CONTRACT DOCUMENTS

Secondary Water Supply

City of Flint
1101 S. Saginaw Street
Flint, MI 48502

February 2020

WADE TRIM
555 South Saginaw Street, Suite 201
Flint, MI 48502

COF106801F

Table of Contents

Division 00
Procurement and Contracting Requirements

CITY OF FLINT

Department of Purchases & Supplies

Sheldon A. Neeley
Mayor

Joyce A. McClane
Purchasing Manager

INVITATION TO BID

OWNER:

THE CITY OF FLINT
DEPARTMENT OF PURCHASES AND SUPPLIES
1101 S. SAGINAW STREET, ROOM 203
FLINT, MI, 48502

Project Name: Secondary Water Supply
Proposal No.: 20000562

SCOPE OF WORK:

The City of Flint, Department of Purchases & Supplies, is soliciting sealed bids for providing:

Work shall include the construction of the Secondary Water Supply which will be approximately 30,000 lineal feet of 36-inch transmission main originating from the City of Flint's Water Treatment Facility (WTP) and connecting to the Genesee County Drain Commissioner's (GCDC's) North Water Loop near the intersection of Frances Road and Dort Highway, including all specified appurtenances. At either end of the transmission main Work will include the construction of a master meter vault, including meters, valves, instrumentation and SCADA for monitoring by the City, Genesee County Drain Commissioner, and the Great Lakes Water Authority.

In addition to the Secondary Water Supply, other modifications will also be completed in a number of areas at the City's WTP, including work at Control Station #2 which will include removing and replacing sections of 36-inch and 60-inch PCC pipe, as well as meters and control valves; SCADA modifications to Control Station #3; the removal and replacement of a 24-inch double-acting altitude valve at the Tank House, including electrical and SCADA modifications; and meter replacement at the Pressure Reducing Pit, including electrical and SCADA modifications.

If your firm is interested in providing the requested services, please submit one (1) original, one (1) electronic copy, one (1) unbound copy of your bid in a sealed envelope to the City of Flint, Department of Purchases by **Thursday, March 12, 2020 @ 1:00 PM EST.** The outside of the envelope should clearly identify the project name and number, and the name and address of the Bidder. Please note: all bids received after 3:00 PM (EST) will not be considered. Faxed bids to the Purchasing Department will not be accepted. Bidding Documents shall meet requirements set forth in Specification Section 00 21 13, Instructions to Bidders.

A mandatory pre-bid meeting will be held on **Thursday, February 20, 2020 @ 10:00 AM EST** at the City of Flint's Water Treatment Plant, 4500 Dort Highway, Flint, Michigan 48506. This will be the only venue that potential contractors will be able to have a face-to-face conversation with both the Purchasing Department and the Flint Water Quality Improvement Program Management Team. This venue will also allow contractors to ask any questions concerning this Project.

A bid guaranty or a cashier's check in the amount of 5% of the total bid must be submitted with the bid. Please note: cashier's check must be payable to Treasurer, City of Flint.

All additional bid documents, requirements, addendums, specifications and plans/drawings (if utilized) are available on the Purchasing page of the City of Flint's web site at https://www.cityofflint.com/finance/purchasing/ under "open bids" and the specific bid or proposal number assigned to this notice.

Anticipated Bid Submission Schedule:

Date Released/Bid Posted to City's Website:	**Monday, February 10, 2020**
Bid Advertisement:	**Monday, February 10, 2020**
Mandatory Pre-bid Meeting:	**Thursday, February 20, 2020 at 10:00 AM EST**
Final Date for Questions:	**Thursday, March 5, 2020 at 5:00 PM EST**
Final Addendum:	**Friday, March 6, 2020 by 5:00 PM EST**
Bid Due Date:	**Thursday, March 12, 2020 at 1:00 PM EST**
Bid Review:	**Friday, March 13, 2020**
Introduce to Finance Committee:	**Wednesday, March 18, 2020**
Anticipated City Council Approval:	**Monday, March 23, 2020**
Anticipated Contract Execution:	**Wednesday, April 15, 2020**
Anticipated Notice to Proceed:	**Thursday, April 16, 2020**

The dates provided above are estimated dates only and may be subject to change.

Submit to City:
One (1) printed, signed, original proposal and addenda
One (1) electronic copy of the proposal and addenda on flash drive
One (1) printed, signed, copy of the proposal and addenda (unbound)

Send to:
The City of Flint
Department of Purchases and
Supplies 1101 S. Saginaw Street,
Room 203 Flint, MI 48502

Effective immediately upon release of these Bidding Documents, and until notice of contract award, all official communications from proposers regarding the requirements of this Bid shall be directed to:

Joyce A. McClane
810-766-7340
jmcclane@cityofflint.com

The City, or designee, shall distribute all official changes, modifications, responses to questions or notices relating to the requirements of this Bid. Addendum to this Bid may be developed and shared with all Vendors. Any other information of any kind from any other source shall not be considered official, and proposers relying on other information do so at their own risk.

Sincerely,

Joyce A. McClane, Purchasing Manager

Section 00 2113
Instructions to Bidders

Part 1 General

1.01 Defined Terms

A. Terms used in these Instructions to Bidders have the meanings assigned to them in the General Conditions.

1. The term "Bidder" means one who submits a Bid directly to OWNER as distinct from a subbidder who submits a Bid to a Bidder.

2. The term "Successful Bidder" means the lowest, qualified, responsible Bidder to whom OWNER makes an award.

3. The term "OWNER" means City of Flint, a Municipal Corporation, and being a party of the first part of this Contract.

4. The term “ENGINEER” means Wade Trim, Inc., 555 South Saginaw Street, Suite 201, Flint, Michigan 48502, or his duly authorized representative.

5. The term “Issuing Office” means the office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.

1.02 Copies of Bidding Documents

A. Complete sets of the Bidding Documents may be obtained from the Issuing Office stated in the Advertisement for Bid or Invitation to Bid.

B. Complete sets of Bidding Documents shall be used in preparing Bids; neither OWNER nor ENGINEER assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

C. OWNER and ENGINEER, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

1.03 Scope of Work

A. The scope and location of Work are set forth in Section 01 1100, Summary of Work.

1.04 Bidders Qualifications

A. No Bid will be considered from any Bidder unless known to be skilled and regularly engaged in work of a character similar to that covered by the Contract Documents. In order to aid OWNER in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by OWNER to do so, shall furnish evidence, satisfactory to OWNER, of the Bidder's experience and familiarity with Work of the character specified, and his financial ability to properly prosecute the proposed Work to completion within the specified time. The evidence requested may include, but shall not be limited to, the following:

1. The address and description of the Bidder's plant or permanent place of business.

2. The Bidder's performance records for all Work awarded to, or started by, him within the past three years.

3. An itemized list of the Bidder's equipment available for use on the proposed Contract.

4. The Bidder's financial statement, including statement of ownership of equipment necessary to be used in executing Work under Contract.

5. Evidence that the Bidder is authorized to do business in the state in which the project is located, in case of a corporation organized under the laws of any other state; and,

6. Such additional information as will satisfy OWNER that the Bidder is adequately prepared to fulfill the Contract.

1.05 Pre-Bid Conference

A. A **mandatory** Pre-Bid conference will be held Thursday, February 20, 2020 at 10:00 A.M., at the City of Flint's Water Treatment Plant, located at 4500 Dort Highway, Flint, MI 48506. Attendance at this meeting is required to submit a bid on the project.

B. Representatives of OWNER and ENGINEER will be present to discuss the Project.

C. Bidders are required to attend and participate in the conference.

D. ENGINEER will transmit to all prospective Bidders a record of such Addenda as ENGINEER considers necessary in response to questions arising at the meeting. Oral statements made during the meeting may not be relied upon and will not be binding or legally effective.

1.06 Examination of Contract Documents and Site

A. It is the responsibility of each Bidder before submitting a Bid, to:

1. examine the Contract Documents thoroughly,

2. visit the site to familiarize Bidder with local conditions that may in any manner affect cost, progress or performance of the Work,

3. consider federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work; and

4. study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and

5. promptly notify ENGINEER in writing of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between Contract Documents and such related documents.

6. purchase official Procurement Documents from ENGINEER in order to be included on the project Plan Holder List and be considered eligible for bidding.

B. Reference is made to the Supplementary Conditions for the identification of those reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which have been relied upon by ENGINEER in preparing the Contract Documents.

1. If such reports are not included as appendices to the Contract Documents, OWNER will make copies available to any Bidder requesting them. These reports are included for reference only and are not guaranteed as to accuracy or completeness, nor are they part of the Contract Documents.

2. The Bidder may rely upon the general accuracy of the "technical data" contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the site, nor upon the completeness thereof for bidding or construction purposes.

3. Before submitting each Bidder will, at the Bidder's own expense, make such additional investigations and tests as the Bidder may deem necessary to determine Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

C. On request, OWNER will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of Bid. Bidder shall fill all holes and clean up and restore the site to its former conditions upon completion of such investigations and tests.

D. The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in Section 01 1100, Summary of Work, or on the Plans.

E. The locations of utilities as shown on the Plans are taken from sources believed to be reliable. Neither OWNER nor ENGINEER will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.

F. The submission of a Bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this Article 1.04, that without exception the Bid is based upon performing and furnishing the Work required by the Contract Documents and applying the specific means, methods, techniques, sequences or procedures of construction (if any) that may be shown, indicated or required by the Contract Documents, that Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in Contract Documents and the resolution by ENGINEER is acceptable to Bidder, and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performing and furnishing the Work, and that the time stated in the Proposal is sufficient to complete the project.

1.07 Interpretations and Addenda

A. Should any prospective bidder find discrepancies in, or omissions from the Plans, Specifications or other parts of the Contract Documents, he may submit a written request to the ENGINEER for an interpretation thereof. The person submitting the request will be held responsible for its prompt delivery at least seven (7) days prior to the date for opening of Bids. Questions received less than seven (7) days prior to the date for opening of bids will not be answered. Any interpretation of inquiry will be made by Addendum duly issued to all prospective bidders.

B. Any change in or addition to the Contract Documents deemed necessary by the OWNER shall be made in the form of an Addendum issued to all prospective bidders who have taken out Contract Documents and all such Addenda shall become a part of the Contract Documents as though same were incorporated into same originally. Oral explanations and information do not constitute official notification and are not binding.

1.08 Bid Security

A. Bid Security shall be made payable to OWNER, in an amount of five (5) percent of the Bidder's maximum Bid price and in a form as indicated in the Advertisement. Bid Bonds, if indicated as acceptable in the Advertisement, shall be issued on the form included in the Contract Documents by a Surety meeting the requirements of paragraph 5.01 of the General Conditions.

B. The Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required Contract Security, whereupon it will be returned; if the successful Bidder fails to execute and deliver the Agreement and furnish the required Contract Security within 15 days of the Notice of Award, OWNER may annul the Notice of Award and the Bid Security of that Bidder will be forfeited. The Bid Security of any Bidder whom OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the earliest of the seventh day after the "Effective Date of Agreement" (which term is defined in the General Conditions) or the expiration of the hold period on the Bids. Bid Security of other Bidders will be returned within 14 days of the Bid opening, unless indicated otherwise in the Advertisement.

1.09 Contract Time

A. The number of days within which, or the date by which, the Work is to be Substantially Completed, if applicable, and also completed and ready for final payment (the Contract Time) are set forth in the Proposal and will be included in the Agreement.

1.10 Substitute and "Or-Equal" Items

A. The Contract, if awarded, will be on the basis of materials and equipment described in the Plans or specified in the Specifications without consideration of possible substitute or "or-equal" items. Whenever it is indicated in the Plans or specified in the Specifications that a substitute or an "or-equal" item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, **application for such acceptance shall be considered by ENGINEER up to five (5) business days prior to Bid Opening**. In no case shall ENGINEER's denial of CONTRACTOR's application for substitution give rise to any claim for additional cost, it being understood by CONTRACTOR that acceptance of substitute or an "or equal" item of material is at the sole discretion of ENGINEER.

1.11 Receipt and Form of Bid

A. Bids shall be submitted at the time and place indicated in the Advertisement for Bids and shall be included in an opaque sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid Security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face thereof. Any Bid received after the scheduled time and place indicated in the Advertisement for Bids shall be returned unopened.

1. OWNER invites bids on the Proposal and other form(s) attached hereto. Bids will be received at the time and place indicated in the Advertisement and thereupon will be publicly opened and read. An abstract of the amounts of the base bids and any major alternates will be made available after the opening of Bids.

2. OWNER may consider as informal any Bid on which there is an alteration of, or departure from the Proposal Form attached hereto.

3. The complete set of Contract Documents must be used in preparing Bids: neither OWNER nor ENGINEER assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents. In order to verify the completeness of the set of Contract Documents the Bidder used in preparing his Bid, OWNER may require the Bidder to submit the set of Contract Documents he used in preparing his Bid. The Bidder shall submit his Bid on the separate Proposal form included in these Contract Documents.

4. The Proposal shall be legibly prepared, with ink or typewriter, on the form included in these Contract Documents. All blank spaces in the proposal forms must be correctly filled in where indicated for each and every item for which a quantity is given. Proposals will be compared on basis of lump sum items, if any, and on product of the quantities of items listed at the respective unit prices bid.

5. Erasures or other changes in the Bids must be explained or noted over the signature of the Bidder.

6. Names must be typed or printed below the signature.

7. The quantities as shown in the Proposal are approximate only and will be used as a basis of comparison of Bids, and award of Contracts. Payment will be made on basis of actual quantities of Work performed in accordance with the Contract Documents. The Unit Prices bid, shall include such amounts as the Bidder deems proper for overhead, profit, taxes, General Conditions and such other incidentals as noted in the Contact Documents.

8. The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Proposal Form.

9. The Legal Status of Bidder Form contained in the Contract Documents must be submitted with each Proposal and must clearly state the legal position of a Bidder. In the case of a corporation, the home address, name and title of all officers must be given. In the case of a partnership, show names and home addresses of all partners. If an individual, so state. Any individual bid not signed by the individual must have attached, thereto, a power of attorney evidencing authority to sign.

10. Other documents to be attached to the Proposal and made a condition thereof are identified in the Proposal. The same individual signing the Proposal shall sign these other documents.

1.12 Modifications and Withdrawal of Bids

A. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

B. 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 his Bid, that Bidder may withdraw his Bid and the Bid Security will be returned. Thereafter, at the sole option of OWNER, that Bidder will be disqualified from further Bidding on the Work to be provided under the Contract Documents.

1.13 Award of Contract

A. OWNER reserves the right to reject any and all Bids for any reason, to waive any and all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder, and the right to disregard all nonconforming, non-responsive, unbalanced, or conditional Bids. Discrepancies between words and figures will be resolved in favor of words. Discrepancies in the multiplication of units of work and unit prices, will be resolved in favor of unit price. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

B. In evaluating Bids, OWNER shall consider the qualifications of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data if requested in the Bid forms. It is OWNER's intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid form but OWNER may accept them in any order or combination.

C. Subject to the approval of OWNER, the Contract will be awarded to the lowest responsive and responsible Bidder. Responsibility of Bidder will be determined on basis of past performance and Work of similar character, equipment and labor available to do the Work and financial status. The Contract shall be considered to have been awarded after the approval of OWNER has been duly obtained and a formal Notice of Award duly served on the successful Bidder by OWNER. The Contract shall not be binding upon OWNER until the Agreement has been duly executed by the Bidder and the duly authorized officials of OWNER.

D. If the Contract is to be awarded, OWNER will give the successful Bidder a Notice of Award within ninety (90) days after the day of the Bid opening, unless such other time is specified in the Advertisement for Bids. **It is the intention of OWNER to award this Contract no later than March 23, 2020 and for this Contract to be fully executed no later than April 15, 2020.**

1.14 Signing of Agreement

A. Within fifteen (15) days after OWNER gives a Notice of Award to the successful Bidder, CONTRACTOR shall sign and deliver the specified number of counterparts of the Agreement to OWNER with all other Contract Documents attached. Within ten (10) days thereafter, OWNER will deliver two (2) fully signed counterparts to CONTRACTOR. ENGINEER will identify, date or correct those portions of the Contract Documents not fully signed, dated or executed by OWNER and CONTRACTOR and such identification, dating or correction shall be binding on all parties.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 00 2213
Supplementary Instructions to Bidders

Part 1 General

1.01 American Iron and Steel Requirements

A. CONTRACTOR acknowledges to and for the benefit of the City of Flint ("Purchaser") and the Michigan Department of Environmental Quality (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the State Revolving Fund and/or the Drinking Water Revolving Fund and such law contains provisions commonly known as "American Iron and Steel (AIS);" that requires all iron and steel products used in the project be produced in the United States ("AIS Requirements") including iron and steel provided by CONTRACTOR pursuant to this Agreement.

B. CONTRACTOR hereby represents and warrants to and for the benefit of the Purchaser and the State that:

1. CONTRACTOR has reviewed and understands the AIS Requirements:

2. all iron and steel used in the project will be and/or have been produced in the United States in a manner that complies with the AIS Requirements, unless a waiver of the requirements is approved or the State made the determination in writing that the AIS Requirements do not apply to the project, and

3. CONTRACTOR will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the AIS requirements, as may be requested by the Purchaser.

C. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by CONTRACTOR shall permit the Purchaser or State to recover as damages against CONTRACTOR any loss, expense or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser).

D. While CONTRACTOR has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and CONTRACTOR agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give these paragraphs force or effect) shall be amended or waived without the prior written consent of the State.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 00 4243
Proposal

City of Flint
1101 S. Saginaw Street
Flint, MI 48502

Re: Secondary Water Supply

The undersigned Bidder proposes and agrees, if this Proposal is accepted, to enter into an Agreement with the City of Flint (OWNER) in the form included in the Contract Documents to complete all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the Contract Documents.

In submitting this Proposal, Bidder represents, as more fully set forth in the Agreement, that;

a) Bidder has examined copies of all Contract Documents which he understands and accepts as sufficient for the purpose, including any and all Addenda officially issued, the receipt of which is hereby acknowledged.

Addendum No.	Date of Release	Signature
_____	_____	_____
_____	_____	_____
_____	_____	_____

b) Bidder has examined the surface and subsurface conditions where the Work is to be performed, the legal requirements and local conditions affecting cost, progress, furnishing or performance of the Work and has made such independent investigations as Bidder deems necessary.

c) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any Agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or a corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over OWNER.

The Bidder agrees to complete the Work, in accordance with the Contract Documents, for the following Contract Price:

Item	Description	Quantity	Unit	Unit Price	Amount
1.	Mobilization	1	LSUM	$ _____	$ _____
2.	Soil Erosion Sedimentation Control Measures	1	LSUM	$ _____	$ _____
3.	Traffic Maintenance & Control	1	LSUM	$ _____	$ _____
4.	Audio-Video Route Survey	1	LSUM	$ _____	$ _____
5.	Subsurface Utility Investigation	1	LSUM	$ _____	$ _____
6.	Transmission Main, Open Cut, 36-inch	28,910	LFT	$ _____	$ _____
7.	Transmission Main, Jack-and-Bore, 36-inch	1,090	LFT	$ _____	$ _____
8.	Butterfly Valve, 36-inch	2	EACH	$ _____	$ _____
9.	Air Valve for Water Service, 4-inch	4	EACH	$ _____	$ _____
10.	Hydrant Assembly, Blow-off	10	EACH	$ _____	$ _____
11.	Hydrant Assembly, Fire	1	EACH	$ _____	$ _____
12.	Removal & Disposal of Non-Hazardous Materials	50	TONS	$	$

Item	Description	Quantity	Unit	Unit Price	Amount
13.	Removal & Replacement of Bituminous Pavement	800	SYD	$ _____	$ _____
14.	Wetland Restoration, Plan 1	1,890	LFT	$ _____	$ _____
15.	Wetland Restoration, Plan 2	3,730	LFT	$ _____	$ _____
16.	Wetland Restoration, Plan 3	780	LFT	$ _____	$ _____
17.	Wetland Restoration, Plan 4	360	LFT	$ _____	$ _____
18.	GCDC Connection & Meter Vault	1	LSUM	$ _____	$ _____
19.	City of Flint WTP Connection & Meter Vault	1	LSUM	$ _____	$ _____
20.	Control Station No. 2 Modifications	1	LSUM	$ _____	$ _____
21.	Control Station No. 3 Modifications	1	LSUM	$ _____	$ _____
22.	Pressure Reducing Pit Modifications	1	LSUM	$ _____	$ _____
23.	Tank House Modifications	1	LSUM	$ _____	$ _____
24.	Restoration, City of Flint WTP	1	LSUM	$ _____	$ _____
25.	Allowance, Permit Fees	1	LSUM	$ 20,000.00	$ 20,000.00
26.	Allowance, Owner-Controlled Changes	1	LSUM	$ 150,000.00	$ 150,000.00

TOTAL BASE CONTRACT PRICE
(Items 1 through 26) $ _____
(numeric)

_____
(In Words)

All specified cash allowances are included in the price(s) set forth above and have been computed in accordance with Paragraph 11.02 of the General Conditions.

Proposed Subcontractors. Bidder proposes to utilize the services of the major subcontractors listed below for this Work.

Mechanical _____

Electrical _____

Instrumentation/SCADA _____

Other _____

The undersigned, as Bidder, hereby certifies that he or a qualified designated person in his employ has examined the Contract Documents provided by OWNER for bidding purposes. Further, the undersigned certifies that he or his qualified employee has reviewed the Bidder's proposed construction methods and finds them compatible with the conditions and from the information provided for Bidding.

The undersigned, as Bidder, shall complete the Work under any job circumstances or field conditions present and/or ascertainable prior to bidding. In addition, he shall also complete the Work under whatever conditions he may create by his own sequence of construction, construction methods, or other conditions he may create, at no additional cost to OWNER.

The undersigned, as Bidder, declares that he has familiarized himself with the location of the proposed Work and the conditions under which it must be constructed. Also, that he has carefully examined the Plans, the Specifications, and the Contract Documents, which he understands and accepts as sufficient for the purpose and agrees that he will Contract with OWNER to furnish all labor, material, tools, and equipment necessary to do all Work specified and prescribed for the completion of the Project.

The undersigned agrees, if awarded Contract, to sign the Agreement and submit satisfactory bonds and certificates of insurance coverage and other evidence of insurance required by the Contract Documents within fifteen (15) days after the date of OWNER'S Notice of Award.

The undersigned agrees that time is of the essence and, if awarded Contract, that the Work will be substantially completed within two hundred ten (210) calendar days of the issuance of the Notice to Proceed and completed within two hundred seventy (270) calendar days of the issuance of said Notice.

Liquidated damages, as specified in the General Conditions, Supplementary Conditions and Agreement, shall also apply to the above Substantial Completion date.

Engineering and inspection costs incurred after the above final completion date shall be paid by CONTRACTOR to OWNER as specified in the Conditions of the Contract and Agreement.

The following documents are attached to and made a condition of this Proposal:

a) Required Bid security in the form checked below:

☐ Certified Check ☐ Cashier's Check ☐ Money Order ☐ Bid Bond

b) Legal Status of Bidder.

c) Bidder's Name: _____

By: _____
(Signature) *(Printed Name)*

Address: _____

_____

Phone No.: _____ Fax No.: _____

Email: _____

Section 00 4313
Bid Bond Form

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____

as Principal, hereinafter called the Principal, and _____

a corporation duly organized under the laws of the State of _____, and duly authorized to transact business in the state of Michigan, as Surety, hereinafter called the Surety, are held and firmly bound unto the City of Flint, hereinafter called OWNER, in the sum of _____

_____ Dollars ($ _____)

for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a Bid for _____

_____

_____

_____

_____

NOW, THEREFORE, if OWNER shall accept the Bid of the Principal and the Principal shall enter into a Contract with OWNER in accordance with the terms of such Bid, and give such Bond or Bonds as may be specified in the Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such Contract and give such Bond or Bonds, if the Principal shall pay to OWNER the difference not-to-exceed the penalty hereof between the amount specified in said Bid and such larger amount for which OWNER may in good faith contract with another party to perform the Work covered by said Bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and Sealed this _____ day of _____, 20____.

_____	_____
(Witness)	(Principal)
	_____
	(Title)
_____	_____
(Witness)	(Surety)
	_____
	(Title)

Section 00 4345
Legal Status of Bidder

This Proposal is submitted in the name of:

(Print) _____

The undersigned hereby designates below his business address to which all notices, directions or other communications may be served or mailed:

Street _____

City _____

State _____ Zip Code _____

The undersigned hereby declares that he has legal status checked below:

- ☐ SOLE PROPRIETOR
- ☐ SOLE PROPPRIETOR DOING BUSINESS UNDER AN ASSUMED NAME
- ☐ CO-PARTNERSHIP
  The Assumed Name of the Co-Partnership is registered in the County of _____, Michigan
- ☐ CORPORATION INCORPORATED UNDER THE LAWS OF THE STATE OF _____. The Corporation is
  - ☐ authorized to conduct business in the State of Michigan
  - ☐ not now authorized to conduct business in the State of Michigan
  - ☐ possess all required licenses for the work being bid
  - ☐ limited liability corporation

The name, titles, and home addresses of all persons who are officers or partners in the organization are as follows:

NAME AND TITLE	HOME ADDRESS
_____	_____
_____	_____
_____	_____
_____	_____

Signed this _____ day of _____, 20____.

_____
By (Signature)

_____
Printed Name of Signer

_____
Title

Section 00 4539.13
Disadvantaged Business Enterprise (DBE)

Part 1 General

1.01 Summary

A. Prime contractors bidding on this project must follow, document, and maintain documentation of their Good Faith Efforts, as listed below, to ensure that Disadvantaged Business Enterprises (DBEs) have the opportunity to participate in the project by increasing DBE awareness of procurement efforts and outreach. Bidders must make the following Good Faith Efforts for any work that will be subcontracted.

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. Place DBEs on solicitation lists and solicit DBEs whenever they are potential sources.

2. Make information on forthcoming opportunities available to DBEs. Arrange time-frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date. The DBEs should be given a minimum of 5 days to respond to the posting.

3. Consider in the contracting process whether firms competing for large contracts can be subcontracted with DBEs. Divide total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one DBE firm to handle individually.

5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce.

B. Subsequent to compliance with the Good Faith Efforts, the following conditions also apply under the DBE requirements. Completed Good Faith Efforts Worksheets (Attachment 1), along with the required supporting documentation outlined in the instructions, must be submitted with your bid proposal. EPA form 6100-2 must also be provided at the pre-bid meeting. A copy of this form is available on the Forms and Guidance page of the Revolving Loan website.

1. The prime contractor must pay its subcontractor for work that has been satisfactorily completed no more than 30 days from the prime contractor's receipt of payment from the owner.

2. The prime contractor must notify the owner in writing prior to the termination of any DBE subcontractor for convenience by the prime contractor and employ the Good Faith Efforts if soliciting a replacement contractor.

If a DBE contractor fails to complete work under the subcontract for any reason, the prime contractor must employ the Good Faith Efforts if soliciting a replacement contractor.

3. The prime contractor must employ the Good Faith Efforts.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

See next page for Attachment 1, Instructions, Frequently Asked Questions and DBE Subcontractor Participation Form.

Attachment 1

Michigan Department of Environmental Quality
Office of Drinking Water and Municipal Assistance- Revolving Loan Section
Disadvantaged Business Enterprise (DBE) Utilization
State Revolving Fund/Drinking Water Revolving Fund
GOOD FAITH EFFORTS WORKSHEET

Bidder: _____

Subcontract Area of Work (one per worksheet: _____

Outreach Goal: Solicit a minimum of three (3) DBEs via email/letter/fax. it is recommended that various sources be used to locate the minimum number of DBEs. The Michigan Department of Transportation (MDOT) website and www.sam.gov registries may be two resources used to find a minimum of three DBEs.

List the DBEs contacted for the above area of work and complete the following information for each DBE.

Company Name	Type of Contact	Date of Contact	Price Quote Received	Accepted/ Rejected	Please Explain if Rejected
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	
				☐ A ☐ R	

Explanation for Not Achieving a Minimum of Three Contacts; you may include a printout of the MDOT and www.sam.gov search results (attach extra sheets if necessary):

MITA DBE Posting Date (if applicable): _____
(attach a copy of the DBE advertisement)

Other Efforts (attach extra sheets if necessary): _____

Please include the completed worksheet and supporting documentation with the bid proposal.

Michigan Department of Environmental Quality
Office of Drinking Water and Municipal Assistance- Revolving Loan Section
Disadvantaged Business Enterprise (DBE) Utilization
State Revolving Fund/Drinking Water Revolving Fund
GOOD FAITH EFFORTS WORKSHEET

Instructions to Bidders for the Completion of the Good Faith Efforts Worksheet

1. Separate worksheets must be provided for each area of work to be subcontracted out. This includes both major and minor subcontracts.

2. A minimum of three (3) DBEs must be contacted by a verifiable means of communication such as e-mail, lever, or fax for each area of work to be subcontracted out. Copies of the solicitation letters/e-mails and fax confirmation sheets must be provided with the worksheet.

3. if less than three (3) DBEs exist statewide for the area of work, then provide documentation that other DBE resources were consulted. This may include the MOOT and www.sam.gov registries and an advertisement is a publication. A printout of the website searched (conducted prior to the end of the bid period) must be submitted.

