension, are subject to the following limits:

General Assistance (22 M.R.S.A. 4302)	$100,000
Road Commissioner (23 M.R.S.A 2701)	$100,000
Constable (14 M.R.S.A 703)	$500

Catherine M Conlon

Pool Administrator

Coverage in this Member Coverage Certificate will not be valid unless signed by the Pool Administrator.

The forms and endorsements indicated below are made a part of the above mentioned Member Coverage Certificate on the Effective Date shown:

GL 0031-1	Cyber Liability - Retro Date
PR 0012	Owned Police Dog
GL 0033	Unmanned Aircraft
PG 0001	Exclusion-Designated Premise(s) - Property & General Liability
PR 0014	Exclusion of Designated Premise(s) - Property
PR 0001-1	Pilings, Piers, Wharves and Docks
PR 0006	Blanket Buildings and Personal Property
GL 0026	Public Officials Liability - Utilities

WRIGHT-PIERCE

Engineering a Better Environment