4. Posting solicitations for quotes/proposals from DBEs on the MITA website (www.mitadbe.com) is highly recommended to facilitate participation in the competitive process whenever possible. The solicitation needs to identify the project and the areas of work to be subcontracted out. A copy of the MITA DBE advertisement must be submitted with the Good Faith Efforts worksheet, if used, or a printout of the resulting quotes posted to the MITA website can be submitted with this form as supporting documentation.

5. If the area of work is so specialized that no DBEs exist, then an explanation is required to support that conclusion, including the documentation required in No. 3 above.

6. The date of the DBE contact must be identified, as it is important to document that the DBE solicitation was made during the bid period and that sufficient time was given for the DBE to return a quote.

7. Each DBE firm's price quote must be identified if one was received or N A entered on the worksheet if a quote was not received. Copies of all quotes must be submitted with the worksheet.

8. If a quote was received, indicate if it was accepted or rejected. Justification for not accepting a quote and not using the DBE subcontractor must be provided.

9. Under Other Efforts, please indicate additional steps you have taken to obtain DBE contractors and provide the appropriate supporting documentation such as:

   - Follow-up e-mails, faxes, or letters.
   - Copies of announcements/postings in newspapers, trade publications, or minority media that target DBE firms.

Rev. 3-2015

Authorized under Parts 43 & 54 of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Disadvantaged Business Enterprise (DBE) Requirements Frequently Asked Questions Regarding Contractor Compliance

Q: What is the Good Faith Efforts Worksheet form and how is it to be completed?

A: This form captures efforts by the prime contractor to solicit DBEs for each area of work type that will be subcontracted out. A separate Good Faith Efforts Worksheet must be provided by the prime contractor for each area of work type to be subcontracted out. There are specific instructions that accompany this form that prescribe minimum efforts which bidders must make in order to be in compliance with the DBE requirements.

Q: Can non-certified DBEs be used?

A: While non-certified DBEs can be used, only DBEs, MBEs, and WBEs that are certified by EPA, SBA, or MOOT (or by tribal, state and local governments, as long as their standards for certification meet or exceed the standards in EPA policy) can be counted toward the fair share goal. Proof of certification by one of these recognized and approved agencies should be sought from each DBE.

Q: How does a DBE get certified?

A: Applications for certification under MOOT can be found at http://mdotjboss.state.mi.us/UCP/LearnHowServ1et

Applications for certification under EPA can be found on EPA's Small Business Programs website at http://www.epa.gov/osbp/dbe_firm.htm under Certification Forms.

Q: If a bidder follows the MOOT DBE requirements, will the bidder be in compliance with the SRF/DWRF DBE requirements?

A: No. Federally funded highway projects utilize DBE goals, which require that a certain percentage of work be performed by DBE subcontractors. For SRF/DWRF projects there is no financial goal. However, there is a solicitation effort goal. Bidders must use Good Faith Efforts for each and every area of work to be subcontracted out to obtain DBEs. The bidders are not required to use DBEs if the quotes are higher than non-DBE subcontractors. There is no required DBE participation percentage contract goal for the SRF/DWRF. However, if the SRF/DWRF project is part of a joint project with MOOT, the project can be excluded from SRF/DWRF DBE requirements (i.e., the Good Faith Efforts Worksheet is not required) as it would be difficult to comply with both programs' requirements.

Q: Must the Good Faith Efforts Worksheet and supporting documentation be turned in with the bid proposals?

A: Yes. This is a requirement to document that the contractor has complied with the DBE requirements and the Good Faith Efforts. These compliance efforts must be done during the bidding phase and not after-the-fact. It is highly recommended that the need for these efforts and the submittal of the forms with the bid proposals be emphasized at the pre-bid meetings. Failure to show that the Good Faith Efforts were complied with during the bidding process can lead to a prime contractor being found non-responsive.

Q: Does EPA form 6100-2 need to be provided at the pre-bid meeting?

A: Yes. The form must be made available at the pre-bid meeting.

Q: What kinds of documentation should a contractor provide to document solicitation efforts?

A: Documentation can include fax confirmation sheets, copies of solicitation letters/e- mails, printouts of online solicitations, printouts of online search results, affidavits of publication in newspapers, etc.

Q: How much time will compliance with the Good Faith Efforts require in terms of structuring an adequate bidding period?

A: Due to the extent of the efforts required, a minimum of 30 calendar days is recommended between bid posting and bid opening to ensure adequate time for contractors to locate certified DBEs and solicit quotes.

Q: How does a contractor locate certified DBEs?

A: The Michigan Department of Transportation has a directory of all Michigan certified entities located at http://mdotjboss.state.mi.us/UCP/. Additionally, the federal System for Award Management (SAM) is another place to search and can be found at www.sam.gov. SAM contains information from the former Central Contractor Registration (CCR) database.

Q: If the bidder does not intend to subcontract any work, what forms, if any, must be provided with the bid proposal?

A: The bidder should complete the Good Faith Efforts Worksheet with a notation that no subcontracting will be done. However, if the bidder is awarded the contract and then decides to subcontract work at any point, then the Good Faith Efforts must be made to solicit DBEs.

Q: In the perfect world, the Good Faith Efforts Worksheet is required to be turned in with the proposal. What if no forms are turned in with the bid proposal or forms are blank or incomplete? Should this be cause to determine that the bidder is non-responsive?

A: While the Good Faith Efforts Worksheet is important, it is more critical to confirm that the contractor complied with the DBE requirements prior to bid opening. The owner should contact the bidder as soon as deficiencies are noted for a determination/documentation of efforts taken to comply with the DBE requirements, Immediate submittal of the completed forms will be acceptable provided the Good Faith Efforts were made and it is just a matter of transferring information to the forms.

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE[1] subcontractor[2] the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name	Project Name	
Bid/ Proposal No.	Assistance Agreement ID No. (if known)	Point of Contact
Address		
Telephone No.	Email Address	
Prime Contractor Name	Issuing/Funding Entity:	

Contract Item Number	Description of Work Received from the Prime Contractor Involving Construction, Services , Equipment or Supplies	Amount Received by Prime Contractor

[1] A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

[2] Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.

United States Environmental Protection Agency

OMB Control No: 2090-0030
Approved: 8/13/2013
Approval Expires: 8/31/2015

Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form

Please use the space below to report any concerns regarding the above EPA-funded project:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Subcontractor Signature	Print Name
Title	**Date**

Section 00 4546.13
Certification Regarding Debarment, Suspension and Other Responsibility Matters

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

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in transactions under federal non-procurement programs by any federal department or agency;

(2) Have not, within the three-year period preceding the proposal, had one or more public transactions (federal, state, or local) terminated for cause or default; and

(3) Are not presently indicted or otherwise criminally or civilly charged by a government entity (federal, state, or local) and have not, within the three-year period preceding the proposal, been convicted of or had a civil judgment rendered against it:

(a) For the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public transaction (federal, state, or local) or a procurement contract under such a public transaction;

(b) For the violation of federal or state antitrust statutes, including those proscribing prices fixing between competitors, the allocation of customers between competitors, or bid rigging; or

(c) For the commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

I understand that a false statement on this certification may be grounds for the rejection of this proposal or the termination of the award. In addition, under 18 U.S.C. §1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to five years, or both.

_____

Name and Title of Authorized Representative

_____

Name of Participant Agency or Firm

_____

Signature of Authorized Representative Date

☐ I am unable to certify to the above statement. Attached is my explanation.

Section 00 5100
Notice of Award

To: _____ Date: _____, 20_____

_____

_____

Attention: _____

Project: Secondary Water Supply

Pursuant to the provisions of Article 1.11 of the Instructions to Bidders, you are hereby notified that the City of Flint (OWNER) during a _____ Meeting held on _____, _____, 20_____, has directed the acceptance of your Bid for the above-referenced Project in the amount of _____ Dollars ($_____). This project shall consist of the construction of the Secondary Water Supply which will be approximately 30,000 lineal feet of 36-inch transmission, as well as a new meter vault at either end of the transmission main, as well as a number of improvements at various locations at the City of Flint's Water Treatment Plant as delineated in your Bid submitted to the City of Flint on _____, _____, 20_____.

Please comply with the following conditions within fifteen (15) days of the date of this Notice of Award; that is by _____, _____, 20_____.

1. Deliver to the ENGINEER six (6) fully executed counterparts of the Agreement including all the Contract Documents.

2. Deliver with the executed Agreement the Contract Security (Bonds), on the form included in the Contract Documents, as specified in the General Conditions (Article 5).

3. Deliver with the executed Agreement the Insurance Certificates (and other evidence of insurance) as specified in the General Conditions (Article 5).

4. Please do not date Agreement and Contract Security (Bonds) as these will be dated by OWNER when executed by OWNER.

It is important to comply with these conditions and time limits as failure to comply with these conditions within the time specified will entitle OWNER to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten (10) days after you comply with those conditions, OWNER will return to you two (2) fully signed counterparts of the Agreement with the Contract Documents attached.

In accordance with paragraph 2.05 of the General Conditions, please submit to ENGINEER the required schedules prior to the scheduling of a Pre-Construction Meeting.

Copy to ENGINEER:
Wade Trim, Inc.
555 S. Saginaw Street, Suite 201
Flint, MI 48502

_____
(OWNER)

By: _____
(Authorized Signature)

Section 00 5200
Agreement

This Agreement, made and entered into this _____ day of _____ in the year 20_____ by and between the City of Flint, hereinafter called OWNER, and _____ _____ hereinafter called CONTRACTOR, in consideration of the mutual covenants hereinafter sent forth, agree as follows:

ARTICLE 1. WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Work shall include the construction of the Secondary Water Supply which will be approximately 30,000 lineal feet of 36-inch transmission main originating from the City of Flint's Water Treatment Facility (WTP) and connecting to the Genesee County Drain Commissioner's (GCDC's) North Water Loop near the intersection of Frances Road and Dort Highway, including all specified appurtenances. At either end of the transmission main Work will include the construction of a master meter vault, including meters, valves, instrumentation and SCADA for monitoring by the City, Genesee County Drain Commissioner, and the Great Lakes Water Authority.

In addition to the Secondary Water Supply, other modifications will also be completed in a number of areas at the City's WTP, including work at Control Station #2 which will include removing and replacing sections of 36-inch and 60-inch PCC pipe, as well as meters and control valves; SCADA modifications to Control Station #3; the removal and replacement of a 24-inch double-acting altitude valve at the Tank House, including electrical and SCADA modifications; meter replacement at the Pressure Reducing Pit, including electrical and SCADA modifications; and the construction of a 36-inch interconnection between the existing supply lines to the elevated storage tower and the Dort Reservoir.

ARTICLE 2. CONTRACT TIME

2.1 The Work will be substantially completed within **two hundred ten (210)** calendar days of the issuance of the Notice to Proceed, and completed and ready for final payment in accordance with Paragraph 14.11 of the General Conditions within **two hundred seventy (270)** calendar days of said Notice.

2.2 Engineering and inspection costs incurred after the specified final completion date shall be paid by the CONTRACTOR to the OWNER prior to final payment authorization. Charges shall be made at such times and in such amounts as the ENGINEER shall invoice the OWNER, provided however said charges shall be in accordance with the ENGINEER's current rate schedule at the time the costs are incurred. The costs of ENGINEER incurred after the specified final completion date shall be deducted from the CONTRACTOR's progress payments.

2.3 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not Substantially Complete within the time specified in Article 2.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by OWNER if the Work is not Substantially Complete on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as penalty) CONTRACTOR shall pay OWNER **Two Thousand Five Hundred Dollars ($2,500.00)** for each day that expires after the time specified in Article 2.1 for Substantial Completion until the Work is Substantially Complete. Liquidated damages charged shall be deducted from the CONTRACTOR's progress payment.

ARTICLE 3. CONTRACT PRICE

3.1 OWNER shall pay CONTRACTOR as provided in the attached Proposal for performance of the Work in accordance with the Contract Documents.

ARTICLE 4. PAYMENT PROCEDURES

Progress payments and retainage under this Contract are governed by the provisions of PA 1980, No. 524 (MCLA 125.1561 et seq.). That Act is incorporated herein by reference and made a part of this Contract. Without excluding any provisions of the Act from this Contract, but in order to comply therewith and summarize certain provisions, the following shall apply:

4.1 The person representing CONTRACTOR who will submit written requests for progress payments shall be: _____

4.2 The person representing OWNER to whom requests for progress payments are to be submitted shall be: _____

4.3 CONTRACTOR's representative, listed above, shall submit Applications for Payment on the form provided in the Contract Documents in accordance with Article 14 of the General Conditions. Applications for Payment will be processed as provided in the General Conditions.

ARTICLE 5. CONTRACTOR'S REPRESENTATIONS

In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:

5.1 CONTRACTOR has considered the nature and extent of the Contract Documents, Work, locality, and all local conditions and federal, state and local laws, and regulations that may affect cost, progress, performance, or furnishing of the Work.

5.2 CONTRACTOR has studied carefully all reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which were relied upon in the preparation of the Plans and Specifications and which have been identified in the Supplementary Conditions.

5.3 CONTRACTOR has made or caused to be made examinations, investigations and tests and studies of such reports and related data in addition to those referred to in Article 5.2 as he deems necessary for the performance of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required by CONTRACTOR for such purposes.

5.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

5.5 CONTRACTOR has given ENGINEER written notice of all conflicts, errors or discrepancies that he has discovered in the Contract documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

ARTICLE 6. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire Contract between OWNER and CONTRACTOR are attached to this Agreement, made a part hereof and consists of the following:

6.1 Procurement Requirements (including Advertisement for Bids, Instructions to Bidders, Proposal, Legal Status of Bidder, and other documents listed in the Table of Contents thereof);

6.2 This Agreement;

6.3 Performance and other Bonds;

6.4 Notice of Award;

6.5 Notice to Proceed (if issued);

6.6 Conditions of the Contract (including General Conditions and Supplementary Conditions, if any);

6.7 Specifications contained within Division 01 through 49 of the Contract Documents;

6.8 Plans consisting of sheets dated February 2020 and with each sheet bearing the following general title: City of Flint 36" Secondary Water Supply;

6.9 Addenda numbers _____ to _____, inclusive;

6.10 Documentation submitted by CONTRACTOR prior to Notice of Award; and

6.11 Any modification, including Change Orders, duly delivered after execution of Agreement.

ARTICLE 7. MISCELLANEOUS

7.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions shall have the meanings indicated in the General Conditions.

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

7.3 OWNER and CONTRACTOR each binds himself, his partners, successors, assigns and legal representatives to the other party hereto, his partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

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

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in six (6) counterparts. Three (3) fully executed counterparts have been delivered to OWNER, two (2) fully executed counterparts have been delivered to CONTRACTOR, and one (1) fully executed counterpart has been delivered to ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR.

This Agreement will be effective on _____, _____, 20_____.

OWNER _____

By _____

Attest _____

Address for giving notices

_____

_____

_____

CONTRACTOR _____

By _____

Attest _____

Address for giving notices

_____

_____

_____

License No. _____

Agent for service of process: _____

_____

Section 00 5500
Notice to Proceed

To: _____ Date: _____, 20_____

_____

_____

Attention: _____

Project: Secondary Water Supply

Please note that the Contract Time under the above Contract will commence to run on _____, _____, 20_____. Within ten (10) days of this date you are to start performing the Work. The time to achieve Substantial Completion and Final Completion are set forth in the Agreement: **Two Hundred Ten (210)** calendar days and **Two Hundred Seventy (270)** calendar days, respectively.

In accordance with Paragraph 2.05 of the General Conditions, please submit to ENGINEER the required schedules prior to the scheduling of a Pre-Construction Meeting.

Also, in accordance with Paragraph 2.05 of the General Conditions, please request a Pre-Construction Meeting from ENGINEER prior to delivery of any materials or start of any construction. A minimum of three (3) full working days' notice is required to set up the Pre-Construction Meeting. Also, please notify ENGINEER 3 full working days in advance of any staking requirements or other activity on the Project.

Work at the site must be started by _____, _____, 20_____.

Copy to ENGINEER:
Wade Trim, Inc.
555 S. Saginaw Street, Suite 201
Flint, MI 48502

_____
(OWNER)

By: _____
(Authorized Signature)

Section 00 6000
Project Forms

Part 1 General

1.01 Available Forms

A. The following Project Forms are available for use by OWNER, CONTRACTOR and/or ENGINEER for this project and are located in Exhibit 1 of the Contract Documents:

1. Certificate of Substantial Completion
2. Construction Change Requisition / Work Order
3. Field Order
4. Request for Information

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 00 6112
Performance Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, that we, _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____ _____, a corporation organized and existing under the laws of the State of _____ _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ Dollars ($_____) lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the _____ day of _____, _____, for

_____

_____

_____

_____.

Herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

WHEREAS, it was one of the conditions of the award of the said Obligee, pursuant to which said contract was entered into, that these presents should be executed.

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the work to be performed thereunder or the Contract Documents accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

NOW, THEREFORE, if the above Principal shall in all respects comply with the terms and conditions of said contract, and his (their or its) obligations thereunder, including the Contract Documents therein referred to and made a part thereof, and such alteration as may be made in such contract or Contract Documents, as herein or therein provided for, then this obligation shall be void; otherwise, this bond and obligation shall be and remain in full force and effect.

Signed and sealed this _____ day of _____.

Signed, sealed and delivered in the presence of:

_____	_____
Witness for CONTRACTOR	(Principal)
	_____
	(Title)
	By _____
_____	_____
Witness for Surety	(Surety)
	_____
	(Title)
_____	By _____
Attorney-In-Fact (Seal)	
_____	_____
Address	Address of Surety
_____	_____
City Zip Code	City Zip Code
_____	_____
Telephone	Telephone

Section 00 6113
Labor and Material Payment Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, That we, _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____ _____, a corporation organized and existing under the laws of the State of _____ _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ Dollars ($_____), lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the _____ day of _____, _____, for

_____

_____

_____,

which contract is herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

WHEREAS, it was one of the conditions of the award of the said Obligee, pursuant to which said contract was entered into, that these presents should be executed.

AND WHEREAS, this Bond is given in compliance with and subject to the provisions of Act No. 213 of the Public Acts of Michigan for the year 1963, as amended, including all notices, time limitation provisions and other requirements set forth therein, which are incorporated herein by reference.

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work to be performed thereunder or the Contract Documents accompanying the same shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

NOW, THEREFORE, the condition of this obligation is such that if all claimants as defined in Act No. 213 of the Public Acts of Michigan for the year 1963, as amended, are timely paid for all labor and material used or reasonably required for use in the performance of the contract, then this obligation shall be void; otherwise, it shall remain in full force and effect.

Signed and sealed this _____ day of _____.

Signed, sealed and delivered in the presence of:

_____	_____
Witness for CONTRACTOR	(Principal)
	_____
	(Title)
	By _____
_____	_____
Witness for Surety	(Surety)
	_____
	(Title)
_____	By _____
Attorney-In-Fact (Seal)	
_____	_____
Address	Address of Surety
_____	_____
City Zip Code	City Zip Code
_____	_____
Telephone	Telephone

Section 00 6119
Maintenance & Guarantee Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS, That we, _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of Michigan, as Surety, hereinafter called "Surety", are held and firmly bound unto _____, as Obligee, and hereinafter called "Obligee," in the just and full sum of _____ ($_____) Dollars lawful money of the United States of America, to be paid to the said Obligee, to which payment well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the _____ day of _____, _____, for

_____

_____.

Herein referred to and made a part hereof as fully and to the same extent as if the same were entirely written herein, and

NOW THEREFORE, the condition of this obligation is that under the Contract Documents, CONTRACTOR has agreed with OWNER that for a period of one (1) year from the date of payment of the Final Estimate, CONTRACTOR shall keep in good order and repair any defect in the Work, either by CONTRACTOR or its Subcontractors that may develop or be discovered during said one (1) year period due to improper materials, defective equipment, workmanship, or arrangements and any other work affected in making good such imperfections. CONTRACTOR also agreed to promptly make such repairs as directed by OWNER for replacement of the Work, without cost to OWNER, except for such parts of the Work as may have been disturbed without the consent of CONTRACTOR after the final acceptance of the Work, whenever directed so to do by notice from OWNER. If CONTRACTOR fails to make such repair within one (1) week from the date of receipt of such notice, then OWNER shall have the right to purchase such materials and employ such labor and equipment as may be necessary for the purpose and to undertake, to and make such repairs and charge the cost thereof to CONTRACTOR and receive payment for the same promptly from the CONTRACTOR or Surety.

If any repair is necessary to be immediately made to protect persons or property then, and in such event, OWNER may, but shall not be required to, take immediate steps to repair such defects without notice to CONTRACTOR. In such event, OWNER shall not be required to obtain the lowest bid for the performance of the Work or any part thereof, and all sums actually paid therefore shall be charged to the CONTRACTOR or Surety. In this regard, the judgment of OWNER shall be final and conclusive. CONTRACTOR shall, for a period of one (1) year from the date of payment of the Final Estimate, keep the Work in good order and repair, except for such parts of the Work which may have been disturbed without the consent of CONTRACTOR after the final acceptance of the Work. CONTRACTOR shall further, whenever notice is given as hereinbefore specified, promptly proceed to make the repair as in said notice directed or reimburse OWNER for any cost incurred by OWNER in making such repairs.

If CONTRACTOR or Surety shall fail to do as hereinbefore specified, they shall jointly and severally indemnity, defend, and hold harmless OWNER from and against all and any losses, costs, suits, and actions for damages of every kind and description brought or claimed against OWNER for or on account of any injury or damage to persons or property received or sustained by any party or parties by or from any of the acts of omissions or through the negligence of CONTRACTOR, its Subcontractors, Suppliers, servants, agents, or employees in connection with the Work and then from any and all claims arising under the Workmen's Compensation Act of the State of Michigan.

IN WITNESS WHEREOF, the parties hereto have caused this Maintenance and Guarantee Bond to be executed by their respective authorized officers this _____ day of _____, 20__.

Signed, sealed and delivered in the presence of:

_____	_____
Witness for CONTRACTOR	(Principal)
	_____
	(Title)
	By _____
_____	_____
Witness for Surety	(Surety)
	_____
	(Title)
_____	By _____
Attorney-In-Fact (Seal)	
_____	_____
Address	Address of Surety
_____	_____
City Zip Code	City Zip Code
_____	_____
Telephone	Telephone

Section 00 6275
Engineer's Certificate for Payment

Job Number: _____ Certificate Number: _____ Date: _____

OWNER: _____

CONTRACTOR: _____

Project: _____

Contract Date: _____

Substantial Completion Date: _____ Extended To: _____

Completion Date: _____ Extended To: _____

Original Contract Price		Total Earned To Date	
Adjustments to Quantities		Retention	
Extras		Deductions	
Total Change Orders		Total Withheld	
Amended Contract Price		Total Net Due	
Less Total Net Due		Less Previous Certificates	
Balance on Contract		Total Balance Due this Certificate	

ENGINEER'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on the data comprising the above application, the ENGINEER to the best of his knowledge, information, and belief and subject to the limitations stated in the Contract Documents certifies to the OWNER that: (1) Work has progressed to the point indicated, (2) that the quality of the Work is in accordance with the Contract Documents, and (3) the CONTRACTOR is entitled to payment of the Total Balance Due This Certificate.

Certified _____ Recommended _____

ENGINEER Date Date

Section 00 6276
Contractor's Application for Payment

Job No. _____ Application No. _____ Date _____

OWNER: _____

CONTRACTOR: _____

Project: _____

Period of this Application for Payment and Declaration _____ to _____

Contract Dated _____

CONTRACTOR'S CERTIFICATION

Total Earned to Date ..... $ _____

Less Total Earned to Date ..... $ _____
Previous Certificate No. _____

Total Earned This Application ..... $ _____

The undersigned CONTRACTOR certifies that to the best of his knowledge, information, and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by him for Work for which previous Certificates for Payment were issued and payments received from the OWNER, and that current payment shows herein is now due.

_____
(CONTRACTOR)

By: _____

Title: _____

CONTRACTOR'S DECLARATION

I hereby declare that I have not, during the period covered by this Application, performed any work, furnished any material, sustained any loss, damage, or delay for any reason, including soil conditions encountered or created, or otherwise done anything for which I shall ask, demand, sue for, or claim compensation from the OWNER, or its agents, and the ENGINEER, or its agents, in addition to the regular items set forth in the Contract as dated above executed between myself and the OWNER, and in the Change Orders for Work issued by the OWNER in writing as provided thereunder, except as I hereby make claim for additional compensation and/or extension of time, as set forth on the itemized statement attached hereto.

_____
(CONTRACTOR)

By: _____

Title: _____

Section 00 6277
Payment Schedule

Job No. _____ Application No. _____ Date _____

Project: _____ Period: _____

Item of Work	Unit	Original Est. Quantity	Unit Price	Period Quantity	Period Amount	Total Quantity to Date	Total Amount to Date

Section 00 6325
Substitution Request Form

Specification Section # _____

Article # _____

Specified Product _____

Proposed Substitution _____

A.	Does specified product exceed, in any respect proposed substitution?	☐ Y ☐ N
B.	Does substitution affect dimensions shown on Plans?	☐ Y ☐ N
C.	Does substitution affect other trades more than original product?	☐ Y ☐ N
D	Does warranty differ from that specified?	☐ Y ☐ N
E.	Does substitution affect cost to OWNER?	☐ Y ☐ N
F.	Does substitution result in any license fee or royalty?	☐ Y ☐ N

If you indicated "Yes" to any of the items above, attach thorough explanation on your Company letterhead, as follows:

1. Explain any differences between proposed substitution and specified product.
2. Summarize experience with product and manufacturer in Project area.
3. Attach complete technical data and literature.

The undersigned states that the function, appearance, and quality of the proposed substitution is equivalent or superior to the specified item, and that all information above and attached is true and correct.

Submitted by: _____ Date Submitted: _____

Company: _____

Address: _____

Telephone: _____ Fax: _____

Signature: _____

For use by ENGINEER

ENGINEER'S RESPONSE		RESPONSE REQUIRED OF CONTRACTOR	
No Exceptions Taken	☐	None	☐
Note Markings	☐	Confirm	☐
Comments Attached	☐	Resubmit	☐
Rejected	☐		

Engineer's review is for general conformance with the design concept and contract documents. Markings or comments should not be construed as relieving the contractor from compliance with the project plans and specifications, nor departures therefrom. The contractor remains responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of assembly, and for performing his work in a safe manner.

By _____ Date _____

Section 00 6363
Change Order Form

Date of Issuance: _____ Effective Date: _____

Project: Change Order No.:

Contract: Prepared by:

Contractor:

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

_____

_____

_____

Attachments: (List documents supporting change):

A. _____

B. _____

C. _____

CHANGE IN CONTRACT PRICE	**CHANGE IN CONTRACT TIME**
Original Contract Price: $	Original Contract Times: ☐ Working Days ☐ Calendar Days Substantial Completion (date): Ready for final payment (date):
[Increase] [Decrease] from previously approved Change Orders No. to No. : $	[Increase] [Decrease] from previously approved Change Orders No. to No. : Substantial completion (days): Ready for final payment (days):
Contract Price prior to this Change Order: $	Contract Times prior to this Change Order: Substantial completion (date): Ready for final payment (date):
[Increase] [Decrease] of this Change Order: $	[Increase] [Decrease] of this Change Order: Substantial completion (days): Ready for final payment (days):
Contract Price incorporating this Change Order: $	Contract Times with all approved Change Orders: Substantial completion (date): Ready for final payment (date):

PREPARED BY:	ACCEPTED:	ACCEPTED:
By: _____ *Engineer (Authorized Signature)*	By: _____ *Owner (Authorized Signature)*	By: _____ *Contractor (Authorized Signature)*
Date: _____	Date: _____	Date: _____

Section 00 6520
Sworn Statement

STATE OF MICHIGAN

COUNTY OF _____}

_____ being duly sworn, deposes and says:

_____ is the (CONTRACTOR) (Subcontractor) for an improvement to the following described real property situated in _____ County, Michigan described as follows: _____

_____

_____

_____

(Insert Legal Description of Property)

That the following is a statement of each Subcontractor and Supplier and laborer, for which the payment of wages or fringe benefits and withholdings is due but unpaid, with whom (CONTRACTOR) (Subcontractor) has (contracted) (subcontracted) for performance under the contract with OWNER or lessee thereof, and that the amounts due to the persons as of the date hereof are correctly and fully set forth opposite their names, as follows:

Name of Subcontractor, Supplier, or Laborer	Type of Improvement Furnished	Total Contract Price	Amount Already Paid	Amount Currently Owing	Balance to Complete (optional)	Amount of Laborer Wages Due but Unpaid	Amount of Laborer Fringe Benefits and Withholdings Due But Unpaid
TOTALS:							

(Some columns are not applicable to all persons listed)

(CONTINUED)

That the CONTRACTOR has not procured material from, or subcontracted with, any person other than those set forth on the reverse side and owes no money for the improvement other than the sums set forth on the reverse side.

Deponent further says that he or she makes the foregoing statement as the (CONTRACTOR) (Subcontractor) or as _____ of the (CONTRACTOR) (Subcontractor) for the purpose of representing to the OWNER or lessee of the described on the reverse side premises and his or her agents that the property described on the reverse side is free from claims of construction liens, or the possibility of construction liens, except as specifically set forth on the reverse side and except for claims of construction liens by laborers which may be provided pursuant to section 109 of the construction lien act, Act No. 497 of the Public Acts of 1980, as amended, being section 570.1109 of the Michigan Compiled Laws.

WARNING TO OWNER: AN OWNER OR LESSEE OF THE PROPERTY DESCRIBED ON THE REVERSE SIDE MAY NOT RELY ON THIS SWORN STATEMENT TO AVOID THE CLAIM OF A SUBCONTRACTOR, SUPPLIER, OR LABORER WHO HAS PROVIDED A NOTICE OF FURNISHING OR A LABORER WHO MAY PROVIDE A NOTICE OF FURNISHING PURSUANT TO SECTION 109 OF THE CONSTRUCTION LIEN ACT TO THE DESIGNEE OR TO THE OWNER OR LESSEE IF THE DESIGNEE IS NOT NAMED OR HAS DIED.

_____
(Deponent)

WARNING TO DEPONENT: A PERSON, WHO WITH INTENT TO DEFRAUD, GIVES A FALSE SWORN STATEMENT IS SUBJECT TO CRIMINAL PENALTIES AS PROVIDED IN SECTION 110 OF THE CONSTRUCTION LIEN ACT, ACT NO. 497 OF THE PUBLIC ACTS OF 1980, AS AMENDED, BEING SECTION 570.1110 OF THE MICHIGAN COMPILED LAWS.

Subscribed and sworn to before me this _____ day of _____, 20_____.

_____
Notary Public

_____ County, Michigan

My Commission Expires _____

INSTRUCTIONS

1. A Sworn Statement in the preceding form must be provided before any CONTRACTOR or Subcontractor can file a Complaint, Cross-Claim, or Counter-Claim to enforce a construction lien.
2. An OWNER or lessee may withhold payment to a CONTRACTOR or Subcontractor who has not provided a Sworn Statement. An OWNER or lessee may withhold from a CONTRACTOR or Subcontractor who has provided a Sworn Statement the amount sufficient to pay all sums shown on the statement as owing Subcontractors, Suppliers, and laborers, or the amount shown to be due to lien claimants who have provided Notices of Furnishing pursuant to the Construction Lien Act of 1980.
3. An OWNER or lessee may rely on a Sworn Statement to avoid a lien claim unless the lien claimant has provided the OWNER or lessee with a Notice of Furnishing pursuant to the Construction Lien Act of 1980.
4. If the contract provides for payments by the OWNER to the general contractor, if any, in the normal course of construction, but the OWNER elects to pay lien claimants directly, the first time the OWNER elects to make payment directly to a lien claimant he or she shall provide at least 5 business days' notice to the general contractor of the intention to make direct payment. Subsequent direct disbursements to lien claimants need not be preceded by the 5-day notice provided in this section unless the OWNER first returns to the practice of paying all sums to the general contractor.

Section 00 6521
Prevailing Federal Wage Rate

Part 1 General

1.01 Summary

A. P.L. 111-88 requires compliance with the Davis Bacon Act and adherence to the current U.S. Department of Labor Wage Decision. Attention is called to the fact that not less than the minimum salaries and wages as set forth in the Contract Documents (see Wage Decision included herein) must be paid on this project. The Wage Decision, including modifications, must be posted by the Contractor on the job site. A copy of the Federal Labor Standards Provisions is included and is hereby a part of this contract.

B. In case there is an omission of any trade from the list of wage and fringe benefit rates to be paid to each class of mechanic by CONTRACTOR, it shall be understood that the trades omitted shall also be paid not less than the wage and fringe benefit rates prevailing in the locality in which the work is to be performed.

C. A finding by the U.S. Department of Labor's Wage and Hour Division that CONTRACTOR or subcontractor is in violation of the requirements of the contract shall be final.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

See Next Page for Wage Rate Determination.

"General Decision Number: MI20200057 01/03/2020

Superseded General Decision Number: MI20190057

State: Michigan

Construction Type: Heavy

County: Genesee County in Michigan.

Heavy, Includes Water, Sewer Lines and Excavation (Excludes Hazardous Waste Removal; Coal, Oil, Gas, Duct and other similar Pipeline Construction)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.80 for calendar year 2020 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.80 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2020. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/03/2020

CARP0706-017 06/01/2019

	Rates	Fringes
CARPENTER, Includes Form Work	$ 27.21	21.54

ELEC0948-009 05/26/2019

	Rates	Fringes
ELECTRICIAN	$ 38.31	23.06

* ENGI0325-019 09/01/2019

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes

POWER EQUIPMENT OPERATOR

GROUP 1	$ 34.63	24.35
GROUP 2	$ 29.90	24.35
GROUP 3	$ 29.17	24.35
GROUP 4	$ 28.60	24.35

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Backhoe/ Excavator, Boring Machine, Bulldozer, Crane, Grader/ Blade, Loader, Roller, Scraper, Trencher (over 8 ft. digging capacity)

GROUP 2: Trencher (8-ft digging capacity and smaller)

GROUP 3: Boom Truck (non-swinging, non- powered type boom)

GROUP 4: Broom/ Sweeper, Fork Truck, Tractor, Bobcat/ Skid Steer /Skid Loader

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ENGI0326-011 06/01/2018

EXCLUDES UNDERGROUND CONSTRUCTION

	Rates	Fringes
OPERATOR: Power Equipment		
Group 1	$ 38.68	23.85
Group 2	$ 35.38	23.85
Group 3	$ 32.73	23.85
Group 4	$ 31.02	23.85
Group 5	$ 31.02	23.85
Group 6	$ 25.16	23.85

FOOTNOTES:

Crane operator with main boom and jib 300' or longer: $1.50 per hour above the group 1 rate.
Crane operator with main boom and jib 400' or longer: $3.00 per hour above the group 1 rate.

PAID HOLIDAYS: New Year's Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas Day.

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

GROUP 1: Crane operator with main boom and jib 400', 300', or 220' or longer.

GROUP 2: Crane operator with main boom and jib 140' or longer, tower crane, gantry crane, whirley derrick

GROUP 3: Backhoe/Excavator; Boring Machine; Bulldozer; Crane; Grader/Blade; Loader; Roller; Scraper; Tractor; Trencher

GROUP 4: Bobcat/Skid Loader; Broom/Sweeper; Fork Truck (over 20' lift)

GROUP 5: Boom truck (non-swinging)

GROUP 6: Fork Truck (20' lift and under for masonry work)

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* IRON0025-006 06/01/2019

	Rates	Fringes
IRONWORKER		
Reinforcing	$ 30.98	27.99
Structural	$ 36.77	29.03

LABO0334-009 06/01/2019

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
Landscape Laborer		
GROUP 1	$ 20.75	7.10
GROUP 2	$ 18.75	7.10

LANDSCAPE LABORER CLASSIFICATIONS

GROUP 1: Landscape specialist, including air, gas and diesel equipment operator, lawn sprinkler installer and skidsteer (or equivalent)

GROUP 2: Landscape laborer: small power tool operator, material mover, truck driver and lawn sprinkler installer tender

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LABO0334-015 09/01/2018

SCOPE OF WORK:
OPEN CUT CONSTRUCTION: Excavation of earth and sewer, utilities, and improvements, including underground piping/conduit (including inspection, cleaning, restoration, and relining)

	Rates	Fringes
LABORER		
(1) Common or General	$ 21.94	12.85
(2) Mason Tender-Cement/Concrete	$ 22.08	12.85
(4) Grade Checker	$ 22.25	12.85
(5) Pipelayer	$ 22.39	12.85
(7) Landscape	$ 16.84	12.85

LABO1075-010 06/01/2019

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Mason Tender - Cement/Concrete; Pipelayer	$ 23.00	13.66

PAIN1052-003 06/01/2018

	Rates	Fringes
PAINTER		
Brush & Roler	$ 24.40	12.95
Spray	$ 25.75	12.95

PLAS0016-016 04/01/2014

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 25.58	12.88

PLUM0370-006 06/01/2018

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 37.81	20.60

TEAM0007-006 06/01/2019

	Rates	Fringes
TRUCK DRIVER		
Dump Truck under 8 cu. yds.; Tractor Haul Truck	$ 27.15	.50 + a+b
Dump Truck, 8 cu. yds. and over	$ 27.25	.50 + a+b
Lowboy/Semi-Trailer Truck	$ 27.40	.50 + a+b

FOOTNOTE:
a. $446.70 per week.
b. $67.00 daily.

SUMI2010-055 11/09/2010

	Rates	Fringes
TRUCK DRIVER: Off the Road Truck	$ 20.82	3.69

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of

each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION
"

Section 00 7200
General Conditions

Article 1 Definitions

1.01 Defined Terms

A. Wherever used in these General Conditions or in the other Contract Documents, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1. Addenda - Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Contract Documents.

2. Agreement - The written Agreement between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

3. Application and Certificate for Payment - The form included in the Contract Documents which is to be used by CONTRACTOR in requesting progress or final payment and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. Bid - The offer or proposal of the bidder submitted on the prescribed form setting forth the price(s) for the Work to be performed.

5. Bidding Requirements -- The Advertisement for Bids, Instructions to Bidders, Supplementary Instructions to Bidders, Proposal, Legal Status of Bidder, Bid Bond, and any other documents identified in the Proposal, to be submitted with the Bid.

6. Bonds - Bid, Performance and Payment bonds and other instruments of security.

7. Change Order - A written order to CONTRACTOR, reviewed by the ENGINEER and signed by OWNER, issued after execution of the Contract, authorizing a change in the Work or an adjustment in the Contract Price or the Contract Time. The Contract Price and Contract Time may be changed only by Change Order. A Change Order signed by CONTRACTOR indicates his agreement therewith, including that the Change Order constitutes a final adjustment in the Contract Price or Contract Time for all issues addressed or described in the Change Order.

8. Change Proposal - A written request by CONTRACTOR, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by ENGINEER concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

9. Claims –

   a. A demand or assertion by OWNER directly to CONTRACTOR, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by ENGINEER concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting ENGINEER's decision regarding a Change Proposal; seeking resolution of a

contractual issue that ENGINEER has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by CONTRACTOR directly to OWNER, duly submitted in compliance with the procedural requirements set forth herein, contesting ENGINEER's decision regarding a Change Proposal, or seeking resolution of a contractual issue that ENGINEER has declined to address.

c. A demand or assertion by OWNER or CONTRACTOR, duly submitted in compliance with the procedural requirements set forth herein, arising after ENGINEER has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

10. Constituents of Concern - Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

11. Contract - The entire and integrated written contract between OWNER and CONTRACTOR concerning the Work

12. Contract Documents - Those items so designated in the Agreement, and which together comprise the Contract.

13. Contract Price - The monies or other considerations payable by OWNER to CONTRACTOR for completion of acceptable Work in accordance with the Contract Documents as stated in the Agreement.

14. Contract Time - The number of days or the date stated in the Agreement:

a. to achieve Substantial Completion of all or any specified portions of the Work, and;

b. to complete the Work so that it is ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.11.

15. CONTRACTOR - The person, firm or corporation with whom OWNER has entered into the Agreement.

16. Cost of the Work - The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined in paragraph 12.01.

17. Day - A calendar day of 24 hours measured from midnight to the next midnight.

18. Defective - An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER's recommendation of final payment.

19. Drawings - See Plans.

20. Effective Date of Agreement -- The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

21. Electronic Document - Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

22. Electronic Means - Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow:

    a. the transmission or communication of Electronic Documents;

    b. the documentation of transmissions, including sending and receipt;

    c. printing of the transmitted Electronic Document by the recipient;

    d. the storage and archiving of the Electronic Document by sender and recipient; and

    e. the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

23. ENGINEER - The person, firm, or corporation identified in the Supplementary Instructions to Bidders hired by OWNER to prepare Plans and Specifications for the Project and to assist OWNER in interpreting Plans and Specifications during the performance of the Work. ENGINEER's authority and responsibility are set forth in the Contract between OWNER and ENGINEER. CONTRACTOR acknowledges and agrees that ENGINEER's obligations and duties under ENGINEER's contract with OWNER are obligations and duties to OWNER only, and ENGINEER has no independent obligation to CONTRACTOR of any kind, including but not limited to providing services, or to take any action or to refrain from taking action on behalf of CONTRACTOR or any Subcontractor, Sub-Subcontractor or Supplier.

24. Field Order - A written order issued by ENGINEER which clarifies or interprets the Contract Documents or orders minor changes in the Work in accordance with paragraphs 9.04 and 9.05 but which does not involve a change in the Contract Price or the Contract Time.

25. Hazardous Environmental Conditions - The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

26. Laws and Regulations; Laws or Regulations Any and all applicable laws, rules, regulations, ordinances, codes and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

27. Lump Sum - Construction Work where the OWNER pays a single stipulate price (Lump Sum) for the entire scope of Work; plus, or minus, alternates and/or allowances. However, unit prices may be required for individual items of Work for the purposes of changes, additions, or deletions.

28. Milestone - A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of the Work.

29. Notice of Award - The written notice by OWNER to the apparent successful Bidder stating that, upon compliance by the apparent successful Bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

30. Notice to Proceed - A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Time will commence to run and on which CONTRACTOR shall start to perform his obligation under the Contract Documents.

31. OWNER - The public body or authority, corporation, limited liability company, association, partnership, or individual with whom CONTRACTOR has entered into the Agreement and for whom the Work is to be provided and as identified in the Supplementary Instructions to Bidders.

32. Partial Utilization - Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

33. Plans - The part of the Contract Documents which graphically show the extent, character and Scope of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by the ENGINEER or OWNER; sometimes also referred to as Drawings.

34. Progress Schedule - A schedule, prepared and maintained by CONTRACTOR, describing the sequence and duration of the activities comprising CONTRACTOR's plan to accomplish the Work within the Contract Times.

35. Project - The total construction of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.

36. Project Manual - The volume assembled for the Project which may include, among other parts, Procurement Requirements, Contracting Requirements and Specifications.

37. Proposal - The offer or bid of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

38. Radioactive Material - Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 as amended.

39. Resident Project Representative - The authorized representative of ENGINEER who may be assigned to the Site or any part thereof.

40. Samples - Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

41. Schedule of Submittals - A schedule, prepared and maintained by CONTRACTOR, of required Submittals and the time requirements for ENGINEER's review of the Submittals.

42. Schedule of Values - A schedule, prepared and maintained by CONTRACTOR, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing CONTRACTOR's Applications for Payment.

43. Shop Drawings - All drawings, diagrams, illustrations, schedules and other data or information required by the Contract Documents which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate material or equipment for some portion of the Work.

44. Site - Lands or areas indicated in the Contract Documents as being furnished by OWNER upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by OWNER which are designated for the use of CONTRACTOR.

45. Specifications - That part of the Contract Documents which consist of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

    a. Project Specifications are those portions of the Contract Documents which have been prepared specifically for this Project and which are identified by the job number in the lower right-hand corner of each page.

    b. Standard Specifications are Specification sections that are the same from Project to Project as of the revision date shown in the lower left-hand corner of the page.

c. Standard Specification Section Revisions - Section 00 9120 of the Specifications which amends or supplements the Standard Specification Sections.

46. Subcontractor - An individual, firm or corporation having a direct contract with CONTRACTOR or with any other Subcontractor for the performance of a part of the Work at the Site.

47. Submittal - A written or graphic document, prepared by or for CONTRACTOR, which the Contract Documents require CONTRACTOR to submit to ENGINEER, or that is indicated as a Submittal in the Schedule of Submittals accepted by ENGINEER. Submittals may include Shop Drawings and Samples; schedules; product data; OWNER-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by ENGINEER, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

48. Substantial Completion - The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER's written recommendation of final payment in accordance with paragraph 14.11. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

49. Supplementary Conditions - The part of the Contract Documents which amends or supplements these General Conditions.

50. Supplementary Instructions to Bidders - The part of the Contract Documents which amends or supplements the Instructions to Bidders.

51. Supplier - A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with CONTRACTOR, or with any Subcontractor, or with OWNER, to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

52. Unit Price - Construction Work where the OWNER pays a fixed sum (Unit Price) per each completed unit of Work. Units are listed on the Proposal Form.

53. Utilities - Underground or above ground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any structures or encasements containing such facilities, which have been installed to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products,

telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, water or other liquids or chemicals.

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

55. Work Change Directive - A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and reviewed by ENGINEER, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.03 or to emergencies under paragraph 6.18. A Work Change Directive will not change the Contract Price or Contract Time but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in paragraph 10.01.

1.02 Terminology

A. The following words, terms, or phrases are not defined but, when used in the Contract Documents, have the following meaning:

1. Whenever in the Contract Documents the terms “as ordered,” “as directed,” “as required,” “as allowed,” “as approved” or terms of like effect or import are used; or the adjectives “reasonable,” “suitable,” “acceptable,” “proper” or “satisfactory” or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of ENGINEER as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the technical requirements of and information in the Contract Documents and conformance with the design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

2. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

3. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

4. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

5. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of CONTRACTOR, "provide" is implied.

B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

Article 2 Preliminary Matters

2.01 Delivery of Bonds and Insurance

A. When CONTRACTOR delivers the executed Agreements to OWNER, CONTRACTOR shall also deliver to OWNER such Bonds and Insurance Certificates and other evidence of Insurance requested as CONTRACTOR may be required to furnish in accordance with Article 5. No Work at the site may begin or progress payments made to CONTRACTOR until all Bonds and Insurance Certificates in the form and substance required in Article 5 have been submitted and approved by OWNER.

2.02 Copies of Documents

A. OWNER shall furnish to CONTRACTOR up to 5copies of the Contract Documents (including at least one fully signed counterpart of the Agreement) as are reasonably necessary for the execution of the Work. Additional copies will be furnished, upon request, at the cost of reproduction.

2.03 Commencement of Contract Time; Notice to Proceed

A. Time is of the essence in the performance of the Work. The Contract Time will commence to run on the 30th day after the effective date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the effective date of the Agreement. In no event will the Contract Time commence to run later than the 30th day after the effective date of the Agreement. Time limits stated in the Contract Documents are of the essence of the Agreement.

2.04 Starting the Project

A. CONTRACTOR shall start to perform the Work within 10 days of when the Contract Time commences to run, but no Work shall be done at the Site prior to the date on which the Contract Time commences to run. CONTRACTOR shall notify the ENGINEER at least 3 working days in advance of the time he intends to start Work.

2.05 Preconstruction Meeting

A. Within 10 days of the Effective Date of the Agreement and prior to the delivery of materials or the start of any construction, the CONTRACTOR shall request a Preconstruction Meeting from ENGINEER. A minimum of 3 full working days' notice shall be required.

B. Prior to the scheduling of the Preconstruction Meeting, CONTRACTOR shall submit to ENGINEER for review:

1. A preliminary Progress Schedule indicating the starting and completion dates of the various stages of the Work, including any Milestones specified in the Contract Documents;

2. A preliminary Schedule of Submittals which will list each required Submittal and the times for submitting, reviewing and processing such Submittal;

3. An estimated monthly payment schedule, and a preliminary Schedule of Values for all of the Work.

C. The Preconstruction Meeting will be held for review and acceptance of the schedules, to establish procedures for handling Shop Drawings and other Submittals, for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

2.06 Electronic Transmittals

A. Except as otherwise stated elsewhere in the Contract, the OWNER, ENGINEER, and CONTRACTOR may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then OWNER, ENGINEER, and CONTRACTOR shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

Article 3 Contract Documents Intent and Reuse

3.01 Intent

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. ENGINEER will issue clarifications and interpretations of the Contract Documents as provided herein.

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

G. Nothing in the Contract Documents creates:

1. any contractual relationship between OWNER or ENGINEER and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations; or

3. any obligation on the part of ENGINEER to CONTRACTOR.

3.02 Reference to Standards and Specifications of Technical Societies

A. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, or Laws or Regulations in effect at the time of opening of Bids or, on the effective date of the Agreement if there were no Bids, except as may be otherwise specifically stated in the Contract Documents.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result shall be furnished and performed whether or not it is specifically called for.

C. No provision of any standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of OWNER, CONTRACTOR or ENGINEER, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER, ENGINEER or any of ENGINEER's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.10 or any other provision of the Contract Documents.

3.03 Reporting and Resolving Discrepancies

A. Before undertaking each part of the Work, CONTRACTOR shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. CONTRACTOR has a duty to and shall promptly report in writing to ENGINEER any conflict, error, ambiguity, or discrepancy which CONTRACTOR should reasonably have discovered and shall obtain a written interpretation or clarification from ENGINEER before proceeding with any Work affected thereby.

B. If, during the performance of the Work, CONTRACTOR discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, CONTRACTOR shall report it to ENGINEER in writing at once, and, CONTRACTOR shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.18) until receiving written instruction or clarification from ENGINEER or OWNER.

However, CONTRACTOR shall not be liable to OWNER or ENGINEER for failure to report any such conflict, error, ambiguity or discrepancy unless CONTRACTOR knew or reasonably should have known thereof.

C. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement issued by one of the methods indicated in paragraph 3.05, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and;

1. the provisions of any standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

2. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Requirements of Contract Documents

A. During the performance of the Work and until final payment, CONTRACTOR and OWNER shall submit to the ENGINEER in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. ENGINEER will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

B. ENGINEER will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. ENGINEER's written clarification, interpretation, or decision will be final and binding on CONTRACTOR, unless it appeals by submitting a Change Proposal, and on OWNER, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve

1. the performance or acceptability of the Work under the Contract Documents,

2. the design (as set forth in the Drawings, Specifications, or otherwise), or

3. other engineering or technical matters, then ENGINEER will promptly notify OWNER and CONTRACTOR in writing that ENGINEER is unable to provide a decision or interpretation. If OWNER and CONTRACTOR are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in paragraph 11.01.

3.05 Order of Precedence

A. In resolving conflicts, errors or discrepancies between Plans and Specifications,

1. figured dimensions shall govern over scaled dimensions;

2. Plans shall govern over Standard Specifications;

3. and Project Specifications shall govern over Standard Specifications and Plans.

3.06 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

1. a Field Order (pursuant to paragraph 9.05), or,

2. a Change Order (pursuant to paragraph 10.01.A.1), or

3. a Work Change Directive Order (pursuant to paragraph 10.01.A.2)

B. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:

1. a Field Order (pursuant to paragraph 9.05),

2. ENGINEER's review of a Shop Drawing or Sample (pursuant to paragraph 6.21), or

3. ENGINEER's written interpretation or clarification (pursuant to paragraph 9.04).

3.07 Reuse of Documents

A. Neither CONTRACTOR nor any Subcontractor, manufacturer, fabricator, Supplier, distributor, or other person or organization performing or furnishing any of the Work under a direct or indirect contract with OWNER:

1. shall have or acquire any title to or ownership rights in any of the Plans, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of ENGINEER or ENGINEER's Consultant, and

2. they shall not reuse any of such Plans, Specification, other documents or copies on extensions of the Project or any other project without written consent of OWNER and ENGINEER and specific written verification or adaptation by ENGINEER.

3.08 Electronic Data

A. Except as otherwise stated elsewhere in the Contract Documents, OWNER, ENGINEER and CONTRACTOR may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information and graphics, including but not limited to Shop Drawings and other Submittals, in electronic media or digital format, either directly or through access to a secure Project website.

B. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

Article 4 Availability of Lands; Subsurface and Physical Conditions; Reference Points

4.01 Availability of Lands

A. OWNER shall furnish, as indicated in the Contract Documents and not later than the established date for beginning Work on the Contract, the lands upon which the Work is to be performed, rights of way and easements for access thereto, and such other lands which are designated for the use of CONTRACTOR. OWNER shall identify any encumbrances or restrictions not of general application but specifically related to use of lands so furnished with which CONTRACTOR will have to comply in performing the Work. Easements for permanent structures or permanent changes in existing facilities will be obtained and paid for by OWNER, unless otherwise provided in the Contract Documents. CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment unless otherwise provided in the Contract Documents.

4.02 Subsurface and Physical Conditions; Investigations and Reports

A. Reference is made to the Supplementary Conditions for identification of those reports of investigations and tests of subsurface and physical conditions at the Site or otherwise affecting cost, progress or performance of the Work which have been reviewed in preparation of the Contract Documents. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents.

B. The locations of utilities or other physical conditions relating to existing surface or subsurface structures at or contiguous to the Site as shown on the Plans are taken from drawings from sources believed to be reliable. Neither the OWNER nor ENGINEER will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.

C. CONTRACTOR shall draw its own conclusions as to the general accuracy of the "technical data" contained in such reports and drawings, and confirms such reports and drawings are not Contract Documents. CONTRACTOR may not rely upon or make any Claim against OWNER, ENGINEER or any of ENGINEER's Consultants with respect to:

a. the completeness of such reports and drawings for CONTRACTOR's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by CONTRACTOR and safety precautions and programs incident thereto, or

b. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings, or

c. any CONTRACTOR interpretation of or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.

2. The cost of all the following will be included in the Contract Price and CONTRACTOR shall have full responsibility for:

a. reviewing and checking all such information and data,

b. locating all Utilities during construction,

c. coordination of the Work with the owners of such Utilities, and

d. the safety and protection of all such Utilities as provided in paragraph 6.15 and repairing any damage thereto resulting from the Work.

4.03 Unforeseen Physical Conditions

A. If CONTRACTOR discovers one or both of the following physical conditions of surface or subsurface at the Project or improvement Site, before disturbing the physical condition, the CONTRACTOR shall immediately notify OWNER and ENGINEER of the physical condition; and follow up within 48 hours in writing:

1. A subsurface or a physical condition at the Site differing materially from those indicated in the Contract Documents, or

2. An unknown physical condition at the Site of a nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for the improvement project.

B. ENGINEER's Review. After receipt of written notice as required by the preceding paragraph, ENGINEER will promptly review the subsurface or physical condition in question; determine the necessity of OWNER's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in paragraph 4.03.A above; obtain any pertinent cost or schedule information from CONTRACTOR; prepare recommendations to OWNER regarding the CONTRACTOR's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise OWNER in writing of ENGINEER's findings, conclusions, and recommendations.

C. OWNER's Statement to CONTRACTOR Regarding Site Condition. After receipt of ENGINEER's written findings, conclusions, and recommendations, OWNER shall issue a written statement to CONTRACTOR (with a copy to ENGINEER) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting ENGINEER's written findings, conclusions, and recommendations, in whole or in part.

D. Possible Price and Times Adjustments.

1. CONTRACTOR shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must fall within any one or more of the categories described in paragraph 4.03.A;

b. with respect to Work that is paid for on a Unit Price basis, any adjustment in Contract Price will be subject to the provisions of paragraph 12.03; and

c. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times pursuant to paragraph 10.05.

2. CONTRACTOR shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. CONTRACTOR knew of the existence of such condition at the time CONTRACTOR made a commitment to OWNER with respect to Contract Price and Contract times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for CONTRACTOR prior to CONTRACTOR's making such commitment; or

c. CONTRACTOR failed to give the written notice as required by paragraph 4.03.A.

3. If OWNER and CONTRACTOR agree regarding CONTRACTOR's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order or Work Change Directive.

4. CONTRACTOR may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after OWNER's issuance of the OWNER's written statement to CONTRACTOR regarding the subsurface or physical condition in question.

4.04 Utilities

A. CONTRACTOR's Responsibilities. The information and data shown or indicated in the Contract Documents with respect to existing Utilities at or adjacent to the Site, if any, is based on information and data furnished to OWNER or ENGINEER by the owners of such Utilities, including OWNER, or by others.

1. OWNER and ENGINEER do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and CONTRACTOR shall have full responsibility for:

a. reviewing and checking all information and data regarding existing Utilities at the Site;

b. locating all Utilities shown or indicated in the Contract Documents as being at the Site;

c. coordination of the Work with the owners (including OWNER) of such Utilities, during construction; and

d. the safety and protection of all existing Utilities at the Site, and repairing any damage thereto resulting from the Work.

B. Notice by CONTRACTOR. If CONTRACTOR believes that an Utilities that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then CONTRACTOR shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.18), identify the owner of such Underground Facility and give written notice to that owner and to OWNER and ENGINEER.

C. ENGINEER's Review. ENGINEER will:

1. promptly review the Utilities and conclude whether such Utilities was not shown or indicated in the Contract Documents,

2. or was not shown or indicated with reasonable accuracy;

3. obtain any pertinent cost or schedule information from CONTRACTOR;

4. prepare recommendations to OWNER regarding the CONTRACTOR's resumption of Work in connection with the Utilities in question;

5. determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Utilities;

6. and advise OWNER in writing of ENGINEER's findings, conclusions, and recommendations.

During such time, CONTRACTOR shall be responsible for the safety and protection of such Underground Facility.

D. OWNER's Statement to CONTRACTOR Regarding Utilities. After receipt of ENGINEER's written findings, conclusions, and recommendations, OWNER shall issue a written statement to CONTRACTOR (with a copy to ENGINEER) regarding the Utilities in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting ENGINEER's written findings, conclusions, and recommendations in whole or in part.

E. Possible Price and Times Adjustments:

1. CONTRACTOR shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Utilities at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in CONTRACTOR's cost of, or time required for, performance of the Work; subject, however, to the following:

a. CONTRACTOR did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Utilities in question;

b. With respect to Work that is paid for on a Unit Price basis, any adjustment in Contract Price will be subject to the provisions of paragraph 12.03;

c. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times; and

d. CONTRACTOR gave the notice required in paragraph 4.04.B.

2. If OWNER and CONTRACTOR agree regarding CONTRACTOR's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. CONTRACTOR may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after OWNER's issuance of the OWNER's written statement to CONTRACTOR regarding the Underground Facility in question.

4.05 Reference Points

A. OWNER shall provide engineering surveys for construction to establish property corners, monuments, bench marks and similar reference points which in his judgment are necessary to enable CONTRACTOR to proceed with the Work. CONTRACTOR shall be responsible for the preservation of established reference points and shall make no changes or relocations without the prior written approval of OWNER. CONTRACTOR shall report to ENGINEER whenever any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations. Reference points destroyed by negligence of CONTRACTOR will be replaced by OWNER at the expense of CONTRACTOR. Construction Staking will be furnished by OWNER as provided in Division 01 of the Specifications.

4.06 Constituents of Concern

A. OWNER shall be responsible for any Constituents of Concern uncovered or revealed at the Site which was not shown or indicated in Plans or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the Site. OWNER shall not be responsible for any such materials brought to the Site by CONTRACTOR, Subcontractor, Suppliers or anyone else for whom CONTRACTOR is responsible.

B. Upon discovering any such material, CONTRACTOR shall immediately:

1. stop all Work in connection with such Hazardous Environmental Condition and in any area affected thereby (except in emergency as required by paragraph 6.18), and

2. notify OWNER and ENGINEER (and thereafter confirm such notice in writing). OWNER shall promptly consult with ENGINEER concerning the necessity for OWNER to retain a qualified expert to evaluate such Hazardous Environmental Condition or take corrective action, if any.

C. CONTRACTOR shall not be required to resume Work in connection with such Hazardous Environmental Condition or in any such affected areas until after OWNER has obtained any required permits related thereto and delivered to CONTRACTOR special written notice:

1. specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or

2. specifying any special conditions under which such Work may be resumed safely.

D. If OWNER and CONTRACTOR cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Terms as a result of such Work stoppage or such special conditions under which Work is agreed by CONTRACTOR to be resumed, either party may make a Claim therefor as provided in paragraph 11.01.

E. If after receipt of such special written notice CONTRACTOR does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then OWNER may order such portion of the Work that is in connection with such condition, or in such affected area, to be deleted from the Work. If OWNER and CONTRACTOR cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Time as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 11.01. OWNER may have such deleted portion of the Work performed by OWNER's own forces or others in accordance with paragraph 7.01.

F. To the fullest extent permitted by Laws and Regulations, OWNER shall indemnify and hold harmless CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from such condition per this paragraph 4.06, provided that:

1. any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and

2. nothing in this paragraph 4.06 shall obligate OWNER to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.

G. The provisions of paragraph 4.03 are not intended to apply to the presence of Constituents of Concern or Hazardous Environmental Conditions uncovered or revealed at the Site.

Article 5 Bonds and Insurance

5.01 Performance and Other Bonds

A. CONTRACTOR shall furnish performance and payment Bonds, on the form included in the Contract Documents, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of CONTRACTOR's obligations under the Contract Documents. These Bonds shall remain in effect at least until 1 year after the date when final payment becomes due, except as otherwise provided by Laws and Regulations or as specified in the Contract Documents or Bond. CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary Conditions.

B. All Bonds shall be in the forms prescribed by the Contract Documents and be executed by such Sureties as

1. are licensed to conduct business in the state where the Project is located, and

2. are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch.

C. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

D. If Surety on any Bond furnished by CONTRACTOR is declared as bankrupt or becomes insolvent, or its right to do business is terminated in any state where any part of the Project is located, or it ceases to meet the requirements of clauses (1) and (2) of paragraph 5.01, CONTRACTOR shall within 5 days thereafter substitute another Bond and Surety, both of which shall be acceptable to OWNER.

5.02 Licensed Insurers and Sureties

A. Bonds and insurance required by the Contract Documents to be purchased and maintained by OWNER or CONTRACTOR shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required.

5.03 Insurance

A. CONTRACTOR shall purchase and maintain during the term of the Project such insurance as will protect him, OWNER(s) and ENGINEER(s) from Claims arising out of the Work described in this Contract and performed by CONTRACTOR, Subcontractor(s) or Sub subcontractor(s) consisting of:

1. Workers' Compensation Insurance including Employer's Liability to cover employee injuries or disease compensable under the Workers' Compensation Statutes of the states in which Work is conducted under this Contract; disability benefit laws, if any; or Federal compensation acts such as U.S. Longshoremen or Harbor Workers', Maritime Employment, or Railroad Compensation Act(s), if applicable. Self-insurance plans approved by the regulatory authorities in the state in which Work on this Project is performed are acceptable.

2. An occurrence form Commercial General Liability policy to cover bodily injury to persons other than employees and for damage to tangible property, including loss of use thereof, plus appropriate endorsements to protect OWNER and ENGINEER against Claims, demands, and lawsuits from employees of CONTRACTOR and Subcontractors, including the following exposures:

a. All premises and operations.

b. Explosion, collapse and underground damage.

c. CONTRACTOR's Protective coverage for independent contractors or Subcontractors employed by him.

d. Broad form blanket, contractual liability for the obligation assumed in the Indemnification or Hold Harmless agreement found in the General Conditions or Supplementary Conditions of this Contract.

e. Personal Injury Liability endorsement with no exclusions pertaining to employment.

f. Products and Completed Operations coverage. Coverage shall extend through the Contract guarantee period.

g. Broad form property damage.

h. Cross liability endorsement.

i. For design professional additional insureds, ISO Endorsement CG 20 32 04 13, "Additional Insured-Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

3. Comprehensive Automobile Liability policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned and hired vehicles. Comprehensive General Liability and the Comprehensive Auto Liability shall be written by the same insurance carrier, though not necessarily in one policy.

4. CONTRACTOR shall purchase for OWNER an Owner's Protective Liability policy to protect OWNER, ENGINEER, their consultants, agents, employees and such public corporations in whose jurisdiction the Work is located for their liability for Work performed by the CONTRACTOR, the Subcontractor(s) or the Sub subcontractor(s) under this Contract.

5. When a limit of liability is identified in the Supplementary Conditions, CONTRACTOR shall purchase a Builder's Risk Installation Floater in a form acceptable to OWNER covering property of the Project for the full cost of replacement as of the time of any loss which shall include, as named insureds,

   a. CONTRACTOR,

   b. all Subcontractors,

   c. all Sub subcontractors,

   d. OWNER, and ENGINEER(s) or Architect(s), as their respective interests may prove to be at the time of loss, covering insurable property which is the subject of this Contract, whether in place, stored at the Site, stored elsewhere, or in transit at the risk of the insured(s).

   Coverage shall be effected on an "All Risk" form including, but not limited to, the perils of fire, wind, vandalism, collapse, theft, flood and earthquake, with removal of passive design error exclusion. Except as may otherwise be required by OWNER, CONTRACTOR may arrange for such deductibles as CONTRACTOR deems to be within CONTRACTOR's ability to self-assume, but CONTRACTOR will be held solely responsible for the amount of such deductible and for any co-insurance penalties. Any insured loss shall be adjusted with OWNER and CONTRACTOR and paid to OWNER and CONTRACTOR as Trustee for the other insureds.

6. Umbrella or Excess Liability

a. The CONTRACTOR is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limit(s) requested. Umbrella or Excess policy wording shall be at least as broad as the primary or underlying policy(ies) and shall apply both to CONTRACTOR's General Liability and Automobile Liability Insurance and shall be written on an occurrence basis.

7. Railroad Protective Liability

a. Where any of the Work is within a railroad right-of-way or where a limit of liability is identified in the Supplementary Conditions, CONTRACTOR will provide coverage in the name of each railroad company having jurisdiction over rights of way across which Work under the Contract is to be performed. The form of policy and the limits of liability shall be determined by the railroad company(ies) involved. See the Supplementary Conditions for limits and coverage requested.

8. CONTRACTOR’s Professional Liability Insurance

a. 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 shall provide protection against Claims arising out of performance of professional design or related services caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by CONTRACTOR itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

B. OWNER's responsibilities in respect of purchasing and maintaining insurance are set forth below:

1. OWNER shall assume responsibility for such boiler and machinery insurance as may be required or considered to be necessary by OWNER in the course of construction, testing or after completion.

a. OWNER shall assume responsibility for such insurance as will protect the OWNER against any loss of use of OWNER's property due to those perils insured pursuant to paragraph 1 above.

5.04 Limits of Liability

A. The required limits of liability for insurance coverages required in paragraphs 5.03 shall be not less than those specified in the Supplementary Conditions.

5.05 Notice of Cancellation or Intent Not to Renew

A. Policies will be endorsed to provide that at least 30 days written notice shall be given to OWNER and to ENGINEER of cancellation, intent not to renew, or material modification of the coverage.

5.06 Evidence of Coverage

A. Prior to commencement of the Work, CONTRACTOR shall furnish to OWNER and ENGINEER, Certificates of Insurance in force on current Accord® Certificate of Insurance form. Other forms of Certificate are acceptable only if;

1. they include all of the items prescribed in the current Accord® Certificate of Insurance form, including agreement to cancellation provisions outlined in paragraph 5.05 above; and

2. they have approval of OWNER and ENGINEER.

B. Prior to the commencement of the Work, CONTRACTOR shall furnish to OWNER complete "originally signed" copies of the Owner's Protective Liability Policy. The number of copies shall be the same as the number of counterparts of the Agreement. OWNER reserves the right to request complete copies of other policies if deemed necessary to ascertain details of coverage not provided by the certificates. Such policy copies shall be "Originally Signed Copies," and so designated.

5.07 Qualification of Insurers

A. In order to determine financial strength and reputation of insurance carriers, all companies providing the coverages required shall be licensed or approved by the Insurance Bureau of the state in which the Project is located and shall have a financial rating not lower than XI and a policyholder's service rating no lower than B+ as listed in A.M. Best's Key Rating Guide, current edition. Companies with ratings lower than B+:XI will be acceptable only upon written consent of OWNER.

5.08 Damage Claims - Acknowledgment and Reports

A. CONTRACTOR shall furnish to OWNER an acknowledgment receipt from the insurance carrier for each damage claim against the Project. The receipt shall include the insurance carrier’s assigned claim number.

B. Upon request, CONTRACTOR or his insurance carrier shall also furnish to OWNER a status report on all damage claims. This report shall include inspections made, the disposition of claims, and what action has been taken towards settlement of each claim.

C. Failure of CONTRACTOR to comply with this paragraph 5.08 may result in the amount of such damage claims being withheld from CONTRACTOR’s monthly pay estimate. Such withholding shall be reimbursed in the monthly pay estimate following compliance with this paragraph.

5.09 Cost of Insurance

A. The unit cost of the insurance herein specified will not be a specific bid item, but the cost of such insurance will be included by the CONTRACTOR in the various prices bid.

5.10 Waiver of Rights

A. OWNER and CONTRACTOR intend that all policies purchased in accordance with paragraph 5.03 will protect OWNER, CONTRACTOR, Subcontractors, ENGINEER, ENGINEER's Consultants (and all other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds in such policies) and will provide primary coverage for all losses and damages caused by the perils covered thereby. Such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder.

B. OWNER and CONTRACTOR waive all rights against each other and their respective officers, directors, employees and agents for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work; and in addition, waive all such rights against Subcontractors, ENGINEER, ENGINEER's Consultants and any other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds under such policies for loss and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by OWNER as trustee or otherwise payable under any policy so issued.

5.11 Receipt and Application of Insurance Proceeds

A. Any insured loss under the policies of insurance required by paragraph 5.03.A.5 will be adjusted with OWNER and made payable to OWNER as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause. If no other special agreement is reached the damaged Work shall be repaired or replaced, the monies so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order, Field Oder or Work Change Directive.

B. OWNER as fiduciary shall have power to adjust and settle any loss under the policies required by paragraph 5.03.A.5 with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to OWNER's exercise of this power. If such objection be made, OWNER as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, OWNER as fiduciary shall adjust and settle the loss with the insurers.

Article 6 Contractor's Responsibilities

6.01 Supervision and Superintendence

A. CONTRACTOR shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. CONTRACTOR shall be responsible to see that the finished Work complies with the Contract Documents. However, if specific means, methods, techniques, sequences and procedures of construction are prescribed in the Plans or Specifications, CONTRACTOR shall be responsible to comply therewith, but may implement such prescribed Work in a

manner of CONTRACTOR's choosing so long as the Work complies with the requirements of the Plans and Specifications.

B. At all times during the progress of the Work, CONTRACTOR shall assign and maintain a competent superintendent who shall not be replaced without written notice to OWNER and ENGINEER except under extraordinary circumstances. Any superintendent or foreman who neglects to have Work done in accordance with the Plans and Specifications shall be removed from the Project. The superintendent will be CONTRACTOR's representative at the Site and shall have authority to act on behalf of CONTRACTOR. All communications given to the superintendent shall be as binding as if given to CONTRACTOR.

6.02 Labor and Working Hours

A. CONTRACTOR shall provide competent, suitably qualified personnel in their various duties. CONTRACTOR shall at all times maintain good discipline and order at the Site. Except as otherwise required for the safety or protection of persons, the Work, property at the Site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Work at the Site shall be performed during regular working hours (7:00 a.m. to 7:00 p.m.), and CONTRACTOR will not permit the performance of Work on Sunday or any legal holiday without OWNER's written consent given after prior written notice to ENGINEER.

6.03 Services, Materials and Equipment

A. Unless otherwise specified in the Contract Documents, CONTRACTOR shall furnish and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start up and completion of the Work.

B. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Contract Documents shall expressly run to the benefit of OWNER. If required by ENGINEER, CONTRACTOR shall furnish satisfactory evidence, (including reports of required tests) as to the kind and quality of materials and equipment to be incorporated in the Work. The CONTRACTOR shall not use material in the Work until Shop Drawing or Submittals have been reviewed by the ENGINEER. All materials which do not meet the requirements of the Specifications at the time they are to be used will be rejected, and unless otherwise permitted by ENGINEER, shall be plainly marked and removed immediately from the Work.

C. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, Supplier or distributor, except as otherwise provided in the Contract Documents.

6.04 Substitutes and "Or-Equals"

Whenever an item of materials or equipment is specified or described in the Contract Documents for installation in the Work by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier or distributor; or means, methods, techniques, sequences and procedures of

construction are prescribed in the Plans or Specifications; the specification or description is intended to establish the type, function and quality required or the means, methods, techniques, sequences and procedures of construction required. Unless the specification or description contains or is followed by words indicating that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment or materials or equipment of other manufacturers, fabricators, suppliers or distributors; or other means, methods, techniques, sequences and procedures of construction may be accepted by ENGINEER under the following circumstances:

1. "Or-Equal": If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

2. Substitute Items: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.04.A; or a proposed means, methods, techniques, sequences and procedures of construction are different from what is prescribed in the Plans or Specifications, it will be considered a proposed substitute item.

B. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or equipment or means, methods, techniques, sequences and/or procedures proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by the ENGINEER will include the following, as supplemented in the Specifications, and as ENGINEER may decide is appropriate under the circumstances. Requests for review of substitute items of material and equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

C. If CONTRACTOR wishes to furnish or use a substitute, CONTRACTOR shall make written application to ENGINEER on the Substitution Request Form provided for acceptance thereof, certifying that the proposed substitute will:

1. perform adequately the functions and achieve the results called for by the general design,

2. be similar in substance to that specified,

3. and be suited to the same use and capable of performing the same function as that specified.

The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not acceptance of the proposed substitute for use in the Work will require a change in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute, and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.

D. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service shall be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by ENGINEER in evaluating the proposed substitute. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute.

E. All data to be provided by CONTRACTOR in support of any proposed "or-equal" or substitute item will be at CONTRACTOR's expense. ENGINEER will be the sole judge of acceptability, and ENGINEER's determination shall be final and binding, may not be reversed through an appeal under any provisions of the Contract Documents, and no "or-equal" or substitute shall be ordered, installed or utilized without ENGINEER's prior written acceptance. OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute which has been approved by ENGINEER.

F. ENGINEER will record time required by ENGINEER and ENGINEER's consultants in evaluating substitutions proposed by CONTRACTOR and in making changes in the Contract Documents occasioned thereby. Whether or not ENGINEER accepts a proposed substitute, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's consultants for evaluating any proposed substitute and in making any changes in the Contract Documents resulting therefrom.

6.05 Concerning Subcontractors

A. CONTRACTOR shall not employ any Subcontractor, Supplier or other person or organizations, including those who are to furnish the principal items of materials or equipment, whether initially or as a substitute, against whom OWNER or ENGINEER may have reasonable objection. CONTRACTOR shall furnish ENGINEER a complete list of any Subcontractor, Supplier or other person or organization furnishing principal items of material or equipment within 4 days of request. Failure to object to any Subcontractor, Supplier, other person or organization by OWNER or ENGINEER shall not constitute a waiver of any right of OWNER or ENGINEER to reject defective Work.

B. If OWNER or ENGINEER, after due investigation, has reasonable objection to any Subcontractor, Supplier, other person or organization proposed by CONTRACTOR after the Notice of Award, CONTRACTOR shall submit an acceptable substitute and the Contract Price shall be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate Change Order shall be issued. CONTRACTOR shall not be required to employ any Subcontractor, Supplier, other person or organization against whom CONTRACTOR has reasonable objection.

C. The CONTRACTOR shall not award Work to Subcontractor(s), in excess of 50% of the Contract Price, without prior written approval of the OWNER.

D. CONTRACTOR shall be fully responsible for all acts and omissions of his Subcontractors, Suppliers and of persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR just as CONTRACTOR is responsible for CONTRACTOR's own acts and omissions.

Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier of other person or organization any contractual relationship between OWNER or ENGINEER and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of OWNER or ENGINEER to pay or to see to the payment of any moneys due any Subcontractor, Supplier or other person or organization. OWNER or ENGINEER may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, evidence of amounts paid to CONTRACTOR on account of specific Work done.

E. The CONTRACTOR shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with CONTRACTOR. CONTRACTOR shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with the ENGINEER through CONTRACTOR.

F. If the amount of the subcontract or the nature of the Work to be performed thereunder warrants, OWNER may require Subcontractor to furnish, for the benefit of the OWNER and CONTRACTOR jointly, Bonds in an amount proportioned to the amount of his subcontract, and for the same purpose and under the same specifications as those of the general Contract. The Surety on the general Contract shall not be eligible to furnish such Subcontract Bonds.

G. All Work performed for CONTRACTOR by a Subcontractor or Supplier will be pursuant to an appropriate agreement between CONTRACTOR and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of OWNER and ENGINEER. Whenever any such agreement is with a Subcontractor or Supplier who is listed as and additional insured on the property insurance provided in paragraph 5.03.A.5, the agreement between the CONTRACTOR and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against OWNER, CONTRACTOR, ENGINEER, ENGINEER's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, CONTRACTOR will obtain the same. CONTRACTOR shall file a true copy of such agreement with OWNER.

6.06 Patent Fees and Royalties

A. CONTRACTOR shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of OWNER or ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by OWNER in Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall defend, indemnify and hold harmless OWNER and ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

6.07 Permits and Licenses

A. CONTRACTOR shall obtain and pay for all construction permits and licenses. OWNER shall assist CONTRACTOR, when necessary, in obtaining such permits and licenses. CONTRACTOR shall pay all governmental charges, permit, review, and inspection fees necessary for the prosecution of the Work, which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. CONTRACTOR shall pay all charges of utility owners for connections to the Work.

6.08 Laws and Regulations

A. CONTRACTOR shall give all notices and comply with all laws, ordinances, rules, and regulations applicable to furnishing and performance of the Work. Neither OWNER nor ENGINEER shall be responsible for monitoring CONTRACTOR's compliance with any Laws, ordinances, rules, and Regulations.

B. If CONTRACTOR performs any Work that is contrary to such laws, ordinances, rules and regulations, CONTRACTOR shall bear all claims, costs, losses, damages and expenses caused by, arising out of, or resulting therefrom. However, it shall not be CONTRACTOR's primary responsibility to make certain that the Specifications and Plans are in accordance with such laws, ordinances, rules, and regulations, but this shall not relieve CONTRACTOR of CONTRACTOR's obligations under paragraph 3.03.

C. OWNER or CONTRACTOR may give notice to the other party of any changes after the submission of CONTRACTOR's Bid (or after the date when CONTRACTOR became bound under a negotiated Contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If OWNER and CONTRACTOR are unable to agree on entitlement to, or on the amount, or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice CONTRACTOR may submit a Change Proposal, or OWNER may initiate a Claim.

6.09 Taxes

A. CONTRACTOR shall pay all sales, consumer, use and other similar taxes required to be paid by CONTRACTOR in accordance with Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.10 Use of Premises

A. CONTRACTOR shall confine construction equipment, the storage of materials and equipment and the operations of workers to the Project Site and land and areas identified in and permitted by the Contract Documents and other land and areas

permitted by Laws and Regulations, rights of way, permits and easements, and shall not unreasonably encumber the premises with construction equipment or other materials or equipment. CONTRACTOR shall assume full responsibility for any damage to any such land or area or to the owner or occupant thereof or of any adjacent land or areas resulting from the performance of the Work. Should any claim be made by any such owner or occupant because of the performance of the Work, CONTRACTOR shall promptly settle with any such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law. CONTRACTOR's continuing obligations under paragraph 6.24 shall be applicable to any claim hereunder.

6.11 Removal of Debris and Cleaning

A. During the progress of the Work, CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, appliances, construction equipment and machinery, and surplus materials, and shall leave the Site clean and ready for occupancy by OWNER at Substantial Completion of the Work. CONTRACTOR shall restore to their original condition all property not designated for alteration by the Contract Documents. If CONTRACTOR shall fail to keep the above noted areas cleaned of dust or debris resulting from CONTRACTOR's operations, CONTRACTOR shall be so notified in writing by ENGINEER. If within 24 hours after receipt of such notice CONTRACTOR shall fail to clean such areas satisfactorily, OWNER may have such other agency as he shall designate, perform the work and all costs of such cleaning shall be paid for by CONTRACTOR.

6.12 Loading Structures

A. CONTRACTOR shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall CONTRACTOR subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.13 Protection of Utilities

A. When it is possible for construction operations to endanger any public or private utility, conduit, or structure, CONTRACTOR shall notify the utility owner of this possibility, and safeguard and support such utilities, conduits, or structures. Where it is the policy of any utility owner to make its own repairs to damaged conduit or other structures, CONTRACTOR shall cooperate to the fullest extent with the utility, and he shall see that his operations interfere as little as possible with these operations, and CONTRACTOR shall assume the cost of any charge against OWNER therefor. In cases where existing Utilities or Utility service connections are encountered, CONTRACTOR shall perform his operations in such a manner that service will be uninterrupted, and the cost thereof shall be at CONTRACTOR's expense, unless otherwise provided.

6.14 Record Documents

A. CONTRACTOR shall maintain in a safe place at the Site 1 record copy of all Specifications, Plans, Addenda, Change Orders, Work Change Directives, and Field Orders, in good order and annotated to show all changes made during construction. These record documents together with all Samples and all Shop Drawings shall be available to ENGINEER for examination and shall be delivered to ENGINEER for OWNER upon completion of the Work.

6.15 Safety and Protection

A. CONTRACTOR shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Work Site or who may be affected by the Work,

2. all the Work and materials or equipment to be incorporated therein, whether in storage on or off the Site, and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and Utilities and not designated for removal, relocation or replacement in the course of construction.

B. CONTRACTOR shall comply with all applicable Laws and Regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property, Utilities, and utility owners when prosecution of the Work may affect them.

C. CONTRACTOR shall restore, at his own expense, any public or private property damaged or injured in consequence of any act or omission on his part, or on the part of his employees or agents, to a condition equal or better than that existing before such injury or damage was done. If CONTRACTOR neglects to restore or make good such damages or injury, OWNER may, upon 48 hours' notice, proceed to restore or make good such damage or injury and to order the cost thereof deducted from any monies that are due, or may become due, to CONTRACTOR for this Work.

D. CONTRACTOR's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and ENGINEER has issued a notice to OWNER and CONTRACTOR in accordance with paragraph 14.11 that the Work is Acceptable.

E. CONTRACTOR shall comply with the applicable requirements of OWNER’s safety programs, if any. Any OWNER’s safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

F. CONTRACTOR shall inform OWNER and ENGINEER of the specific requirements of CONTRACTOR’s safety program with which OWNER’s and ENGINEER’s employees and representatives must comply while at the Site.

G. CONTRACTOR’s duties and responsibilities for safety and protection will continue until all the Work is completed, ENGINEER has issued a written notice to OWNER and CONTRACTOR in accordance with paragraph 14.11 that the Work is acceptable, and CONTRACTOR has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

H. CONTRACTOR’s duties and responsibilities for safety and protection will resume whenever CONTRACTOR or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

6.16 Safety Representative

A. CONTRACTOR shall be responsible to designate for itself and its employees, and its Subcontractors a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.17 Hazard Communication Program

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

6.18 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, CONTRACTOR, without special instruction or authorization from OWNER or ENGINEER, is obligated to act to prevent threatened damage, injury or loss. CONTRACTOR shall give ENGINEER prompt written notice if CONTRACTOR believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby. If ENGINEER determines that a change in the Contract Documents is required because of the action taken by CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued to document the consequences of such action.

6.19 Shop Drawings and Samples

A. CONTRACTOR shall submit Shop Drawings required by the Contract Documents to ENGINEER for review, in accordance with an accepted schedule. All Submittals will be identified as ENGINEER may require and in the number of copies specified in the Specifications. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show ENGINEER the materials and equipment CONTRACTOR proposes to provide and to enable ENGINEER to review the information for the limited purposes required by paragraph 6.21.

B. CONTRACTOR shall also submit all samples required by the Contract Documents to ENGINEER for review in accordance with an accepted schedule. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, the use for which intended, and other data as ENGINEER may require to enable ENGINEER to review the Submittal for the limited purposes required by paragraph 6.21. The number of each sample to be submitted will be as specified in the Specifications.

6.20 Submittal Procedures

A. Before submitting each Shop Drawing or Sample, CONTRACTOR shall have determined and verified:

1. all field measurements, quantities, dimension, specified performance criteria, installation requirements, manufacturer's recommendations, material, catalog numbers and similar information with respect thereto,

2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and

3. all information relative to CONTRACTOR's responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.

B. CONTRACTOR shall have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

C. Each Submittal will bear a stamp or specific written indication that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents with respect to review and approval of that Submittal.

D. At the time of each submission, CONTRACTOR shall in writing call ENGINEER's attention to any deviations that the Shop Drawings or Samples may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to ENGINEER for review of each such variation.

E. CONTRACTOR shall make corrections required by ENGINEER and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. CONTRACTOR shall direct specific attention in writing to revisions other than the corrections called for by ENGINEER on previous Submittals.

F. CONTRACTOR shall furnish required Submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. ENGINEER will record ENGINEER's time for reviewing a fourth or subsequent submittal of Shop Drawings, sample, or other item requiring approval, and CONTRACTOR shall be responsible for ENGINEER's charges to OWNER for such time. OWNER may impose a set-off against payments due to CONTRACTOR to secure reimbursement for such charges.

G. If CONTRACTOR requests a change of a previously approved Submittal item, CONTRACTOR shall be responsible for ENGINEER's charges to OWNER for its review time, and OWNER may impose a set-off against payments due to CONTRACTOR to secure reimbursement for such charges, unless the need for such change is beyond the control of CONTRACTOR.

6.21 Engineer's Review

A. ENGINEER will review Shop Drawings and Samples in accordance with the Schedule of Submittals accepted by ENGINEER as required by paragraph 2.05. ENGINEER's review shall be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate review of the assembly in which the item functions.

B. ENGINEER's review of Shop Drawings or samples shall not relieve CONTRACTOR from responsibility for any variations from the Contract Documents unless CONTRACTOR has in writing called ENGINEER's attention to such variation at the time of submission and ENGINEER has given written concurrence to the specific variation, nor shall any concurrence by ENGINEER relieve CONTRACTOR from

responsibility for errors or omissions in the Shop Drawings. ENGINEER's review shall not relieve CONTRACTOR from responsibility for complying with the requirements of paragraph 6.20.

C. Where a Shop Drawing or sample is required by the Contract Documents or the Schedule of Submittals accepted by ENGINEER per paragraph 2.05, no related Work shall be commenced until the Submittal has been reviewed by the ENGINEER.

6.22 Continuing the Work

A. CONTRACTOR shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with OWNER. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as CONTRACTOR and OWNER may otherwise agree in writing.

6.23 Contractor's General Warranty and Guarantee

A. CONTRACTOR warrants and guarantees to OWNER, ENGINEER, and ENGINEER's Consultants that all work will be in accordance with the Contract Documents and will not be defective. CONTRACTOR's warranty and guarantee excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than CONTRACTOR, Subcontractors, Suppliers, or their employees, agents, or representatives, or any person or entity for whom CONTRACTOR is responsible; or

2. normal wear and tear under normal usage.

B. CONTRACTOR's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of CONTRACTOR's obligation to perform the Work in accordance with the Contract Documents:

1. observations by ENGINEER;

2. recommendation of any progress or final payment by ENGINEER;

3. the issuance of a certificate of Substantial Completion or any payment by OWNER to CONTRACTOR under the Contract Documents;

4. use or occupancy of any part of the Work by OWNER;

5. any acceptance by OWNER or failure to do so;

6. any review or approval of a Shop Drawing or Sample Submittal or the issuance of a notice of acceptability by ENGINEER per paragraph 14.11;

7. any inspection, test or approval by others; or

8. any correction of defective Work by OWNER.

C. If Contract requires the CONTRACTOR to accept the assignment of a contract entered into by OWNER, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to CONTRACTOR's performance obligations to OWNER for the Work described in the assigned Contract.

D. CONTRACTOR shall assign to OWNER all warranties extended to CONTRACTOR by material Suppliers and Subcontractors. If an assignment of warranty requires the material Supplier or Subcontractor to consent to same, then CONTRACTOR shall secure the material Supplier's or Subcontractor's consent to assign said warranties to OWNER.

E. The warranties provided in this section shall be in addition to, and not in limitation of, any other warranty or remedy required by law.

6.24 Indemnification

A. To the fullest extent permitted by law, CONTRACTOR shall indemnify, defend (with counsel acceptable to OWNER) and hold harmless OWNER, ENGINEER and any additional indemnitees identified in the Supplementary Conditions and their respective directors, officers, members, partners, affiliates, employees, agents and successors, from and against any and all liabilities, claims, causes of action, lawsuits, liens, injuries, damages, losses and expenses (collectively "Demands") to the extent caused by, arising out of, resulting from or occurring in connection with:

1. CONTRACTOR's breach of, or failure to comply with, the Agreement, the Contract Documents, or any other contract that it enters into regarding the Work, including any default in performance; or

2. Personal injury or death to any person (including, but not limited to, CONTRACTOR, CONTRACTOR's employees, Subcontractors, Subcontractors' employees, and material Suppliers) or injury to or destruction of property (including claims for loss of use) caused by, arising out of, resulting from, or in any way connected with

   a. the Work,

   b. any activity associated with the Work, or

   c. the operations or acts of commission or omission of CONTRACTOR, CONTRACTOR's employees, Subcontractors, Subcontractors' employees, material suppliers, or anyone for whom CONTRACTOR is legally liable in the performance of Work, whether arising before or after completion of the Work.

B. To the extent caused by, arising out of, resulting from, or occurring in connection with the provisions of the above paragraph 6.24.A, CONTRACTOR's indemnity obligations under this Agreement shall include, but are not limited to:

1. Indemnity for all damages and judgment interest, all costs and fees, including, but not limited to, all defense costs, expenses and actual attorneys' fees, and all settlement payments relating to, arising out of, resulting from or in any way connected with any demand requiring indemnity by this Agreement;

2. All expenses, including but not limited to, costs, expenses and actual attorneys' fees, incurred in securing and enforcing indemnity from CONTRACTOR if CONTRACTOR fails or refuses promptly to fulfill any of the indemnity obligations under this Agreement;

3. All indemnification obligations imposed upon OWNER or ENGINEER, or both, arising out of or in connection with the Work; and

4. Indemnification for any penalties and/or fines arising or resulting from CONTRACTOR's or any SUBCONTRACTOR's failure to comply with laws and/or regulations applicable to its/their Work.

C. Contractor's duty to indemnify under Subpart A.2. of Article 6.24 is limited to the negligence of Contractor, Contractor's employees, Subcontractors, Subcontractor's employees, material Suppliers, or anyone for whom Contractor is legally liable in the performance of the Work, whether arising before or after the completion of the Work.

D. The indemnification rights under this Agreement shall not be construed to negate, abridge, or otherwise reduce any other right or obligations of indemnity which would otherwise exist.

E. OWNER, at its option, may select counsel to defend any demand brought against it without impairing any obligation of the CONTRACTOR to provide indemnification.

F. The indemnification provisions under this Agreement shall survive the completion or termination of this Agreement.

G. In the case of claims by any employee of CONTRACTOR, anyone directly or indirectly employed by CONTRACTOR, or anyone for whose acts CONTRACTOR may be liable, the indemnification obligations under this Agreement shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for CONTRACTOR under workers' compensation acts. Such obligations shall not be construed to negate, abridge or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Agreement.

H. Indemnification, additional insured and hold harmless obligations of CONTRACTOR and Subcontractor under the Contract Documents shall survive the termination of this Agreement.

I. CONTRACTOR and Subcontractors will compel their insurance company to waive subrogation against OWNER, all ENGINEERS and all CONTRACTORS and Subcontractors identified as additional insureds in the Contract Documents, including any municipal entity now existing or newly created during the term of the Contract Documents.

6.25 Delegation of Professional Design Services

A. CONTRACTOR will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out CONTRACTOR's responsibilities for construction means, methods, techniques, sequences or procedures. CONTRACTOR shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, equipment, structures, means, methods, techniques or sequences of construction are specifically required of CONTRACTOR by the Contract Documents, OWNER and ENGINEER will specify all performance and design criteria that such services must satisfy. CONTRACTOR shall cause such services or certifications to be provided by a professional properly licensed in the

state in which the project is located, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other Submittals prepared by such professional. Shop Drawings and other Submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to ENGINEER.

C. OWNER and ENGINEER shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals.

D. Pursuant to this paragraph 6.25, ENGINEER's review or approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. ENGINEER's review or approval of Shop Drawings and other Submittals (except design calculations and design drawings) will be only for the purpose stated in paragraph 6.21.

E. CONTRACTOR shall not be responsible for the adequacy of the performance or design criteria specified by OWNER or ENGINEER.

Article 7 Work by Others

7.01 Related Work at Site

A. In addition to and apart from the Work under the Contract Documents, the OWNER may perform other work at or adjacent to the Site. Such other work may be performed by OWNER's employees, or through contracts between the OWNER and third parties. OWNER may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If any part of CONTRACTOR's Work depends on proper execution or results upon the work of any such other contractor or utility owner, CONTRACTOR shall inspect and promptly report to ENGINEER in writing any delays, defects or deficiencies in such other work that render it unavailable, or unsuitable for such proper execution and results of CONTRACTOR's Work. CONTRACTOR's failure to so report shall constitute an acceptance of the other work as fit and proper for integration with CONTRACTOR's Work except for latent or non-apparent defects and deficiencies in the other work.

C. CONTRACTOR shall afford each contractor who is party to such a direct contract, and each utility owner, (and OWNER, if OWNER is performing the additional work with OWNER's employees), proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, CONTRACTOR shall do all cutting, fitting and patching of CONTRACTOR's Work that may be required to make its several parts come together properly and integrate with such other work. CONTRACTOR shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of ENGINEER and the others whose work will be affected.

D. If the performance of additional work by other contractors, utility owner, or OWNER was not noted in the Contract Documents, written notice thereof shall be given to CONTRACTOR prior to starting any such additional work. If CONTRACTOR believes that the performance of such additional work by OWNER or others involves additional expense to CONTRACTOR, or requires an extension of the Contract Time, CONTRACTOR may make a Claim therefor as provided in paragraph 11.01. Claims for delay or inconveniences due to operations of such other parties for work noted in the Contract Documents will not be allowed.

Article 8 Owner's Responsibilities

8.01 Communication to Contractor

A. Except as otherwise provided in these General Conditions, OWNER shall issue all communications to CONTRACTOR through ENGINEER.

8.02 Replacement of ENGINEER

A. In case of termination of the employment of ENGINEER, OWNER shall appoint an engineer against whom CONTRACTOR makes no reasonable objection, whose status under the Contract Documents shall be that of the former ENGINEER.

8.03 Furnishing Data

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

8.04 Pay When Due

A. OWNER shall make payments to CONTRACTOR promptly after they are due as provided in paragraphs 14.05 and 14.11.

8.05 Lands and Easements; Reports and Tests

A. OWNER's duties in respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in paragraphs 4.01 and 4.05. Paragraph 4.02 refers to OWNER's identifying and making available to CONTRACTOR copies of reports of investigations and tests of subsurface and latent physical conditions at the Site.

8.06 Change Orders

A. In connection with OWNER's rights to request changes in the Work in accordance with Article 10, OWNER (especially in certain instances as provided in paragraph 10.01) is obligated to execute Change Orders.

8.07 Inspections, Tests, and Approvals

A. OWNER'S responsibility in respect to certain inspections, tests and approvals is set forth in paragraph 13.02.

8.08 Limitation on Owner's Responsibility

A. OWNER shall not supervise, direct or have control or authority over, nor be responsible for, CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. OWNER will not be responsible for CONTRACTOR's failure to perform or furnish the Work in accordance with the Contract Documents.

8.09 Undisclosed Hazardous Materials

A. OWNER's responsibility in respect of undisclosed Constituents of Concern uncovered or revealed at the Site is set forth in paragraph 4.06.

8.10 Owner's Designated Representative

A. OWNER shall designate a person to act as its representatives during the performance of the Work. OWNER's designated representative will attend meetings and perform on behalf of OWNER all obligations required of OWNER under the provisions of the Contract Documents.

Article 9 Engineer's Status During Construction

9.01 Owner's Representative

A. ENGINEER will be OWNER's representative during the construction period. The duties and responsibilities and the limitations of authority of ENGINEER as OWNER'S representative during construction shall be as set forth in the Contract Documents.

9.02 Visits to Site

A. ENGINEER may make visits to the Site at intervals appropriate to the various stages of construction to observe the progress and quality of the executed Work, and to determine solely for the benefit of OWNER, in general, if the Work is proceeding in accordance with the technical requirements of the Contract Documents. It will not be the responsibility of ENGINEER to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.

9.03 Resident Project Representative

A. If OWNER and ENGINEER agree, ENGINEER will furnish a Resident Project Representative to assist ENGINEER in providing more continuous observation of the Work. A Resident Project Representative will act as directed by and under the supervision of ENGINEER and will confer with ENGINEER regarding his actions. Resident Project Representative's dealings in matters pertaining to the on-site Work shall in general be only with ENGINEER and CONTRACTOR, and dealings with Subcontractors shall only be through or with the full knowledge of CONTRACTOR. The Resident Project Representative's duties and responsibilities include:

1. Schedules

    a. Review the Progress Schedule, Schedule of Submittals and Schedule of Values prepared by CONTRACTOR.

2. Conferences

    a. Arrange a schedule of progress meetings and other job conferences as required in consultation with ENGINEER and OWNER and notify those expected to attend in advance.

3. Liaison

    a. Serve as ENGINEER's liaison with CONTRACTOR, working principally through CONTRACTOR's superintendent and assist him in understanding the intent of the technical aspects of the

Contract Documents. Assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-site operations.

4. Shop Drawings and Samples

   a. Advise ENGINEER and CONTRACTOR, or CONTRACTOR's superintendent, immediately of the commencement of any Work requiring a Shop Drawing or Sample submission if the submission was identified on the schedule and has not been reviewed by ENGINEER.

5. Review of Work, Rejection of Defective Work, Inspections, and Tests:

   a. Conduct on Site observations of the Work and report to ENGINEER whenever Resident Project Representative believes that technical aspects of any executed Work is unsatisfactory, faulty or defective or does not meet the requirements of any inspections, tests or approval required to be made or has been damaged prior to final payment; and advise ENGINEER when Resident Project Representative believes that any partially completed portion of the Work should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

   b. Observe, record and report to ENGINEER appropriate details relative to test procedures and startups.

   c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the outcome of these inspections and report to ENGINEER.

6. Modifications

   a. Consider CONTRACTOR's suggestions for modifications in Plans or Specifications and report them to ENGINEER.

7. Reports

   a. Prepare periodic reports as required of progress of the Work and CONTRACTOR's compliance with the approved Progress Schedule and Schedule of Submittals.

8. Completion

   a. Verify that all items on final list of items requiring completion or correction have been completed or corrected and make recommendations to ENGINEER concerning acceptance.

9. Exceptions

   a. Resident Project Representative:

      (1) Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.

      (2) Shall not approve or accept any portion of the completed Work.

(3) Shall not undertake any of the responsibilities of CONTRACTOR, Subcontractors or CONTRACTOR's superintendent, or expedite the Work.

(4) Shall not advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract Documents.

(5) Shall not advise on or issue directions as to safety precautions and programs in connection with the Work.

(6) Shall not advise on or issue directions regarding CONTRACTOR's failure to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

9.04 Clarifications and Interpretations

A. ENGINEER will issue with reasonable promptness such written clarifications or interpretations of the Contract Documents as ENGINEER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 Authorized Variations in Work - Field Order

A. ENGINEER may authorize minor adjustments in the Work to avoid obstructions or interferences which do not involve an adjustment in the Contract Price or the Contract Time, and which are consistent with the overall intent of the Contract Documents. These may be accomplished by a Field Order and shall be binding on OWNER, and also on CONTRACTOR who shall perform the change promptly. If OWNER or CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a request for a Change Proposal may be made therefore as provided in paragraph 10.06 or a Claim may be submitted as set forth in paragraph 11.01.

9.06 Rejecting Defective Work

A. ENGINEER will have authority to disapprove or reject completed portions of the Work which ENGINEER believes to be defective and will also have authority to require special inspection or testing of the Work as provided in paragraph 13.04, whether or not the Work is fabricated, installed or completed.

9.07 Shop Drawings, Change Orders, and Payments

A. ENGINEER's responsibility for Shop Drawings and samples are set forth in paragraphs 6.19 through 6.21 inclusive.

B. ENGINEER's responsibilities as to Change Orders are set forth in Articles 10, 11, and 12.

C. ENGINEER's responsibilities in respect of Applications for Payment are set forth in Article 14.

9.08 Determinations for Unit Price Work

A. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of paragraph 10.06.

9.09 Decisions on Disagreements, Claims

A. ENGINEER will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work performed thereunder. Claims, disputes and other matters relating to the acceptability of the Work, or the interpretation of the requirements of the Contract Documents pertaining to the execution and progress of the Work, shall be referred initially to ENGINEER in writing with a request for a formal decision in accordance with this paragraph 9.09.

B. ENGINEER will, with reasonable promptness, render a written decision on the issue referred. If OWNER or CONTRACTOR believe that any such decision entitles them to an adjustment in the Contract Price, or Contract Times, or both, a Claim may be made under paragraph 11.01.

C. ENGINEER's written decision on the issue referred will be final and binding on OWNER and CONTRACTOR, subject to the provisions of paragraph 11.01.

D. In this capacity ENGINEER will not show partiality to OWNER or CONTRACTOR and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.10 Limitations on Engineer's Responsibilities

A. Neither ENGINEER's authority to act under this Article 9 or elsewhere in the Contract Documents, nor any decision made by ENGINEER in good faith either to exercise or not exercise such authority, shall give rise to any duty or responsibility of ENGINEER to OWNER or CONTRACTOR, any Subcontractor, any manufacturer, fabricator, Supplier, distributor, surety, or any other person, employee, or agent of any of them.

B. ENGINEER will not supervise, direct, control or have authority over, or be responsible for CONTRACTOR's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of the Work. ENGINEER will not be responsible for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents. These limitations on authority and responsibility shall also apply to ENGINEER's Consultant's, Resident Project Representative and assistants.

C. ENGINEER will not be responsible for the acts or omissions of CONTRACTOR or of any Subcontractor, Supplier, or of any other individual or entity performing any of the Work.

D. ENGINEER will not be responsible to CONTRACTOR or any Subcontractor, or Supplier, or to their agents or employees for injuries, damages, claims, losses, or expenses (including attorney's fees) of whatsoever kind resulting from or caused by any act or omission of ENGINEER in preparation for, arising from, relating to, or concerning the Project. Such acts or omissions include, but are not limited to, ENGINEER's negligence, tortuous conduct, errors, omissions, strict liability, breach of contract, or breach of warranty. ENGINEER makes no representations to CONTRACTOR, Subcontractors, Suppliers or their agents or employees regarding or respecting any work performed by ENGINEER in preparation for, arising from, relating to, or concerning the Project.

E. Neither CONTRACTOR, its agents or employees, nor any Subcontractors or Suppliers or their agents or employees, are intended beneficiaries of ENGINEER's agreement with OWNER, nor are such parties intended beneficiaries of ENGINEER's duties or responsibilities arising therefrom. ENGINEER disclaims all duties to CONTRACTOR, Subcontractors, Suppliers or their agents or employees arising from, relating to, or concerning ENGINEER's involvement in the Project. OWNER and CONTRACTOR further agree to notify all CONTRACTOR's, Subcontractors or Suppliers of this disclaimer of ENGINEER's liability and require them to abide by this disclaimer.

Article 10 Amending the Contract Documents; Changes in the Work

10.01 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. Change Orders:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. OWNER and CONTRACTOR may amend those terms and conditions of the Contract Documents that do not involve;

(1) the performance or acceptability of the Work,

(2) the design (as set forth in the Drawings, Specifications, or otherwise), or

(3) other engineering or technical matters, without the recommendation of ENGINEER. Such an amendment shall be set forth in a Change Order.

2. Work Change Directives.

a. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work

Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including paragraph 10.04 regarding change of Contract Price.

b. CONTRACTOR must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the issuance of the Work Change Directive.

c. OWNER must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. Field Orders.

a. ENGINEER may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on OWNER and CONTRACTOR, which shall perform the Work involved promptly.

b. If CONTRACTOR believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, CONTRACTOR shall submit a Change Proposal as provided herein.

10.02 Owner-Authorized Changes in the Work

A. Without invalidating the Contract and without notice to any surety, OWNER may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by ENGINEER's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if OWNER and CONTRACTOR have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive.

B. Upon receipt of any such document, CONTRACTOR shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph 10.02 shall obligate CONTRACTOR to undertake work that CONTRACTOR reasonably concludes cannot be performed in a manner consistent with CONTRACTOR's safety obligations under the Contract Documents or Laws and Regulations.

10.03 Unauthorized Changes in the Work

A. CONTRACTOR shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in paragraph 6.18 or in the case of uncovering Work as provided in paragraph 13.03.

10.04 Change of Contract Price

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of paragraph 11.01.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by Unit Prices contained in the Contract Documents, then by application of such Unit Prices to the quantities of the items involved (subject to the provisions of paragraph 12.03); or

2. where the Work involved is not covered by Unit Prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 10.04.C.2); or

3. where the Work involved is not covered by Unit Prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in paragraph 12.01) plus a CONTRACTOR's fee for overhead and profit (determined as provided in paragraph 10.04.C).

C. CONTRACTOR's Fee: When applicable, the CONTRACTOR's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under paragraph 12.01.B.1 and 12.01.B.2, the CONTRACTOR's fee shall be 15 percent;

b. for costs incurred under paragraph 12.01.B.3, the CONTRACTOR's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 10.04.C.2.a and 10.04.C.2.b is that the CONTRACTOR's fee shall be based on:

(1) a fee of 15 percent of the costs incurred under paragraphs 12.01.B.1 and 12.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and

(2) with respect to CONTRACTOR itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor;

provided, however, that for any such subcontracted work the maximum total fee to be paid by OWNER shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. no fee shall be payable on the basis of costs itemized under paragraphs 12.01.B.4, 12.01.B.5, and 12.01.C;

e. the amount of credit to be allowed by CONTRACTOR to OWNER for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in CONTRACTOR's fee by an amount equal to 5 percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in CONTRACTOR's fee shall be computed on the basis of the net change in accordance with paragraphs 10.04.C.2.a through 10.04.C.2.e, inclusive.

10.05 Change of Contract Times

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of paragraph 11.01.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in paragraph 12.04, concerning delays in CONTRACTOR's progress.

10.06 Change Proposals

A. CONTRACTOR shall submit a Change Proposal to ENGINEER to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by ENGINEER concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seeking other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only 1 issue, or a set of closely related issues.

1. Procedures. CONTRACTOR shall submit each Change Proposal to ENGINEER promptly (but in no event later than 5 days) after the start of the event giving rise thereto, or after such initial decision. CONTRACTOR shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any) to ENGINEER and OWNER within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which CONTRACTOR believes it is entitled as a result of said event. ENGINEER will advise OWNER regarding the Change Proposal and consider any comments or response from OWNER regarding the Change Proposal.

2. ENGINEER's Action. ENGINEER will review each Change Proposal and, within 30 days after receipt of the CONTRACTOR's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to OWNER and CONTRACTOR. If ENGINEER does not take

action on the Change Proposal within 30 days, then either OWNER or CONTRACTOR may at any time thereafter submit a letter to the other party indicating that as a result of the ENGINEER's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under paragraph 11.01.

3. Binding Decision. ENGINEER's decision will be final and binding upon OWNER and CONTRACTOR, unless OWNER or CONTRACTOR appeals the decision by filing a Claim under paragraph 11.01.

B. Resolution of Certain Change Proposals: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then ENGINEER will notify the parties that the ENGINEER is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and CONTRACTOR may choose to seek resolution under the terms of paragraph 11.01.

10.07 Execution of Change Orders

A. OWNER and CONTRACTOR shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the Parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an OWNER set-off, unless CONTRACTOR has duly contested such set-off;

3. changes in the Work which are:

a. ordered by OWNER pursuant to paragraph 10.02,

b. required because of OWNER's acceptance of defective Work under paragraph 13.08 or OWNER's correction of defective Work under paragraph 13.09, or

c. agreed to by the parties, subject to the need for ENGINEER's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under paragraph 10.06, or Article 16.

B. If OWNER or CONTRACTOR refuses to execute a Change Order that is required to be executed under the terms of this paragraph 10.07, it shall be deemed to be of full force and effect, as if fully executed.

10.08 Notification to Surety

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

Article 11 Claims

11.01 Claims

A. Claims Process: The following disputes between OWNER and CONTRACTOR shall be submitted to the Claims process set forth in this Article:

1. Appeals by OWNER or CONTRACTOR of ENGINEER's decisions regarding Change Proposals;

2. OWNER demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that ENGINEER has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 10 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the ENGINEER, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by CONTRACTOR seeking an increase in the Contract Times or Contract Price, or both, CONTRACTOR shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of CONTRACTOR's knowledge and belief the amount of time or money requested accurately reflects the full amount to which CONTRACTOR is entitled.

C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to ENGINEER.

D. Mediation:

1. At any time after initiation of a Claim, OWNER and CONTRACTOR may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If OWNER and CONTRACTOR agree to mediation, then after 60 days from such agreement, either OWNER or CONTRACTOR may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. OWNER and CONTRACTOR shall each pay one-half of the mediator's fees and costs.

E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 16 for final resolution of disputes.

F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either OWNER or CONTRACTOR may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 16 for final resolution of disputes.

G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

Article 12 Cost of the Work; Allowances; Unit Price Work

12.01 Cost of Work

A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this paragraph 12.01 are used to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, CONTRACTOR is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. Costs Included: Except as otherwise may be agreed to in writing by OWNER, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in paragraph 12.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of CONTRACTOR in the performance of the Work under schedules of job classifications agreed upon by OWNER and CONTRACTOR. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by OWNER.

2. Costs of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to CONTRACTOR unless OWNER deposits funds with CONTRACTOR with which to make payments, in which case the cash

discounts shall accrue to OWNER. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to OWNER, and CONTRACTOR shall make provisions so that they may be obtained.

3. Payments made by CONTRACTOR to Subcontractors for Work performed by Subcontractors. If required by OWNER, CONTRACTOR shall obtain competitive bids from Subcontractors acceptable to OWNER and CONTRACTOR and shall deliver such bids to OWNER, who will then determine, with the advice of ENGINEER, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as CONTRACTOR's Cost of the Work and fee as provided in this paragraph 12.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of CONTRACTOR.

    b. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from CONTRACTOR or others in accordance with rental agreements approved by OWNER with the advice of ENGINEER, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

        (1) The rental rate established for each piece of CONTRACTOR owned equipment, including appurtenances and attachments to the equipment, used will be determined by use of the Rental Rate Blue Book for Construction Equipment, Volume 1, 2 or 3, as applicable; the edition which is current at the time the Work was started will apply. The established rental rate will be equal to the "Monthly" rate divided by 176; modified by the rate adjustment factor and the applicable map adjustment factor, plus the "Estimated Operating Costs per Hour."

        (2) For equipment not listed in the Rental Rate Blue Book, Volume 1, 2 or 3, the rental rate will be determined by using the rate listed for a similar piece of equipment or by proportioning a rate listed so that the capacity, size, horsepower, and age are properly considered.

(3) For equipment for which there are no comparables in the Rental Rate Blue Book, Volume 1, 2 or 3, the monthly rate shall be reasonable, but not more than 5 percent of the current list price, or invoice, of the equipment. The base hourly rate shall then be determined by dividing the monthly rate by 176 to which 20 percent will be added to the sum which will account for adjustments and operating costs.

c. Sales, consumer, use, and other similar taxes related to the Work, and for which CONTRACTOR is liable, as imposed by laws and regulations.

d. Deposits lost for causes other than negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

e. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by CONTRACTOR in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with paragraph 5.03), provided such losses and damages have resulted from causes other than the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of OWNER. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining

f. The cost of utilities, fuel, and sanitary facilities at the Site.

g. The costs of premiums for all bonds and insurance that CONTRACTOR is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of CONTRACTOR's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by CONTRACTOR, whether at the Site or in CONTRACTOR's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 12.01.B.1 or specifically covered by paragraph 12.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the CONTRACTOR's fee.

2. Expenses of CONTRACTOR's principal and branch offices other than CONTRACTOR's office at the Site.

3. Any part of CONTRACTOR's capital expenses, including interest on CONTRACTOR's capital employed for the Work and charges against CONTRACTOR for delinquent payments.

4. Costs due to the negligence of CONTRACTOR, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 12.01.B.

D. CONTRACTOR's Fee: When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, CONTRACTOR's fee shall be determined as set forth in paragraph 10.04.C.

E. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 12, CONTRACTOR will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to ENGINEER on a daily basis, an itemized cost breakdown together with supporting data.

12.02 Allowances

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

B. Cash Allowances: CONTRACTOR agrees that:

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

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

C. Contingency Allowance: CONTRACTOR agrees that a contingency allowance, if any, is for the sole use of OWNER to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by ENGINEER to reflect actual amounts due CONTRACTOR on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

12.03 Unit Price Work

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

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to CONTRACTOR for Unit Price Work will be based on actual quantities.

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

D. ENGINEER will determine the actual quantities and classifications of Unit Price Work performed by CONTRACTOR. ENGINEER will review with CONTRACTOR the ENGINEER's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). ENGINEER's written decision thereon will be final and binding (except as modified by ENGINEER to reflect changed factual conditions or more accurate data) upon OWNER and CONTRACTOR, subject to the provisions of the following paragraph 12.03.E.

E. Within 30 days of ENGINEER's written decision under the preceding paragraph 12.03.D, CONTRACTOR may submit a Change Proposal, or OWNER may file a Claim, seeking and adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by CONTRACTOR differs materially and significantly from the estimate quantity of such item indicated in the Proposal (in no event will any change in quantities of less than 25% be considered a material or significant change from the estimated quantities); and

2. there is no corresponding adjustment with respect to any other item of Work.

12.04 Delays in Contractor's Progress

A. If OWNER, ENGINEER, or anyone for whom OWNER is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then CONTRACTOR shall be entitled to request an equitable adjustment in the Contract Times and Contract Price. However, CONTRACTOR's entitlement to an adjustment of the Contract Times or Contract Price is expressly conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times.

B. CONTRACTOR shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of CONTRACTOR. Delay, disruption, and interference attributable to and within the control of a SUBCONTRACTOR or Supplier shall be deemed to be within the control of CONTRACTOR.

C. If CONTRACTOR's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault and beyond the control of OWNER, CONTRACTOR, and those for which they are responsible, then CONTRACTOR shall be entitled to an equitable adjustment in Contract Times. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to CONTRACTOR's ability to complete the Work within the Contract Times. Such an adjustment shall be CONTRACTOR's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include only the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. acts or failures to act of utility owners (other than those performing other works at or adjacent to the Site by arrangement with the OWNER, as specified in paragraph 7.01); and

3. acts of war or terrorism.

D. CONTRACTOR's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. CONTRACTOR's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. CONTRACTOR shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of CONTRACTOR. Such a concurrent delay by CONTRACTOR shall not preclude an adjustment of Contract Times to which CONTRACTOR is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 10.

E. Each CONTRACTOR request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 10.04.

CONTRACTOR shall also furnish such additional supporting documentation as OWNER or ENGINEER may require including, where appropriate, a revised Progress Schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by paragraphs 4.03 and 4.06.

G. Paragraph 7.01 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

H. CONTRACTOR shall not be entitled to any adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of CONTRACTOR.

I. CONTRACTOR must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 5 days of the commencement of the delaying, disrupting, or interfering event.

J. Where CONTRACTOR is prevented from completing any part of the Work within the Contract Time (or Milestones) due to delay beyond the control of both OWNER and CONTRACTOR, an extension of the Contract Times (or Milestones) in an amount equal to the time lost due to such delay shall be CONTRACTOR's sole and exclusive remedy for such delay. In no event shall OWNER or ENGINEER be liable to CONTRACTOR, any Subcontractor, any Supplier, or any other person or organization, or to any surety or employee or any agent of them, for damages, including but not limited to all fees and charges of ENGINEERS, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or resulting from:

1. delays caused by or within the control of CONTRACTOR (or Subcontractor or Supplier);

2. delays beyond the control of both OWNER and CONTRACTOR, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts of neglect by utility owners or other contractors performing other work;

K. Nor shall OWNER or ENGINEER or each of them be liable to CONTRACTOR for any claims, costs, losses or damages sustained by CONTRACTOR on or in connection with any other project or anticipated project.

L. Nothing in this paragraph 12.04 bars a change in Contract Price to compensate CONTRACTOR due to delay, interference, or disruption directly attributable to actions or inactions of OWNER or anyone for whom OWNER is responsible. Except for an adjustment to the Contract Times and Contract Price, the CONTRACTOR shall not be entitled to and hereby waives any and all damages that it may suffer by reason of such delay or for any Act of God, including but not limited lost profits, overhead, and other consequential damages.

Article 13 Tests and Inspection; Correction, Removal or Acceptance of Defective Work

13.01 Access to Work

A. OWNER, ENGINEER and ENGINEER's representatives, other representatives of OWNER, testing agencies and governmental agencies with jurisdictional interests will have access to the Work at reasonable times for their observation, inspection and testing. CONTRACTOR shall provide proper and safe conditions for such access and advise OWNER and ENGINEER of CONTRACTOR's Site safety procedures and programs so that OWNER and ENGINEER may comply therewith as applicable.

13.02 Tests and Inspections

A. CONTRACTOR shall give ENGINEER and testing agency at least 24-hour notice, unless otherwise specified, of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. If any Law and Regulation, code, or order of any public body having jurisdiction requires any Work or part thereof to specifically be inspected, tested or approved, CONTRACTOR shall assume full responsibility therefor, pay all costs in connection therewith and furnish ENGINEER the required certificates of inspection, testing or approval.

C. CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with OWNER's or ENGINEER's acceptance of a manufacturer, fabricator, Supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to CONTRACTOR's purchase thereof for incorporation in the Work.

D. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by OWNER unless otherwise specified.

E. All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to OWNER and CONTRACTOR or by ENGINEER if so specified.

F. Cost of materials to be used in inspection and transportation costs shall be paid for by the CONTRACTOR.

G. Neither observations by ENGINEER nor inspections, tests or approvals by others shall relieve CONTRACTOR from his obligations to perform the Work in accordance with the Contract Documents.

13.03 Uncovering Work

A. If any Work that is to be tested, inspected or approved is covered without written concurrence of ENGINEER, or contrary to the written request of ENGINEER, it shall, if requested by ENGINEER, be uncovered by CONTRACTOR for ENGINEER's observation. Such uncovering shall be at CONTRACTOR's expense unless CONTRACTOR has given ENGINEER timely written notice of his intention to cover such Work and ENGINEER has not acted with reasonable promptness in response to such notice.

B. If ENGINEER considers it necessary or advisable that covered Work be observed by ENGINEER or inspected or tested by others, CONTRACTOR, at ENGINEER's request, shall uncover, expose or otherwise make available for observation, inspection or testing as ENGINEER may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. Except as otherwise specified in paragraph 13.04, the cost of Work shall be paid for as follows:

1. If it is found that such Work is defective, CONTRACTOR shall bear all the expenses of such uncovering, exposure, observation, inspection and testing, and of satisfactory reconstruction, (including, but not limited to, fees and charges of engineers, architects, attorneys, and other

professionals) and an appropriate deductive Change Order shall be issued. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, OWNER may make a Claim as provided in paragraph 11.01.

2. If, however, such Work is not found to be defective, CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, CONTRACTOR may make a Claim as provided in paragraph 11.01.

13.04 Defective Work

A. CONTRACTOR's Obligation: It is CONTRACTOR's obligation to assure that the Work is not defective.

B. ENGINEER's Authority: ENGINEER has the authority to determine whether Work is defective, and to reject defective Work.

13.05 OWNER May Stop the Work

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

13.06 Correction or Removal of Defective Work

A. If required by ENGINEER or OWNER, CONTRACTOR shall promptly either correct all defective Work, whether or not fabricated, installed or completed, or if the Work has been rejected by ENGINEER, remove it from the Site and replace it with non-defective Work. CONTRACTOR shall pay all claims, costs, losses, damages and expenses caused by or resulting from such correction or removal (including, but not limited to all costs of repair or replacement of work of others) and shall take no action that would void or otherwise impair OWNER's special warranty or guarantee, if any, on such Work.

13.07 Guarantee Period

A. If within 1 year after the date of Substantial Completion (or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents), or by any specific provision of the Contract Documents, any Work is found to be defective, CONTRACTOR shall promptly, without cost to OWNER and in accordance with OWNER's written instructions:

1. repair defective land or areas;

2. correct such defective Work;

3. if the defective Work has been rejected by OWNER, remove it from the Site and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work or the work of others or other land or areas resulting therefrom.

B. If CONTRACTOR does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, OWNER may have the defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses, damages and expenses caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement or work of others) shall be paid by CONTRACTOR.

C. Repair or replacements made under the guarantee shall bear an additional 1 year guarantee dated from the acceptance of repair or replacement.

13.08 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, OWNER (and, prior to ENGINEER'S recommendation of final payment, also ENGINEER) prefers to accept it, OWNER may do so. CONTRACTOR shall pay all claims, costs, losses, damages and expenses attributable to OWNER's evaluation of and determination to accept such defective Work (such costs to be approved by ENGINEER as to reasonableness). In such case, if acceptance occurs prior to ENGINEER's recommendation of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and OWNER shall be entitled to an appropriate reduction in the Contract Price. If the acceptance occurs after such recommendation, an appropriate amount shall be paid by CONTRACTOR to OWNER.

13.09 Owner May Correct Defective Work

A. If CONTRACTOR fails within a reasonable time after written notice from ENGINEER to correct defective Work, or to remove and replace rejected Work as required by ENGINEER in accordance with paragraph 13.06, or if CONTRACTOR fails to perform the Work in accordance with the Contract Documents (including any requirements of the Progress Schedule), OWNER may, after 48 hours' written notice to CONTRACTOR and his Surety without prejudice to any other remedy he may have, correct and remedy any such deficiency.

B. In exercising his rights and remedies under this paragraph 13.09, OWNER shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, OWNER may exclude CONTRACTOR from all or part of the Site, take possession of all or part of the Work, and suspend CONTRACTOR's services related thereto, take possession of CONTRACTOR's tools, appliances, construction equipment and machinery at the Site and incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere. CONTRACTOR shall allow OWNER, OWNER's representatives, agents and employees, OWNER's other contractors, and ENGINEER's consultants such access to the Site as may be necessary to enable OWNER to exercise his rights and remedies under this paragraph 13.09.

C. All claims, costs, losses, damages and expenses incurred or sustained by OWNER in exercising such rights and remedies shall be charged against CONTRACTOR and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work. OWNER shall be entitled to an appropriate reduction in the Contract Price equivalent to such claims, costs,

losses, damages and expenses including but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of CONTRACTOR's defective Work.

D. CONTRACTOR shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by OWNER of OWNER's rights under this Article 13.

Article 14 Payments to Contractor and Completion

14.01 Schedules

A. At least 10 days prior to submitting the first Application for Payment, CONTRACTOR shall submit to ENGINEER a final Schedule of Submittals, and, where applicable, a Schedule of Values for the Work. These schedules shall be satisfactory in form and substance to ENGINEER as provided in Article 2.

B. The Schedule of Values shall include quantities and unit prices aggregating the Contract Price and shall subdivide the Work into component parts. Each unit cost so established shall include its proportionate share of CONTRACTOR's general operating charges such as profit, overhead, supervision, insurance, bond premiums, interest, equipment cost, depreciation and rental, contingencies, expendable tools, equipment and supplies. The total cost of the items and quantities CONTRACTOR lists in the Schedule of Values shall equal the total Contract Price established in the Proposal.

C. The Schedule of Values shall include a complete set of detailed work sheets on bid take off and bid summary covering estimated general conditions expense (field overhead), general overhead, profit mark ups and revisions leading to the final bid amount.

D. When the Schedule of Values is approved by the ENGINEER, it shall become part of the Agreement and shall be used as the basis for CONTRACTOR progress payments.

E. Progress payments based upon Unit Price Work will be based upon the number of units completed.

14.02 Application for Progress Payment

A. At least 20 days before each Application for Payment falls due (but not more often than once a month), CONTRACTOR shall submit to ENGINEER for review an Application for Payment, Contractor's Declaration, Payment Schedule, and updated Progress Schedules indicating the anticipated completion dates of the various stages of the Work and estimated payments during the next 3 months. Contractor's Application for Payment shall be filled out on the form provided in the Contract Documents and signed by CONTRACTOR covering the Work completed as of the date of the Application for Payment and accompanied by such supporting documentation as is required by the Contract Documents and as ENGINEER or OWNER may reasonably require. The Payment Schedule shall be on the form provided in the Contract Documents or in a format acceptable to the ENGINEER or OWNER. On the second and all subsequent payments, partial Waivers of Lien and Sworn Statement shall be required for all Work completed and paid for on previous certificates.

B. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by such data, satisfactory to OWNER, as will establish OWNER's title to the material and equipment and protect OWNER's interest therein, including applicable insurance. A receipted vendor's invoice showing the quantities of materials and the amounts paid will be required and shall accompany the Application for Payment.

C. Retainage with respect to progress payments will be in accordance with paragraph 14.03, and it will be retained until after completion of the entire Work and its final acceptance. When the amount to be retained is reduced to less than 10 percent, CONTRACTOR shall file with OWNER the written consent of the Surety to such reduction and shall furnish an affidavit that all CONTRACTOR's indebtedness by reason of the Contract has been paid.

14.03 Retainage

A. On Contracts with a dollar value of $30,000 and greater or on Contracts that provide for more than 3 progress payments, progress payments and retainage shall be governed by the provisions of any statutes, rules or regulations regarding retention and these are incorporated herein by reference and made a part of this Contract.

B. If there are no statutes, rules, or regulations applicable to retention, retainage shall be 10%, or such an amount as OWNER deems necessary.

14.04 Review of Applications for Progress Payment

A. ENGINEER will, within 10 days after receipt of each Contractor's Application for Payment and Payment Schedule, including each resubmittal, either indicate in writing a recommendation of payment and present an Engineer's Certificate for Payment to OWNER, or may return the Application to CONTRACTOR indicating in writing ENGINEER's reasons for refusing to recommend payment. In the latter case, CONTRACTOR may make the necessary corrections and resubmit the Application.

B. ENGINEER's recommendation of any payment requested in CONTRACTOR's Application for Payment will constitute a representation by ENGINEER to OWNER, based on ENGINEER's review of the Contractor's Application for Payment and Certificate for Payment and the accompanying data and schedules, as an experienced and qualified design professional that to the best of ENGINEER's knowledge, information and belief;

1. the Work has progressed to the point indicated;

2. the quality of the Work is in accordance with the technical aspects of the Contract Documents subject to an evaluation of the Work as a functioning Project upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for any Unit Price Work under paragraph 12.03, and any qualifications stated in the recommendation; and

3. the conditions precedent to CONTRACTOR's being entitled to such payment appear to have been fulfilled in so far as it is ENGINEER's responsibility to observe the Work.

C. However, by recommending any such payment ENGINEER will not thereby be deemed to have represented that:

1. exhaustive or continuous on-Site inspections have been made to check the quality or the quantity of the Work; or

2. involved detailed inspections of the Work beyond the responsibilities specifically assigned to ENGINEER in the Contract; or

3. there may not be other matters or issues between the parties that might entitle CONTRACTOR to be paid additionally by OWNER or entitle OWNER to withhold payment to CONTRACTOR.

D. Neither ENGINEER's review of CONTRACTOR's Work for the purpose of recommending payments nor ENGINEER's recommendation of any payment, including final payment, will impose responsibility on ENGINEER:

1. to supervise, direct or control the Work;

2. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

3. for the failure of CONTRACTOR to comply with Laws and Regulations applicable to the furnishing or performance of Work;

4. for any failure of CONTRACTOR to perform or furnish Work in accordance with the Contract Documents;

5. to make any examination to ascertain how or for what purposes CONTRACTOR has used the moneys paid on account of the Contract Price;

6. to determine that title to any Work, materials, or equipment has passed to OWNER free and clear of Liens.

E. ENGINEER may refuse to recommend the whole or any part of any payment if, in ENGINEER's opinion, it would be incorrect to make such representations as stated above to OWNER. ENGINEER may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended to such extent as may be necessary in ENGINEER's opinion to protect OWNER from loss because:

1. the Work is defective, or completed Work has been damaged requiring correction or replacement;

2. the Contract Price has been reduced because of Change Orders;

3. OWNER has been required to correct defective Work in accordance with paragraph 1309, or has accepted defective Work in accordance with paragraph 13.08;

4. OWNER has been required to remove or remediate a Hazardous Environmental Condition for which CONTRACTOR is responsible;

5. ENGINEER has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.

14.05 Payment Becomes Due

A. Thirty (30) days after presentation of the Application for Payment to OWNER with ENGINEER's recommendation, the amount recommended will (subject to the provisions of paragraph 14.05.B) become due, (or only if OWNER is a public agency, within 15 days after OWNER receives the funds which are to be provided by a department or agency of the federal or state government, whichever is later, or in accordance with any time periods required by any applicable statute, rule or regulation) and when due will be paid by OWNER to CONTRACTOR.

B. OWNER may refuse to make payment of the full amount recommended by ENGINEER because:

1. Claims have been made against OWNER based on CONTRACTOR's conduct in the performance or furnishing of the Work, or OWNER has incurred costs, losses, or damages resulting from CONTRACTOR's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

2. CONTRACTOR has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

3. CONTRACTOR has failed to provide and maintain required bonds or insurance;

4. OWNER has been required to remove or remediate a Hazardous Environmental Condition for which CONTRACTOR is responsible;

5. OWNER has incurred extra charges or engineering costs related to Submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

6. The Work is defective, requiring correction or replacement;

7. OWNER has been required to correct defective Work in accordance with paragraph 13.09, or has accepted defective Work pursuant to paragraph 13.08;

8. The Contract Price has been reduced by Change Orders;

9. An event has occurred that would constitute a default by CONTRACTOR and therefore justify a termination for cause;

10. Liquidated or other damages have accrued as a result of CONTRACTOR's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

11. Liens have been filed in connection with the Work, except where CONTRACTOR has delivered a specific bond satisfactory to OWNER to secure the satisfaction and discharge of such Liens;

12. there are other items as set forth in the Contract Documents entitling OWNER to a set off against the amount recommended; or

13. OWNER has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.04.E.1 through 14.04.E.5.

C. If OWNER refuses to make payment of the full amount recommended by ENGINEER, OWNER will give CONTRACTOR immediate written notice (with a copy to ENGINEER) stating the reasons for such action and promptly pay CONTRACTOR any amount remaining after deduction of the amount so withheld. OWNER shall promptly pay CONTRACTOR the amount so withheld, or any adjustment thereto agreed to by OWNER and CONTRACTOR, when CONTRACTOR corrects, to OWNER's satisfaction, the reasons for such action. The reduction imposed shall be binding on CONTRACTOR unless CONTRACTOR duly submits a Change Proposal contesting the reduction.

D. If it is subsequently determined that OWNER's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.05.

14.06 Contractor's Warranty of Title

A. CONTRACTOR warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to OWNER at the time of payment free and clear of all Liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

14.07 Substantial Completion

A. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER and ENGINEER in writing that the entire Work is substantially complete and request that ENGINEER issue a Certificate of Substantial Completion. CONTRACTOR shall at the same time submit to OWNER and ENGINEER an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after CONTRACTOR's notification, OWNER, CONTRACTOR, and ENGINEER shall make an inspection of the Work to determine the status of completion. If ENGINEER does not consider the Work substantially complete, ENGINEER will notify CONTRACTOR in writing giving the reasons therefor.

C. Once ENGINEER considers the Work substantially complete, ENGINEER will deliver to OWNER a preliminary Certificate of Substantial Completion which shall fix the date of Substantial Completion. ENGINEER shall attach to the certificate a punch list of items to be completed or corrected before final payment. OWNER shall have 7 days after receipt of the preliminary certificate during which to make written objection to ENGINEER as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, ENGINEER concludes that the Work is not substantially complete, ENGINEER will, within 14 days after submission of the preliminary certificate to OWNER, notify CONTRACTOR in writing that the Work is not substantially complete, stating the reasons therefore. If OWNER does not object to the provisions of the certificate, or if despite consideration of OWNER's objections ENGINEER concludes that the Work is substantially complete, then ENGINEER will, within said 14 days, execute and deliver to OWNER and CONTRACTOR a final Certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as ENGINEER believes justified after consideration of any objections from OWNER.

D. At the time of receipt of the preliminary Certificate of Substantial Completion, OWNER and CONTRACTOR will confer regarding OWNER's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by OWNER. Unless OWNER and CONTRACTOR agree otherwise in writing, OWNER shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon OWNER's use or occupancy of the Work.

E. After Substantial Completion the CONTRACTOR shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases CONTRACTOR may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. OWNER shall have the right to exclude CONTRACTOR from the Site after the date of Substantial Completion subject to allowing CONTRACTOR reasonable access to remove its property and complete or correct items on the punch list.

14.08 Partial Utilization

A. Use by OWNER of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:

1. OWNER at any time may request CONTRACTOR in writing to permit OWNER to use any part of the Work which OWNER believes to be substantially complete and which may be so used without significant interference with construction of the other parts of the Work. If CONTRACTOR agrees, CONTRACTOR will certify to OWNER and ENGINEER that said part of the Work is substantially complete and request ENGINEER to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time thereafter OWNER, CONTRACTOR and ENGINEER shall make an inspection of that part of the Work to determine its status of completion.

    a. If ENGINEER does not consider that part of the Work to be substantially complete, ENGINEER will notify OWNER and CONTRACTOR in writing giving his reasons therefor.

    b. If ENGINEER considers that part of the Work to be substantially complete, ENGINEER will execute and deliver to OWNER and CONTRACTOR a certificate to that effect, fixing the date of Substantial Completion for that part of the Work, attaching thereto a punch list of items to be completed or corrected before final payment.

2. Prior to issuing a certificate of Substantial Completion for that part of the Work, ENGINEER will deliver to OWNER and CONTRACTOR a written recommendation as to the division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, utilities and insurance for that part of the Work, which shall become binding upon OWNER and CONTRACTOR at the time of issuing the definitive certificate of Substantial Completion for that part of the Work unless OWNER and CONTRACTOR shall have otherwise agreed in writing and so informed ENGINEER.

3. OWNER shall have the right to exclude CONTRACTOR from any part of the Work which ENGINEER has so certified to be substantially complete, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the punch list.

4. In lieu of the issuance of a certificate of Substantial Completion as to part of the Work, OWNER may take over operation of a facility constituting part of the Work whether or not it is Substantially Complete if such facility is functionally and separately usable; provided that prior to any such takeover, OWNER and CONTRACTOR have agreed as to the division of responsibilities between OWNER and CONTRACTOR for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.

14.09 Final Inspection

A. Upon written notice from CONTRACTOR that the Work is complete, ENGINEER will make a final inspection with OWNER and CONTRACTOR and will notify CONTRACTOR in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. CONTRACTOR shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.10 Final Application for Payment

A. After CONTRACTOR has completed all corrections to the satisfaction of ENGINEER and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked up record documents and other documents (all as required by the Contract Documents), and after ENGINEER has indicated that the Work is acceptable, subject to the provisions of paragraph 14.13, CONTRACTOR may make application for final payment following the procedure for progress payments.

B. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as ENGINEER may reasonably require, consent of Surety, if any, to final payment, together with complete and legally effective releases or waivers, satisfactory to OWNER, of all Liens arising out of or filed in connection with the Work.

C. In lieu of the releases or waivers of Lien, if approved by OWNER, CONTRACTOR may furnish receipts or releases in full; an affidavit of CONTRACTOR that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which OWNER or his property might in any way be responsible, have been paid or otherwise satisfied.

D. If any Subcontractor, manufacturer, fabricator, Supplier or distributor fails to furnish a release or receipt in full, CONTRACTOR may furnish a Bond or other collateral satisfactory to OWNER to indemnify OWNER against any Claim or Lien.

14.11 Final Payment and Acceptance

A. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation (all as required by the Contract Documents), ENGINEER is satisfied that to the best of ENGINEER’s knowledge, information and belief as a design professional that the Work has been completed and CONTRACTOR has fulfilled all of his obligations under the Contract Documents,

ENGINEER will, within 10 days after receipt of the final Application for Payment, indicate in writing ENGINEER's Certificate for Payment and present the application to OWNER for payment. At that time ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.13.

B. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application.

C. If the Application and accompanying documentation are appropriate as to form and substance, OWNER shall, within 45 days (or within the time period required by any applicable statute, rule or regulation) after receipt thereof pay CONTRACTOR the amount recommended by ENGINEER less any amounts of OWNER claimed set-offs allowed under the Contract Documents, including but not limited to any applicable liquidated damages as determined by OWNER. If OWNER rejects the Application, OWNER shall do so in writing stating the appropriate sections of the Contract Documents upon which the rejection is based. CONTRACTOR may take the necessary remedial actions and resubmit the Application.

14.12 Final Completion Delayed

A. If, through no fault of CONTRACTOR, final completion of the Work is significantly delayed, and if ENGINEER so confirms, OWNER shall, upon receipt of CONTRACTOR's final Application for Payment and recommendation of ENGINEER, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by OWNER for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds have been furnished as required in paragraph 5.01, the written consent of the Surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by CONTRACTOR to ENGINEER with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.13 Waiver of Claims

A. The making and acceptance of final payment shall constitute:

1. a waiver of all Claims by OWNER against CONTRACTOR, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.09, or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; and shall not constitute a waiver by OWNER of any rights in respect of CONTRACTOR's existing or continuing obligations under the Contract Documents; and,

2. a waiver of all Claims by CONTRACTOR against OWNER other than those previously made in writing and still pending in accordance with Article 16.

14.14 Late Payments

A. All monies not paid when due hereunder, except monies involving Federal and/or State Loans, Grants, or other sources which are delinquent because of no fault of the OWNER, shall bear interest at the maximum rate allowed by law at the time and place of the Project.

Article 15 Suspension of Work and Termination

15.01 Owner May Suspend Work

A. OWNER may, at any time and without cause, suspend the Work or any portion thereof for a period as OWNER may deem necessary by notice in writing to CONTRACTOR and ENGINEER. If it should become necessary to stop work for an indefinite period, CONTRACTOR shall store all materials in such manner that they will not become an obstruction, nor become damaged in any way, and CONTRACTOR shall take every precaution to prevent damage or deterioration of the Work performed; provide suitable drainage by opening ditches and drains, and erect temporary structures where necessary. CONTRACTOR may request an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if he makes a Claim therefor as provided in paragraph 11.01.

15.02 Owner May Terminate for Cause

A. The occurrence of any one or more of the following events will constitute a default by CONTRACTOR and justify termination for cause:

1. CONTRACTOR commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if CONTRACTOR takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time;

2. a petition is filed against CONTRACTOR under any chapter of the Bankruptcy Code as now or hereinafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against CONTRACTOR under any other federal or state law in effect at the time relating to bankruptcy or insolvency;

3. CONTRACTOR makes a general assignment for the benefit of creditors;

4. a trustee, receiver, custodian or agent of CONTRACTOR is appointed under applicable law or under contract, whose appointment or authority to take charge of property of CONTRACTOR is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of CONTRACTOR's creditors;

5. CONTRACTOR admits in writing an inability to pay its debts generally as they become due;

6. CONTRACTOR persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under paragraph 2.05 as revised from time to time);

7. CONTRACTOR disregards Laws and Regulations of any public body having jurisdiction;

8. CONTRACTOR disregards the authority of ENGINEER or OWNER; or,

9. CONTRACTOR otherwise violates any provisions of the Contract Documents.

B. OWNER may, after giving CONTRACTOR (and the Surety, if there be one) 7 days' written notice, and to the extent permitted by Laws and Regulations, terminate the services of CONTRACTOR, exclude CONTRACTOR from the Site, take possession of the Work and of all CONTRACTOR's tools, appliances, construction equipment, and machinery at the site and use the same to the full extent they could be used by CONTRACTOR (without liability to CONTRACTOR for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which OWNER has paid CONTRACTOR but which are stored elsewhere, finish the Work as OWNER may deem expedient, and/or enforce the rights available to OWNER under any applicable Performance Bond.

C. In such case, CONTRACTOR shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, damages and expenses sustained by OWNER arising out of or resulting from completing the Work, such excess will be paid to CONTRACTOR. If such claims, costs, losses, damages and expenses exceed such unpaid balance, CONTRACTOR shall pay the difference to OWNER. Such claims, costs, losses, damages and expenses incurred by OWNER will be reviewed as to reasonableness by ENGINEER and when so approved, incorporated in a Change Order, but when exercising any rights or remedies under this paragraph, OWNER shall not be required to obtain the lowest price for the Work performed.

D. Where CONTRACTOR's services have been so terminated by OWNER, the termination shall not affect any rights or remedies of OWNER against CONTRACTOR or its Surety then existing or which may thereafter accrue. Any retention or payment of monies due CONTRACTOR by OWNER will not release CONTRACTOR from liability.

15.03 Termination for Convenience

A. Upon 7 days' written notice to CONTRACTOR and ENGINEER, OWNER may, without cause and without prejudice to any other right or remedy, elect to terminate the Agreement. In such case, CONTRACTOR shall be paid (without duplication of any items):

1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination;

2. for actual expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work; and

3. for reasonable expenses directly attributable to protecting work as a result of termination.

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

C. Upon such termination, CONTRACTOR shall:

1. Immediately discontinue Work on the date and to the extent specified in the notice except to the extent necessary to protect Work in place;

2. Place no further orders for materials, services, or facilities, other than as may be necessary or required for completion of such portion of Work under the Contract that is not terminated;

3. Promptly make every reasonable effort to obtain cancellation upon terms reasonably satisfactory to OWNER of all purchase orders and subcontracts to the extent they relate to the performance of Work terminated or assign to OWNER those orders and subcontracts and revoke agreements specified in such notice;

4. Reasonably assist OWNER, as specifically requested in writing, in the maintenance, protection and disposition of property acquired by OWNER under the Contract Documents, as may be necessary;

5. Complete performance of any Work which is not terminated; and

6. Deliver to OWNER an affidavit regarding the identity of potential unpaid Subcontractors or Suppliers and the amounts due to each.

15.04 Contractor May Stop Work or Terminate

A. If OWNER has failed to pay CONTRACTOR any sum finally determined to be due in accordance with the time limits specified in paragraph 14.05, CONTRACTOR may upon 7 days' written notice to OWNER and ENGINEER, stop the Work until payment of all amounts then due.

B. If through no act or fault of CONTRACTOR, the Work is suspended for a period of more than 90 days by OWNER, or under an order of court or other public authority, then CONTRACTOR may, upon 7 days written notice to OWNER and ENGINEER and provided OWNER or ENGINEER does not remedy such suspension or failure within that time, terminate the Agreement and recover from OWNER payment on the same terms as provided in paragraph 15.03.

C. The provisions of this paragraph 15.04 shall not relieve CONTRACTOR of his obligations under paragraph 6.22 to carry on the Work in accordance with the Progress Schedule and without delay during disputes and disagreements with OWNER.

Article 16 Final Resolution of Disputes

16.01 Methods and Procedures

A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between OWNER and CONTRACTOR concerning the Work or obligations under the Contract Documents and arising after final payment has been made.

B. Final Resolution of Disputes: For any dispute subject to resolution under this Article, OWNER or CONTRACTOR may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, the following dispute resolution process shall be followed:

   a. The parties shall submit the dispute to mediation under the mediation procedures outlined in the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Rules.

   b. If the dispute is not resolved by mediation, the parties shall proceed to resolve the dispute by arbitration in accordance with the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Association. The decision of the arbitrator(s) shall be final and binding and is enforceable in a court of competent jurisdiction.

Article 17 Miscellaneous

17.01 Giving Notice

A. Whenever any provision of the Contract Documents requires the giving of written notice to OWNER, ENGINEER, or CONTRACTOR, it shall be deemed to have been validly given only if delivered:

1. in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended;

2. by registered or certified mail postage prepaid to, the last business address known to the giver of the notice;

3. or delivered in person to such person by a commercial courier service or otherwise to the recipient's place of business; or

4. by secure file transfer with receipt documentation or other document control software.

17.02 Computation of Time

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

17.03 General

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and shall not be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Law or Regulation, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this paragraph shall be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

B. All representations, warranties and guarantees made in the Contract Documents shall survive final payment and termination or completion of this Agreement.

17.04 Professional Fees and Court Costs Included

A. Whenever reference is made to "claims, costs, losses, damages and expenses," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

17.05 Nondiscrimination of Employment

A. The CONTRACTOR shall covenant and agree not to discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, sex, age, religion, national origin or ancestry, height, weight, or marital status, or any other classification protected by law, and to require a similar covenant on the part of any Subcontractor employed in the performance of the Contract.

17.06 Post Completion Date Engineering and Inspection Costs

A. All engineering and inspection costs incurred after the specified completion date shall be paid by CONTRACTOR to OWNER prior to final payment authorization. However, CONTRACTOR shall not be charged with any post completion date engineering and inspection costs when the delay in completion of the Work is due to the following and CONTRACTOR has promptly given written notice of such delay to OWNER or ENGINEER:

1. to any preference, priority or allocation order duly issued by OWNER;

2. to unforeseeable causes beyond the control and without the fault or negligence of CONTRACTOR, including but not restricted to, acts of God, or of the public enemy, acts of OWNER, acts of another contractor in the performance of a Contract with OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and,

3. to any delays of Subcontractors or Suppliers occasioned by any of the causes specified in this Article.

B. Charges after the specified completion date shall be made at such times and in such amounts as ENGINEER shall invoice OWNER, provided, however said charges shall be in accordance with ENGINEER's current rate schedule at the time the costs are incurred. Engineering and inspection costs so incurred shall be deducted from CONTRACTOR's progress payments.

17.07 Waiver of Consequential Damages

A. CONTRACTOR and OWNER waive Claims against each other for consequential damages arising out of or relating to this Contract or the Work. This mutual waiver includes but is not limited to:

1. damages incurred by OWNER for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

2. damages incurred by CONTRACTOR for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit in connection with any other project or anticipated project.

B. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination or default. Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. CONTRACTOR also waives any Claim for consequential damages against ENGINEER where such Claims arise out of or relate in any way to the Project or the Contract Documents.

17.08 No Waiver

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

17.09 Controlling Law

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

17.10 Headings

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

End of Section

Section 00 7300
Supplementary Conditions

These Supplementary Conditions amend or supplement Section 00 7200, General Conditions, as indicated below. All provisions which are not amended or supplemented by this section remain in full force and effect. The terms used in these Supplementary Conditions have the meanings assigned to them in the General Conditions.

SGC-1.01 Defined Terms - Substantial Completion

Delete the definition for "Substantial Completion" in Article 1.01 of the General Conditions, and insert the following in its place:

48. Substantial Completion - The Work has progressed to the point where, in the opinion of the ENGINEER as evidenced by his definitive Certificate of Substantial Completion, it is sufficiently complete in accordance with the Contract Documents such that the connection and meter vault have been constructed, tested and are operational for the Genesee County Drain Commissioner and the City of Flint; the transmission main has been constructed, tested and is operational; modifications at the City of Flints Water Treatment Plant have been constructed, tested and are operational, including modifications to Control Station No. 3, the Tank House and the Pressure Reducing Pit; the existing 60-inch PCCP pipe in Control Station No. 2 has been removed and replaced with a 36-inch ductile iron pipe (including butterfly valve, venturi meter, etc.), and has been tested and is operational.

    The terms "Substantially Complete" and "Substantially Completed" as applied to any Work refer to Substantial Completion thereof.

SGC-4.02 Physical Conditions - Investigations and Reports

Add a new paragraph immediately after the last paragraph of Section 4.02 of the General Conditions, which is to read as follows:

D. In the preparation of Plans and Specifications, ENGINEER has relied upon the following reports and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work:

    Exhibit 2 – Geotechnical Report by Construction Testing Services dated November 11, 2019
    Exhibit 3 – Wetland Delineation dated October 25, 2019
    Exhibit 4 – Environmental Corridor Study dated October 8, 2019

SGC-5.03.D Additional Insured

Add the following language at the end of Article 5.03.D. of the General Conditions:

The name insured on OWNER's and CONTRACTOR's Protective Policy shall be: The City of Flint

Additional named insured on OWNER's and CONTRACTOR's Protective Policy shall include:

1. Wade Trim, Inc.
2. Genesee County Drain Commissioner
3. Great Lakes Water Authority
4. Genesee County Road Commission
5. Michigan Department of Transportation

SGC-5.04 Limits of Liability

The required limits of liability for insurance coverages requested in Section 5.03 shall be not less than the following:

SGC-5.04.A Worker's Compensation

Coverage A – Compensation	Statutory
Coverage B – Employer's Liability	
Each Accident	$ 100,000
Disease – Policy Limit	$ 100,000
Disease – Each Employee	$ 100,000

SGC-5.04.B Comprehensive General Liability

General Aggregate	$2,000,000
Products – Com/Ops Aggregate	$2,000,000
Personal and Advertising Injury	$1,000,000
Each Occurrence	$1,000,000
Fire Damage (any one fire)	$ 50,000
Medical Expense (any one person)	$ 5,000

SGC-5.04.C Comprehensive Automobile Liability

Bodily Injury	$ 500,000
Property Damage	$ 200,000
or combined single limit	$1,000,000

SGC-5.04.D Owner's Protective – Coverage shall be Occurrence Form

General Aggregate	$1,000,000
Each Occurrence	$1,000,000

SGC-5.04.F Umbrella or Excess Liability

Each Occurrence	$2,000,000
Aggregate	$2,000,000

SGC-18 Dispute Resolution

Dispute resolution, if applicable, are referenced in the General Conditions. The requirements for dispute resolution should be included herein:

Article 18 Dispute Resolution

18.01 Methods and Procedures

A. Either OWNER or CONTRACTOR may request mediation of any Claim submitted to ENGINEER for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 11.01.

B. OWNER and CONTRACTOR shall participate in the mediation process in good faith. The process shall be concluded within sixty (60) days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, ENGINEER's action under Paragraph 11.01 or a denial pursuant to Paragraphs 11.01 shall become final and binding 30 days after termination of the mediation unless, within that time period, OWNER or CONTRACTOR:

1. elects in writing to demand arbitration of the Claim, pursuant to Paragraph 18.02; or

2. agrees with the other party to submit the Claim to another dispute resolution process.

18.02 Arbitration

A. Claims or counterclaims, disputes, or other matters in question between OWNER and CONTRACTOR arising out of or relating to the Contract Documents or the breach thereof (except for Claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.01) including but not limited to those not resolved under the provisions of Paragraphs 18.01 will be decided by arbitration in accordance with the rules of the American Arbitration Association, subject to the conditions and limitations of this Paragraph. This agreement to arbitrate and any other agreement or consent to arbitrate entered into will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitrator or arbitration provider, and a copy will be sent to ENGINEER for information. The demand for arbitration will be made within the 30-day period specified in Paragraph 18.01, and in all other cases within a reasonable time after the Claim or counterclaim, dispute, or other matter in question has arisen, and in no event shall any such demand be made after the date when institution of legal or equitable proceedings based on such Claim or other dispute or matter in question would be barred by the applicable statue of limitations.

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

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

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration and which will arise in such proceedings.

D. The award rendered by the arbitrator(s) shall be consistent with the agreement of the parties, in writing, and include:

1. a concise breakdown of the award;

2. a written explanation of the award specifically citing the Contract Document provisions deemed applicable and relied on in making the award.

E. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Controlling Law relating to vacating or modifying an arbitral award.

F. The fees and expenses of the arbitrators and any arbitration service shall be shared equally by OWNER and CONTRACTOR.

SGC-19 Liquidated Damages

Liquidated damages, if applicable, are referenced in the Proposal and Agreement. The requirements for liquidated damages should be included herein.

Article 19 Liquidated Damages

A. If CONTRACTOR shall fail to Substantially Complete the Work within the Contract Time, or extension of time granted by OWNER, then CONTRACTOR will pay to OWNER the amount for liquidated damages as specified in the Agreement for each calendar day that CONTRACTOR shall be in default after the time stipulated in the Contract Documents. The liquidated damages charged shall be deducted from CONTRACTOR's progress payments.

B. CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in Substantial Completion of the Work is due to the following and CONTRACTOR has given written notice of such delay within seven (7) calendar days to OWNER or ENGINEER.

1. To any preference, priority or allocation order duly issued by the OWNER.

2. To unforeseeable causes beyond the control and without the fault or negligence of the CONTRACTOR, including but not restricted to, acts of God, or of the public enemy, acts of the OWNER, acts of another CONTRACTOR in the performance of a Contract with the OWNER, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and

3. To any delays of subcontractors occasioned by any of the causes specified in Items A and B of this Article.

End of Section

Division 01
General Requirements

Section 01 1100
Summary of Work

Part 1 General

1.01 Work Covered by Contract Documents

A. This Project includes the construction of the Secondary Water Supply which will be approximately 30,000 lineal feet of 36-inch transmission main originating from the City of Flint's Water Treatment Facility (WTP) and connecting to the Genesee County Drain Commissioner's (GCDC's) North Water Loop near the intersection of Frances Road and Dort Highway, including all specified appurtenances. At either end of the transmission main Work will include the construction of a master meter vault, including meters, valves, instrumentation and SCADA for monitoring by the City, Genesee County Drain Commissioner, and the Great Lakes Water Authority.

B. In addition to the Secondary Water Supply, other modifications will also be completed in a number of areas at the City's WTP, including work at Control Station #2 which will include removing and replacing sections of 36-inch and 60-inch PCC pipe, as well as meters and control valves; SCADA modifications to Control Station #3; the removal and replacement of a 24-inch double-acting altitude valve at the Tank House, including electrical and SCADA modifications; meter replacement at the Pressure Reducing Pit, including electrical and SCADA modifications; and the construction of a 36-inch interconnection between the existing supply lines to the elevated storage tower and the Dort Reservoir.

1.02 Sequence of Construction

A. General:

1. Time is of the essence for this Project and CONTRACTOR shall provide at least two (2) crews in order to construct the transmission main, vaults and other improvements specified in the Contract Documents within the Contract Time specified.

B. Subsurface Utility Investigation:

1. Prior to the commencement of Work at the City of Flint's Water Treatment Plant, located at 4500 Dort Highway, Flint, Michigan 48506, CONTRACTOR shall conduct a Subsurface Utility Investigation as specified in Article 1.16 of this Section.

C. Transmission Main:

1. GCDC Meter Vault:

a. Connection to the 36-inch "North Water Loop" near the intersection of Frances Road and Dort Highway will be made in accordance with the standards and requirements set forth by the Genesee County Drain Commissioner.

b. The Genesee County Drain Commissioner has indicated that the North Water Loop cannot be shut down – even temporarily – and it will be necessary for CONTRACTOR to install a 36-inch x 36-inch x 24-inch tapping sleeve and 24-inch tapping valve, as shown in the Contract Documents, while ensuring the water supply is uninterrupted.

(1) At least 1 week (7 calendar days) prior to CONTRACTOR making the planned connection to the North Water Loop, CONTRACTOR shall notify the Genesee County Drain Commissioner so that they may plan for the connection.

(2) At least 72 hours prior to the planned connection to the North Water Loop, CONTRACTOR shall contact and verify construction activities with the Genesee County Drain Commissioner to ensure a representative from the Drain Commissioner is available and will be onsite during the connection process.

(a) Construction of the connection will not proceed without a representative present from the Genesee County Drain Commissioner and ENGINEER.

(b) Construction of the connection, once started, shall proceed expeditiously in order to complete the installation of the tap.

(3) CONTRACTOR shall notify OWNER/ENGINEER of his/her communication(s) with the Genesee County Drain Commissioner.

2. Secondary Water Supply Meter Vault:

a. Connection to the 48-inch water supply line at the City of Flint's Water Treatment Plant will be made in accordance with the standards and requirements set forth by the City of Flint.

b. OWNER has indicated that the 48-inch supply line cannot be shut down – even temporarily – and it will be necessary to install a 48-inch x 48-inch x 36-inch tapping sleeve and 36-inch valve, as shown in the Contract Documents, while ensuring the water supply is uninterrupted.

(1) At least 1 week (7 calendar days) prior to CONTRACTOR making the planned connection to the City of Flint's 48-inch water supply, CONTRACTOR shall notify OWNER so that they may plan for the connection.

(2) At least 72 hours prior to the planned connection to the 48-inch water supply, CONTRACTOR shall contact and verify construction activities with OWNER to ensure a representative from the City is available and will be onsite during the connection process.

(a) Construction of the connection will not proceed without a representative present from the City of Flint and ENGINEER.

(b) Construction of the connection, once started, shall proceed expeditiously in order to complete the installation of the tap.

D. Improvements at Water Treatment Plant:

1. Control Station No. 3:

a. At least 72 hours prior to any planned work at Control Station No. 3 CONTRACTOR shall contact and coordinate construction activities with OWNER and ENGINEER.

b. CONTRACTOR is limited to working on one line at a time if it will interfere with the City's ability to supply water. If the proposed work will not interfere with the water supply, CONTRACTOR may make modifications to both lines simultaneously.

2. Tank House:

a. At least 2 weeks (14 days) prior to any planned work at the Tank House for the Elevated Storage Tower, CONTRACTOR shall contact and coordinate isolation and draining of the elevated storage tank.

b. At least 72 hours prior to any planned work at the Tank House, CONTRACTOR shall contact and coordinate construction activities with OWNER and ENGINEER.

(1) Removal and replacement of the altitude valve and its appurtenances, once started, shall proceed expeditiously in order to complete the removal and replacement of the altitude valve so that it can be tested and accepted by OWNER and the Elevated Storage Tank brought back online and filled.

3. Pressure Reducing Pit:

a. At least 72 hours prior to any planned work on the line through the Pressure Reducing Pit, CONTRACTOR shall contact and coordinate construction activities with OWNER and ENGINEER.

b. OWNER has indicated that the 36-inch supply line to Dort Reservoir will be inactive during this project; CONTRACTOR shall confirm that the line is in active before proceeding with the installation of the proposed meter and appurtenances and ancillary equipment as shown in the Contract Drawings.

4. Control Station No. 2:

a. CONTRACTOR cannot proceed with modifications at the Water Treatment Plant at Control Station No. 2 until the work at the Secondary Water Supply Meter Vault described in Article 1.02.C.2 of this Section is complete, tested and fully operational.

b. At least 2 weeks (14 calendar days) prior to CONTRACTOR beginning the modifications specified for Control Station No. 2, CONTRACTOR shall notify OWNER to arrange the Station to be isolated and drained.

(1) Isolation valves are present per the Contract Drawings; CONTRACTOR shall confirm the valves are in working order before proceeding with the Work at Control Station No. 2.

(2) In the event that the existing isolation valves are not operational or fail to block flow, CONTRACTOR shall provide additional isolation at, or adjacent to, Control Station No. 2 as necessary to allow CONTRACTOR to remove and replace the piping and related appurtenances shown in the Contract Drawings.

(3) The City of Flint currently utilizes a chemical feed system that is located adjacent to Control Station No. 2. CONTRACTOR shall confirm that the chemical feed system will not pose a hinderance during the work on the 60-inch PCCP specified in 1.02.D.4.c(1). If, in the opinion of CONTRACTOR, construction activities will be hindered by the presence of the chemical feed system, CONTRACTOR shall relocate the chemical feed system and ensure it is fully operational prior to beginning work on the 60-inch PCCP.

(a) The relocated chemical feed system shall be located in an enclosure similar to its existing enclosure.

(b) At least 72 hours prior to any planned work at to relocate the chemical feed system CONTRACTOR shall contact and coordinate construction activities with OWNER and ENGINEER.

c. At least 72 hours prior to any planned work at Control Station No. 2 CONTRACTOR shall contact and coordinate construction activities with OWNER and ENGINEER.

(1) The 36-inch PCCP line at Control Station No. 2 is currently used as the City's main water supply from the Great Lakes Water Authority. Work on the 36-inch line therefore will not start until CONTRACTOR has completed the removal of the 60-inch PCCP line and related appurtenances and ancillary items and constructed the new 36-inch ductile iron pipe, as well as the 36-inch butterfly valve and the 36-inch Venturi flow meter, related appurtenances and ancillary equipment shown in the Contract Drawings.

(a) Once the 60-inch PCCP line has been removed and replaced, and the line has been tested and the work has been accepted by OWNER, CONTRACTOR shall coordinate with the Contractor responsible for the Chemical Feed Building project (see Article 1.03 of this Section) so that that Contractor may install the necessary piping and valves needed for the dilution water supply to the Chemical Feed Building, as shown in the Contract Drawings.

(b) CONTRACTOR shall allow the Chemical Feed Building Contractor up to 1 week to complete his/her work as it relates to the dilution water supply.

(2) Following the completion of the work on the 60-inch PCCP line, including work by the other Contractor, CONTRACTOR may begin work on the removal and replacement of the existing 36-inch PCCP line, which shall include the removal of the 36-inch PCCP line and related appurtenances and ancillary items and construction of the new 36-inch ductile iron pipe, as well as the 36-inch butterfly valve and the 36-inch Venturi flow meter, related appurtenances and ancillary equipment shown in the Contract Drawings.

(a) Once the 36-inch PCCP line has been removed and replaced, and the line has been tested and the work has been accepted by OWNER, CONTRACTOR shall coordinate with the Contractor responsible for the Chemical Feed Building project (see Article 1.03 of this Section) so that that Contractor may install the remainder of the piping and valves needed for the dilution water supply to the Chemical Feed Building, as shown in the Contract Drawings.

(b) CONTRACTOR shall allow the Chemical Feed Building Contractor up to 1 week to complete his/her work as it relates to the dilution water supply.

1.03 Work by Others

A. Concurrent to this Project, a Chemical Feed Building will be under construction at the City of Flint's Water Treatment Plant. CONTRACTOR shall coordinate his Work with the work of the Chemical Feed Building so that impacts to this project or that of the Chemical Feed Building are mitigated.

1.04 Right-of-Way Jurisdiction

A. CONTRACTOR shall secure any permits required by the agency having jurisdiction, unless otherwise indicated, and shall abide by all rules and regulations of each and pay all costs in connection with the permits. CONTRACTOR shall pay for all permit and inspection fees as the agencies may charge to ensure compliance with their requirements.

B. Roads:

1. The following roads are under the jurisdiction of the City of Flint:

   a. West Boulevard Drive
   b. Groveland Avenue
   c. East Webster Road
   d. Carpenter Road

2. The following roads are under the jurisdiction of the Genesee County Road Commission:

   a. Schaaf Drive
   b. East Coldwater Road
   c. Lewis Road
   d. East Stanley Road
   e. East Mount Morris Road
   f. Frances Road

3. The following roads are under the jurisdiction of the Michigan Department of Transportation:

   a. Dort Highway (M-54)

   b. MDOT has been contacted and a permit will be issued upon receipt of a Performance Bond ($50,000.00), Certificate of Insurance, and the Certificate of Agency from CONTRACTOR. CONTRACTOR shall reference Permit #65730 and refer to **Exhibit 6** and **Exhibit 7**.

C. Drains:

1. The following drains are under the jurisdiction of the Genesee County Drain Commissioner, Surface Water Management:

   a. Riskin Drain
   b. Cornwell Drain
   c. Costello Drain
   d. Mason Drain

D. Other:

1. The CSX Railroad is under the jurisdiction of CSX Transportation, Inc. and Lake State Railway. A permit has been issued by CSX Transportation and is included as **Exhibit 8**.

2. Soil erosion and sedimentation control is under the jurisdiction of the Genesee County Drain Commissioner, Water & Waste Services.

1.05 Working Space

A. CONTRACTOR shall interfere as little as possible with traffic, either along the transmission main route or at the City of Flint's Water Treatment Plant, and in all cases shall confine the work operations to the minimum space possible.

B. Stockpiling of construction material and equipment will be permitted as necessary, but in no case shall traveled roadways, driveways, or entrances be unduly obstructed.

C. Should storage areas be desired on private property, CONTRACTOR may obtain such space on privately owned property at his own expense, by agreement with the property owner thereof. CONTRACTOR shall provide OWNER with a copy of the written permission from the private property owner prior to occupying the property.

1.06 Work Within Public Streets or Land

A. Where the centerline of the proposed improvement is within the public street or land, CONTRACTOR shall confine his operations to within the public street or land unless easements have been acquired. It shall be CONTRACTOR's responsibility to use such methods and/or materials, including sheeting, so as to prevent any portion of the excavation from encroaching on private property. This shall not preclude CONTRACTOR from obtaining the right to encroach on private land in accord with the foregoing article "Working Space."

B. Within public streets, signing and barricading shall be done in accordance with current edition of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD) as issued by the Michigan Department of Transportation (MDOT).

1.07 Road Detours

A. CONTRACTOR shall provide and maintain all temporary roadways as required for work operations or otherwise specified or shown on the drawings at no extra cost to OWNER.

1.08 Maintenance of Traffic

A. During the progress of the work, CONTRACTOR shall accommodate both vehicular and pedestrian traffic as provided in these specifications and as indicated on the drawings.

B. In the absence of specific requirements, traffic shall be maintained in accordance with the current edition of the MMUTCD. Access to fire hydrants and water valves shall always be maintained. CONTRACTOR's truck and equipment operations on public streets shall be governed by local regulations, all local traffic ordinances, and regulations of the Fire and Police Department.

C. Street openings necessary for manholes, alignment holes, sewer connections, etc. will be permitted. Such holes shall not be open longer than necessary and shall be protected and any traffic detouring necessary shall be done to the satisfaction of OWNER. Wherever possible, small openings shall be covered with steel plates at pavement level secured in place during periods that work is not being performed at no extra cost to OWNER.

D. Where streets are partially obstructed, CONTRACTOR shall place and maintain temporary driveways, ramps, bridges and crossings which in the opinion of the Owner are necessary to accommodate the public at no extra cost to OWNER. In the event of CONTRACTOR's failure to comply with the foregoing provisions, OWNER may, with or without notice, cause the same to be done and deduct the cost of such work from any monies due or to become due CONTRACTOR under this contract. However, the performance of such work by OWNER, or at his insistence, shall serve in no way to release CONTRACTOR from his liability for the safety of the traveling public.

E. CONTRACTOR shall provide flagmen, warning lights, signs, fencing and barricades necessary to direct and protect vehicular and pedestrian traffic at no extra cost to OWNER.

F. CONTRACTOR shall inform the local fire department in advance of work operations of street obstructions and detours, so that the fire department can set up plans for servicing the area in case of an emergency. The governing police department and the owner shall be notified at least one week prior to obstructing any street.

1.09 Easements

A. In certain instances, OWNER may have acquired certain permanent easements for CONTRACTOR's use in constructing the work. CONTRACTOR shall confine work operations to these easements except as noted under Article 1.05 of this Section.

B. If CONTRACTOR will require construction easements in order to conduct his construction activities, CONTRACTOR shall be responsible for obtaining such easements from the private property owner(s) at his own expense, by agreement with the property owner thereof. CONTRACTOR shall provide OWNER with a copy of the signed construction easement from

the private property owner(s) prior to conducting any construction activities on the property in question.

1.10 Locating Work

A. CONTRACTOR shall accurately locate the work from reference points established by OWNER along the surface of the ground and the line of work.

1.11 Soil Conditions

A. CONTRACTOR shall make his own determination as to soil and/or rock conditions and shall complete the work in whatever material and under whatever conditions may be encountered or created, without extra cost to OWNER. This shall apply whether or not borings are shown on the drawings.

B. OWNER does not guarantee that the ground encountered during construction will conform with any boring information furnished herein.

C. OWNER and ENGINEER may have been involved in the design, construction observation, and/or construction of other underground projects in the area of the proposed construction. The observation field reports, soil reports, and any soil information connected with these projects are available for review by prospective Bidders.

1.12 Survey Monuments

A. Monuments or other recognized property boundary markers at street intersections, section corners, acreage or lot corners, and right of way lines shall be preserved and protected.

B. Where such monuments or markers must be removed during construction, OWNER shall be notified, and CONTRACTOR shall make all necessary arrangements with a land surveyor registered in the State of Michigan to have these monuments or markers properly witnessed prior to disturbance or removal and later reset by the registered land surveyor at no cost to OWNER.

1.13 Maintenance and Restoration of Pavements, Road Surfaces, Structures and Trench Backfill

A. Where trenches cross existing improved roadways or drives or where the trench parallels an existing improved roadway which is disturbed by CONTRACTOR’s operations, CONTRACTOR shall consolidate the trench backfill and shall place a temporary gravel fill of at least 8 inches and meeting 21AA Aggregate Gradation. CONTRACTOR shall, during the life of the contract, maintain the same in good condition with additional gravel as settling takes place.

B. Structures, including curbing, walks, paving, gravel, or street road surfaces, etc., that may be damaged or destroyed by CONTRACTOR's operations, shall be repaired and replaced by him at his own expense.

C. In restoring pavement, a saw shall be used and a cut equal to at least 3/4 of the thickness of the existing pavement shall be made on each side of the part to be restored, with the exception of expansion joints that shall be saw cut the full depth of the pavement. Concrete shall be 3500 psi, using 6 sacks of cement per cubic yard of concrete, unless otherwise required.

D. If the pavement removed had an asphaltic concrete surface, the surface shall be removed to a distance one foot beyond the limits of the removed concrete pavement. Butt joints in asphaltic concrete removal shall be prepared by sawing through the total depth of asphaltic concrete. The surface shall be replaced with a nominal four inches of MDOT bituminous surface mixture as required by OWNER and meeting the requirements of the MDOT as to materials and method of replacement at no extra cost to OWNER.

E. Trenches shall be backfilled to the requirement of "Trench A" or "Trench B" specifications as described in this Section and as specified on plans and profiles. After completion of backfill, the work area shall be restored as noted herein.

1.14 Protection of the Public

A. CONTRACTOR shall provide sufficient barricades, guard railings, fencing, advance construction signing, coverings or other means to protect the public from injury due to the work operations, including completed or uncompleted work, at all times until acceptance of the work by OWNER at no extra cost to OWNER.

1.15 Barricades and Protection

A. CONTRACTOR shall provide and maintain in good repair, all barricades, guard railings, etc., as required for the protection of the workers, OWNER's employees and employees of OWNER's agent in strict compliance with state and local requirements.

B. At dangerous points throughout the work, the contractor shall provide and maintain guard rails, colored lights, and flags. All possible precautions shall be taken to protect the workers from injury at no extra cost to OWNER.

1.16 Existing Structures and Utilities

A. General:

1. Certain underground structures and utilities have been shown on the Contract Drawings as an aid to CONTRACTOR; neither OWNER nor ENGINEER guarantee their location or that other underground structures or utilities may not be encountered.

B. Subsurface Utility Investigation:

1. Prior to the commencement of Work at the City of Flint's Water Treatment Plant, CONTRACTOR shall conduct a Subsurface Utility Investigation.

a. The means and methods for excavation in the designated locations will be at the Contractor's discretion. However, many of these areas are vital to the continued operation of the City's water supply system and the Contractor shall use extreme caution when excavating around the underground utilities and facilities. It is anticipated that SUE (Subsurface Utility Engineering) Quality Level A industry standards of care will be adhered to for these exploratory activities.

b. Once a designated utility and/or facility has been exposed, CONTRACTOR shall notify ENGINEER so that the utility location, material type, outside diameter, and closest joint may be recorded and surveyed by ENGINEER's personnel to determine if any changes in the proposed Work will be necessary. After the exposed area has been documented to the satisfaction of ENGINEER, CONTRACTOR will replace the excavated material to temporarily restore the area until the work specified under Article 1.02 of this Section begins.

1.17 Public and Private Utilities

A. Utilities:

1. CONTRACTOR must provide adequate protection for water, sewer, gas, telephone, TV cable, or any other public or private utilities encountered. CONTRACTOR will be held responsible for any damages to such utilities arising from CONTRACTOR'S operation.

2. When it is apparent that construction operations may endanger the foundations of any utility conduit, or the support of any structure, CONTRACTOR shall notify the utility owner of this possibility and shall take steps as may be required to provide temporary bracing or support of conduit or structures.

3. In all cases where permits or inspection fees are required by utilities in connection with changes to or temporary support of their conduits, CONTRACTOR shall secure such permits and pay all inspection fees.

4. Where it is necessary in order to carry out the work that a pole or poles (electric or telephone) be moved to a new location, or moved and replaced after construction, CONTRACTOR shall arrange for the moving of such pole or poles, and the lines thereof, and shall pay any charges necessary to accomplish the relocation or replacement at no cost to OWNER, unless otherwise noted.

5. Where it is the policy of any utility owner to make repairs to damaged conduit or other structures, CONTRACTOR shall cooperate to the fullest extent with the utility and shall see that construction operations interfere as little as possible with the utilities operations. CONTRACTOR shall pay any charges related to repairs or damage done at no cost to OWNER.

B. Existing Sewer Facilities:

1. Existing sewers or drains may be encountered along the line of work or within the Project site. In all such cases, CONTRACTOR shall perform the work in such a manner that sewer service will not be interrupted and shall make temporary provisions to maintain sewer service, which will be considered as incidental to the Work as bid.

2. Unless otherwise indicated on the Contract Drawings, CONTRACTOR shall replace any disturbed sewer or drain, or relay same at a new grade and/or location to be established by OWNER or ENGINEER such that sufficient clearance for the sewer will be provided.

3. CONTRACTOR will receive no extra compensation for replacement or relocation of sewers or drains encountered, or for relaying at a new grade where called for by the Contract Drawings unless a separate bid item has been included in the Proposal.

C. Existing Water Facilities:

1. Where existing water mains are encountered in the work, they shall be maintained in operation. If necessary, they shall be re-laid using ductile iron pipe of the type and with joints as specified within the current water main specifications of the governmental agency controlling said utility.

2. CONTRACTOR will receive no extra compensation for the relaying and/or lowering or raising of water mains or water service leads, except where a separate bid item has been included in the proposal.

D. Existing Gas Facilities:

1. Where existing gas mains and services are encountered, the contractor shall arrange with the gas company for any necessary relaying and shall pay for the cost of such work unless otherwise provided.

1.18 Pumping, Bailing and Draining

A. CONTRACTOR shall provide and maintain adequate pumping and drainage facilities for removal and disposal of water from trenches or other excavations.

B. Where the Work is in ground containing an excessive amount of water, CONTRACTOR shall provide, install, maintain, and operate suitable deep wells or well points, connecting manifolds and reliable pumping equipment to operate same to ensure proper construction of the Work. Alternate dewatering methods may be implemented if approved by OWNER and ENGINEER.

C. Drainage or discharge lines shall be connected to adjacent public storm water drains or extended to nearby water courses wherever possible. In any event, pumping and drainage shall be done without damage to any highway or other property, public or private, and without interference with the rights of the public or private property owners and in accordance with the Michigan Department of Environmental Quality (MDEQ) and local requirements for soil erosion and sedimentation control.

D. CONTRACTOR shall receive no extra compensation for providing, maintaining or operating any dewatering or drainage facilities except where a separate bid item has been included in the proposal.

1.19 Sheeting, Shoring and Bracing

A. Where necessary to construct the Work called for by the contract, to ensure the safety of CONTRACTOR's workers, or to protect other things of value, CONTRACTOR shall use and, if necessary, leave in place, sheeting, shoring, and bracing as is needed to carry out the work or to adequately ensure the stability of such work, or to ensure the safety of CONTRACTOR's workers and/or to protect adjoining things of value. CONTRACTOR will receive no extra compensation for sheeting, shoring, or bracing, whether removed or left in place except where a separate bid item has been included in the proposal.

1.20 Disposal of Excavated Material

A. Excavated material shall remain on site unless otherwise specified; OWNER will designate an area where materials are to be disposed of. CONTRACTOR shall grade materials to blend in with the existing grades and seed final grade in accordance with the Contract Documents.

1.21 Disposal of Waste Materials

A. Unless otherwise directed by OWNER, all waste materials and debris, including pavement, resulting from the construction work shall be removed from the premises at no extra cost to OWNER.

B. CONTRACTOR shall, at all times, keep the premises free from accumulations of waste material or debris caused by CONTRACTOR's employees or their work, and shall remove same when necessary or required by OWNER.

1.22 Inspection of Premises

A. CONTRACTOR shall visit the premises and thoroughly acquaint himself with the conditions to be encountered in the installation of the Work shown on the Contract Drawings and described in the specifications, as no extras will be allowed to cover work which CONTRACTOR has not included in his tender due to his failure to inspect the premises.

1.23 Schedule of Operations

A. CONTRACTOR shall submit, for OWNER's review and approval, a schedule of his proposed operations. CONTRACTOR's schedule shall be complete and shall show in detail the manner in which he proposed to complete the Work under this Contract.

1.24 Ordinances and Codes

A. The Work shall be executed and inspected in accordance with all local and state rules and regulations and all established codes applicable thereto and shall conform in all respects to the requirements of all authorities having jurisdiction thereover.

B. Where the Work required by the Contract Drawings is above the standard required, it shall be done as shown or specified.

1.25 Dust Control

A. CONTRACTOR shall provide adequate measures to control dust caused by his operation. The methods employed, and frequency of application shall be as approved and directed by OWNER.

1.26 Inconveniences

A. CONTRACTOR shall at all times be aware of inconveniences caused to the abutting property owners and general public. Where undue inconveniences are not remedied by CONTRACTOR, OWNER, upon 4 hours' notice, reserves the right to perform the necessary work and to deduct the cost thereof from the money due or to become due to CONTRACTOR.

1.27 Photographs

A. Photographs, as specified in Section 01 3300, Submittal Procedures, shall be required.

1.28 Audio/Video Route Survey

A. An audio/video route survey, as specified in Section 01 3300, Submittal Procedures, shall be required for this Project.

B. The audio/video route survey shall be submitted on a Universal Serial Bus (USB) drive. CONTRACTOR shall submit a minimum of two (2) copies of the audio/video route survey.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 2100
Allowances

Part 1 General

1.01 General

A. CONTRACTOR shall include in his Bid the Allowances listed in the Bid Proposal. These Allowances shall cover work, manufactured equipment or services that will be provided either by CONTRACTOR or by others who may be selected by OWNER.

B. Work performed under Allowances shall be in compliance with Article 12 of the General Conditions (Section 00 7200) and is subject to OWNER approval and under special terms described herein. CONTRACTOR shall coordinate and cause the work covered by these Allowances.

C. It is understood that CONTRACTOR has included in the Contract Price all Allowances so named in the Contract Documents and shall cause the work so covered to be performed for such sums and by such persons or entities as may be acceptable to OWNER.

1.02 Requirements

A. Allowances shall be administered in accordance with the provisions of the General Conditions of the Contract. CONTRACTOR shall be required to coordinate this work with the agency involved and pay all costs the agency may charge in connection with this work.

B. Thereafter, if the actual price for this work is more or less than the allowance, the Contract Price shall be adjusted accordingly by Change Order. The adjustment in Contract Price shall be made on the basis of the actual invoice price without additional charge or markups for overhead, insurances, bonds, or any other incidental expenses.

C. CONTRACTOR shall be responsible for all coordination with the agency involved and for the timely completion of the Work to fit his schedule. CONTRACTOR shall not be allowed any additional compensation for the failure of the agency involved to meet any schedule.

1.03 Definitions

A. Allowance, Permit Fees: A monetary sum that includes, as part of the Contract Price, the associated costs and requirements to complete and obtain outstanding permits that are required for the Work specified herein.

B. Allowance, Owner-Controlled Change: A monetary sum that is, as part of the Contract Price, the sole use of OWNER to cover unanticipated costs and will be used only under the direction of OWNER.

1.04 Submittals

A. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the Site for use in fulfillment of each Allowance.

1.05 Instructions

A. At the earliest feasible date after Contract Award, CONTRACTOR shall advise ENGINEER of the date when the final selection and purchase of each product or system described by an Allowance must be completed in order to avoid delay in performance of the work.

B. When requested by ENGINEER, CONTRACTOR shall obtain Bids for each Allowance for use in making final selections; include recommendations that are relevant to performance of the Work.

C. CONTRACTOR shall rurchase products and systems as selected by ENGINEER from the designated Supplier.

D. Allowances shall be used only as directed for OWNER's purposes, and only by Change Orders which designate amounts to be charged to the Allowance.

E. If the actual price for the specified Allowance is more or less than the stated Allowance, the Contract Price shall be adjusted accordingly by Change Order. The adjustment in Contract Price shall be made in accordance with the General Conditions.

F. At Project closeout, any amounts remaining in Allowances will be credited to OWNER by Change Order.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 2200
Unit Prices

Part 1 General

1.01 Scope

A. This Section describes the method of measurement and basis of payment for all items of Work included in the Contract and specified in the Proposal. CONTRACTOR shall provide labor, material, tools, equipment and services required to complete the Work specified herein and indicated on the Plans.

B. OWNER WILL MAKE NO ALLOWANCES FOR ITEMS NOT INCLUDED IN THE PROPOSAL.

1.02 Items of the Proposal

Item 1
Mobilization will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of CONTRACTOR's, ENGINEER's, and OWNER's field offices, and other facilities necessary to undertake the work on the project; and for other work and operations which must be performed, or for expenses incurred, prior to beginning work on the various contract items on the project site. It shall also include preconstruction costs, including insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the contract. Payment for mobilization will be based upon the following schedule:

Partial Payment Schedule

Percentage of Original Contract Amount Earned	Percentage of Bid Price for Mobilization Allowed
5	50
10	75
25	100

Item 2
Soil Erosion and Sedimentation Control (SESC) Measures will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material and equipment necessary to furnish and install soil erosion and sedimentation control devices, and shall include, but is not limited to, furnishing and installing, inlet filters, check dams, ditch sediment traps, temporary gravel construction entrance/exit, and other devices, as shown on the plans or detailed, maintaining devices, replacement of ineffective devices, removal of temporary devices, miscellaneous cleanup and restoration, and items necessary to complete the Work, whether specifically mentioned or implied.

Item 3
Traffic Maintenance & Control will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, and equipment required for maintaining traffic, and shall include, but is not limited to, furnishing, installing, operating, and maintaining all barricades, lighted arrow boards, drums, traffic control devices, signs, channeling devices, cones, flagmen, flag control, pavement markings, warning flashers, concrete barriers, minor traffic devices, and all other items necessary to complete the job, whether specifically mentioned or implied.

Item 4
Audio-Video Route Survey will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, equipment, and supplies necessary for furnishing an audio-video route survey in accordance with Section 01 3300, Submittal Procedures and Section 01 1100, Summary of Work.

Item 5
Subsurface Utility Investigation will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for all labor, material, equipment, and supplies necessary for an subsurface utility investigation in the designated locations at the City of Flint's Water Treatment Plant. Work shall include, but is not limited to, excavation, sheeting, bracing and shoring to a point that the designated utility is exposed. CONTRACTOR shall notify ENGINEER so that the utility location, material type, outside diameter, and closest joint may be recorded and surveyed by ENGINEER's personnel to verify the proposed locations, elevations, and connections proposed for Items 20 through 24 are accurate and constructible as specified.

Item 6
Transmission Main, of the type, diameter and class specified, in open cut trench, will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing water main and shall include, but is not limited to, specials and fittings, removal and replacement of fencing, excavation, sheeting, shoring and bracing, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling (including backfill with special materials where specified), disposal of excess excavated material, temporary blow-offs, thrust blocks, encasement, barricading, disinfection, testing restoration, final cleanup, connections to existing mains and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for transmission main will be field measured in linear feet along the centerline of the pipe installed by open cut, taken from end-to-end with no reduction for fittings and valves except for special structures, sections or connections for which either Lump Sum or unit prices have been taken will be deducted from the total length of water main and will be paid for at the prices bid therefore.

Item 7
Transmission Main, of the type, diameter and class specified installed by jack-and-bore will be paid for at the Contract Unit Price per Linear Foot. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing bored water main, and shall include, but is not limited to, removal and replacement of fencing, dewatering, excavation, sheeting, shoring and bracing, disposal of excess excavated material, casing pipe, grouting, backfilling, barricading, thrust blocks, disinfection, testing, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for transmission main will be field measured in linear feet for the length of along the centerline of the pipe not exposed by open cut.

Item 8
Butterfly Valve, of the diameter specified will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing valve and well or valve box, and shall include, but is not limited to, valve well foundation, steel reinforcing, bricks, blocks, valve well sections, adjusting rings, well frame and cover, cement mortar plaster coat, valve box, necessary excavation, sheeting and bracing, shoring, dewatering, connection to water main, backfilling, restraints, disposal of excess excavated material, thrust blocks, disinfection, testing, restoration, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied. Valves and wells will be measured as units installed.

Item 9

Air Valve for Water Service, of the diameter specified will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for air release assembly, and shall include, but is not limited to, valve, valve well, valve well foundation, steel reinforcing, bricks, blocks, valve well sections, adjusting rings, well frame and cover, cement mortar plaster coat, valve box, necessary excavation, sheeting and bracing, shoring, dewatering, backfilling, connection to water main, miscellaneous piping, disposal of excess excavated material, thrust blocks, disinfection, testing, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied. Air valve and well or valve box will be measured as units installed.

Item 10

Hydrant Assembly, Blow-off, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing hydrant blow-off assemblies, and shall include, but is not limited to, valves, valve boxes, connecting piping and fittings, necessary excavation, sheeting and bracing, shoring, dewatering, backfilling, disposal of excess excavated material, miscellaneous pipe connecting hydrant to water main, valves and fittings, thrust blocks, disinfection, testing, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied. Hydrants will be measured as units installed.

Item 11

Hydrant Assembly, Fire will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing fire hydrant assemblies, and shall include, but is not limited to, valves, valve boxes, connecting piping and fittings, necessary excavation, sheeting and bracing, shoring, dewatering, backfilling, disposal of excess excavated material, miscellaneous pipe connecting hydrant to water main, valves and fittings, thrust blocks, restoration, cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied. Hydrants will be measured as units installed.

Item 12

Removal & Disposal of Non-Hazardous Materials will be paid for at the Contract Unit Price per Ton. Price paid shall be payment in full for labor, material, and equipment necessary to properly handle, manage, characterize, stockpile, load, transport, and dispose of excess non-hazardous materials generated onsite during the Work. Price for this pay item shall also include, but is not limited to obtaining the necessary permits, including paying all fees associated with said permits; providing proper notifications to applicable regulatory agencies and other authorities; furnishing and maintaining plastic sheeting, physical boundaries or barriers, soil erosion and sedimentation control measures, suppressants and foams for dust control, as needed for stockpiled materials; testing, classifying and determining waste characterization; separating materials based on said characterization, as necessary, for each type of waste; transporting materials to approved licensed facilities, including manifests, records or other documentation; decontamination of trucks leaving the site and proper coverage to prevent soil and/or dust from leaving the truck during transport; and other items necessary to complete the job, whether specifically mentioned or implied.

Item 13

Removal and Replacement of Bituminous Pavement will be paid for at the Contract Unit Price per Square Yard. Price paid shall be payment in full for labor, material, and equipment required for removal of the existing pavement and replacement with bituminous pavement as shown on the plans or specified and shall include, but is not limited to, sawcutting, excavation, removal and disposal of existing pavement and unsuitable material, furnishing, placing, and compacting backfill, protection of existing improvements, barricading, furnishing and applying prime and bond coats, furnishing, placing, rolling, and compacting the bituminous base course and wearing coarse, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal and replacement of bituminous pavement will be by square yard of bituminous pavement field measured in place.

Item 14 - 17

Wetland Restoration, of the type specified will be paid for at the Contract Unit Price per Lineal Foot. Price paid shall be payment in full for labor, material, and equipment necessary to strip and stockpile existing wetland topsoil, as well as restoring and re-grading wetland areas to original contours by re-using stockpiled wetland topsoil in accordance with permit conditions for wetland restoration by the agency having jurisdiction. In addition, work for this item includes but is not limited to furnish and install temporary matting to protect existing wetlands, cofferdams or earthern berms necessary for temporary water control within the designated wetlands. Restoration shall also include labor, material, and equipment necessary to seed and install plantings as shown on the Contract Drawings or as directed by ENGINEER. This includes daily seeding with approved seed mix, mulching where wetland slopes exceed 5%, watering and maintenance to provide for uniform growth and any reseeding and erosion repair. Re-seeding and erosion repair shall be included to provide for uniform growth at the completion of the project.

Measurement for wetland restoration will be by lineal foot determined by field measurement. Areas disturbed by CONTRACTOR outside of the areas designated in the wetland restoration details will be at CONTRACTOR's expense.

Item 18

GCDC Connection & Meter Vault, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for connecting new water main to existing water main, as shown on the Plans, and shall include, but is not limited to, fittings, sleeves and adapters in order to “hot tap” an existing/active transmission main supply, removal and replacement of fencing, excavation, sheeting, shoring and bracing, dewatering, barricading, bedding, manhole structure, testing, disinfecting, filling, backfilling (including backfill with special materials where specified), disposal of excess backfill and fill material, and thrust blocks to provide a complete and functional connection to an existing transmission main.

In addition, this item shall include labor, material, and equipment necessary to provide and install a meter vault including, but not limited to excavation, sheeting, shoring and bracing, dewatering, ground stabilization, barricading, concrete, reinforcing, grouting, flow meters, valves and piping; wiring and transformers necessary for connection to the nearest electrical utility, instrumentation connections, control connections, electrical panels, SCADA panels and equipment; sump, sump pump, plumbing, hatches, drive and drive culvert, disposal of excess material, restoration, disinfection, testing and appurtenances necessary to provide a complete, working meter vault, whether specifically mentioned or implied.

Item 19

City of Flint WTP Connection & Meter Vault, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for connecting new transmission main to existing water supply line and constructing a meter vault, as shown on the Plans, and shall include, but is not limited to, coordination with other Contractor(s) working at the site, fittings, sleeves and adapters in order to "hot tap" an existing/active transmission main supply, as well as excavation, sheeting, shoring and bracing, dewatering, ground stabilization, barricading, concrete, reinforcing, grouting, flow meters, valves and piping; wiring and transformers necessary for connection to the nearest electrical utility, instrumentation connections, control connections, electrical panels, SCADA panels and equipment; sump, sump pump, plumbing, hatches, disposal of excess material, restoration, disinfection, testing and appurtenances necessary to provide a complete, working meter vault, whether specifically mentioned or implied.

Item 20

Control Station No. 2 Modifications, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for connecting new water main to existing water main, as shown on the Plans, and shall include, but is not limited to, coordination with other Contractor(s) working at the site, pipe, fittings, adapters, excavation, sheeting, shoring, bracing, dewatering, ground stabilization, barricading, bedding, testing, disinfecting, filling, backfilling (including backfill with special materials where specified), disposal of excess backfill and fill material, and thrust blocks. In addition, this item shall include labor, material, and equipment necessary to furnish and install the specified meters and valves including, but not limited to bracing and supports, electrical connections, instrumentation connections, control connections, electrical panels, SCADA panels and equipment, disinfection, testing, and appurtenances necessary to provide a complete, working installation, whether specifically mentioned or implied.

Item 21

Control Station No. 3 Modifications, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary to install the necessary electrical and instrumentation connections, electrical panels, SCADA panels and equipment, testing, and appurtenances necessary to provide a complete, working installation, whether specifically mentioned or implied.

Item 22

Pressure Reducing Pit Modifications, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary to furnish and install the specified meter, including but not limited to coordination with other Contractor(s) working at the site, piping modifications, bracing and supports, electrical connections, instrumentation connections, control connections, electrical panels, SCADA panels and equipment, disinfection, testing, and appurtenances necessary to provide a complete, working installation, whether specifically mentioned or implied.

Item 23

Tank House Modifications, will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary to remove the existing altitude valve and related appurtenances and replace it with a new altitude valve. Work shall include but is not limited to but not limited to coordination with other Contractor(s) working at the site, piping modifications, valve, bracing and supports, disinfection, electrical connections, instrumentation connections, control connections, electrical panels, SCADA panels and equipment, disinfection, testing, and appurtenances necessary to provide a complete, working installation, whether specifically mentioned or implied.

Item 24
Restoration, with topsoil (of the depth specified), seed, and mulch will be paid for at the Contract on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary to restore all areas disturbed by CONTRACTOR's operation, including, but not limited to coordination with other Contractor(s) working at the site, subgrade preparation, filling, shaping, grading, plowing, discing, raking, disposing of unsuitable material and excess material, furnishing fill and topsoil, placing topsoil, seed, fertilizers, and mulch, rolling, tamping, mowing, maintenance and care, gravel lined ditch, and all items necessary to complete the job, whether specifically mentioned or implied.

Areas disturbed outside of the limits indicated shall be restored at CONTRACTOR's expense.

Item 25
Allowance, Permit Fees to cover costs to complete and obtain outstanding permits that are required for the specified Work. CONTRACTOR shall submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding permit(s). The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by CONTRACTOR at direction of OWNER.

Item 26
Allowance, Owner-Controlled Changes to cover unanticipated costs throughout the course of the project. CONTRACTOR will obtain OWNER's written acceptance before providing equipment, materials or other Work under this allowance. Payments under this allowance will be made based on actual costs, excluding costs of general conditions, handling, unloading, storage, installation, etc., which will be considered to be included within the Contract Price. Payments within the limits of any allowance will exclude overhead and profit and bond and insurance premiums, since those costs will be considered to be included within the Contract Amount. CONTRACTOR shall submit appropriate documentation to validate the actual cost of the item(s). The amount of the allowance shall be adjusted accordingly by Change Order to recognize the allowable cost incurred by CONTRACTOR at direction of OWNER.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 3119
Project Meetings

Part 1 General

1.01 Preconstruction Meeting

A. Prior to the delivery of materials or the start of any construction, CONTRACTOR shall request a Preconstruction Meeting from ENGINEER. A minimum three (3) working days' notification to meeting participants shall be required.

B. Schedule:

1. ENGINEER will establish the meeting place, time and date, distribute agenda, notify participants, and administer the meeting. CONTRACTOR shall notify major Subcontractors.

C. Attendance:

1. OWNER
2. ENGINEER
3. CONTRACTOR
4. Major Subcontractors
5. Utility Companies
6. Safety Representatives
7. Governmental Agencies

D. Agenda:

1. Distribution by CONTRACTOR and discussion, review and acceptance of:

    a. List of names and telephone numbers for superintendent, foreman and other key personnel.

    b. List of major Subcontractors and Suppliers.

    c. Projected construction preliminary progress schedules.

    d. Preliminary schedule of Shop Drawings and Sample submittals.

    e. Estimated monthly payment schedule and schedule of values

2. Critical Work sequencing.
3. Major equipment deliveries and priorities.
4. Project coordination.
5. Responsibilities of OWNER, ENGINEER, CONTRACTOR and other agencies.
6. Procedures and processing of:

    a. Field decisions.
    b. Proposal requests.
    c. Submittals.
    d. Change Orders.
    e. Applications for Payment.

7. Adequacy of distribution of Contract Documents.
8. Procedures for maintaining Record Documents.
9. Use of premises.
10. Construction facilities, controls and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.
13. Security procedures.
14. Housekeeping procedures.
15. Testing

E. Minutes:

1. ENGINEER will prepare and distribute copies to participants within seven (7) days of meeting. Participants shall report corrections and comments within ten (10) days of receipt of minutes.

1.02 Progress Meetings

A. Periodic Progress Meetings will be held as required by the progress of the Work.

B. Schedule:

1. ENGINEER will establish the meeting place, time and date, distribute agenda, notify participants and administer the meeting. CONTRACTOR shall notify major Subcontractors.

C. Attendance:

1. ENGINEER
2. CONTRACTOR
3. Subcontractor as appropriate to the agenda.
4. Suppliers as appropriate to the agenda.
5. Others

D. Agenda:

1. Review minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Review field observations, problems, conflicts.
4. Review problems which impede Construction Schedules.
5. Review of off-site fabrication, delivery schedules.
6. Review corrective measures and procedures to regain projected schedule.
7. Review revisions to Construction Schedules.
8. Review plan progress, schedule, during succeeding Work period.
9. Review coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Review maintenance of quality standards.
12. Review proposed changes for:

    a. Effect on Construction Schedule and on completion date.
    b. Effect on other Contracts of the Project.

13. Other business.

E. Minutes:

1. ENGINEER will prepare and distribute copies to participants and OWNER within seven (7) days of meeting for review at the next meeting.

1.03 Preinstallation Meeting

A. When required in individual specification sections, CONTRACTOR convene a preinstallation meeting at the Site prior to commencing work of the section.

1. Notify OWNER and ENGINEER four (4) days in advance of meeting date.

B. CONTRACTOR shall require the attendance of parties directly affecting, or affected by, Work of the specific section.

C. Prepare agenda and preside at meeting:

1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

D. CONTRACTOR shall record and distribute copies of meeting minutes within two (2) days after meeting to participants, with copies to ENGINEER, OWNER, participants, and those affected by decisions made.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 3300
Submittal Procedures

Part 1 General

1.01 General Requirements

A. CONTRACTOR shall submit Shop Drawings, product data, and Samples, as required by the individual Specification sections, to ENGINEER for review in accordance with the provisions of General Conditions.

1.02 Progress Schedules

A. CONTRACTOR shall submit one (1) electronic copy in PDF format of Progress Schedules indicating the starting and completion dates of the various stages of the Work and estimated payments to ENGINEER.

1. Proposed Progress Schedules shall be submitted to ENGINEER prior to the pre-construction meeting.

2. CONTRACTOR shall distribute hard copies of the Progress Schedules during the pre-construction meeting for discussion.

3. Progress Schedules shall be updated by CONTRACTOR and submitted electronically (in PDF format) to ENGINEER, as a part of applications for progress payments, through completion of the Work. Failure to update Progress Schedule may be the basis for rejection of Applications for Progress Payments.

1.03 Shop Drawing Schedule

A. CONTRACTOR shall submit one (1) electronic copy in PDF format of the Shop Drawing Schedule indicating the individual items and submission dates to ENGINEER.

1. A preliminary Shop Drawing Schedule in accordance with the requirements in the General Conditions shall be submitted by CONTRACTOR prior to the pre-construction meeting.

2. CONTRACTOR shall distribute hard copies of the Shop Drawing Schedule during the pre-construction meeting for discussion.

3. A final electronic copy of the Shop Drawing Schedule (in PDF format) shall be submitted by CONTRACTOR at least ten (10) days prior to submitting the first Application for a Payment.

1.04 Schedule of Values

A. CONTRACTOR, if applicable, shall submit one (1) electronic copy in PDF format Schedule of Values of the Work to ENGINEER.

1. A preliminary Schedule of Values shall be submitted by CONTRACTOR prior to the pre-construction meeting.

2. CONTRACTOR shall distribute hard copies of the Schedule of Values during the pre-construction meeting for discussion.

3. A final Schedule of Values (in PDF format), prepared in accordance with the General Conditions and presented in sufficient detail to serve as the basis for payments during construction, shall be submitted to ENGINEER for review at least ten (10) days prior to submitting the first Application for Payment.

1.05 Staking Schedule

A. CONTRACTOR shall submit one (1) electronic copy in PDF format of the staking schedule, in accordance with the "Construction Layout" specification section prior to the start of construction.

1. The staking schedule should be updated as outlined in the Specifications and submitted by CONTRACTOR to ENGINEER through completion of the Work.

1.06 Applications for Payment

A. CONTRACTOR shall submit one (1) electronic copy in PDF format Applications for Payment to ENGINEER in accordance with the provisions of Article 14 of the General Conditions.

B. Applications for Payment shall be made on forms provided by or approved by ENGINEER.

1. Sample CONTRACTOR's Application for Payment, Payment Schedule and ENGINEER's Certificate for Payment forms are included in the Contract Documents and can be obtained in digital format from ENGINEER.

C. Copies of these forms, with Project specific information completed by ENGINEER, will be given to CONTRACTOR at the preconstruction meeting or, if applicable, after approval of the final Schedule of Values.

D. CONTRACTOR shall submit a completed Payment Schedule with an executed Contractor's Application for Payment and Contractor's Declaration to ENGINEER not more often than once per month.

E. ENGINEER will certify payments with the use of Engineer's Certificate for Payment.

1.07 Shop Drawings

A. Shop Drawings shall be presented in a clear and thorough manner. Details shall be identified by reference to plan sheet number, detail number if applicable, and Specification section number, and article number.

1.08 Product Data

A. Product Data shall be presented in a clear and thorough manner identified the same as the Shop Drawings. Included with the information shall be performance characteristics and capacities depicting dimensions and clearances required.

B. Manufacturer's standard schematic drawings and diagrams shall be modified to delete information which is not applicable to the Work. Manufacturer's standard information shall be supplemented to provide information specifically applicable to the Work.

1.09 Samples

A. Samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product with integrally related parts and attachment devices depicting full range of color, texture and pattern.

1.10 Submission Requirements

A. CONTRACTOR shall make Submittals in accordance with the approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor. No damages will be awarded, or extension of time granted, due to the Shop Drawing and product data review process.

B. CONTRACTOR shall submit an entire package of Shop Drawings and Product Data information for major items of Work so that ENGINEER can review the package as a unit.

C. CONTRACTOR shall submit one (1) electronic copy in PDF format of Shop Drawings and Product Data information containing the following information at a minimum:

1. Field dimensions clearly identified as such.

2. Relation to adjacent or critical features of the Work or materials.

3. Applicable standards, such as ASTM or Federal Specification Numbers.

4. Identification of deviations from Contract Documents.

5. Identification of revisions on resubmittals.

6. Project Title, Date of Submission, Date of Previous Submission, and Specification Section number.

D. CONTRACTOR shall initial or sign Shop Drawings and Product Data submittals, certifying CONTRACTOR's review and approval of Submittal per the General Conditions; verification of products, field measurements, field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

E. ENGINEER shall initial or sign Shop Drawings and Product Data submittal and shall indicate the status of the Submittal, or requirements for resubmittal. ENGINEER shall return to CONTRACTOR one (1) electronic copy of the Shop Drawing and/or Product Data submittal (in PDF format) for distribution or for resubmission.

1.11 Engineer's Review

A. Upon receipt of any Submittal defined above, ENGINEER will:

1. Check each for completeness, clarity, correctness, cohesiveness, legibility, and reproducibility.

2. Review each only for general conformity with the Contract Documents as specified in the General Conditions.

B. After review of any Submittal, ENGINEER will appropriately affix a stamp, electronic notation box or other means, signifying the Submittal as having received full consideration and review.

C. The "status" of any such Submittal or portion thereof, as appropriate, will be evidenced by any one or more of the following notations clearly signified by a “X” or other similar mark placed in the box adjacent to the notation:

1. Notations for ENGINEER’S Review:
   - No Exceptions Taken
   - Note Markings
   - Comments Attached
   - Rejected

2. Notations for Response Required by CONTRACTOR:
   - None
   - Confirm
   - Resubmit

D. Notation Meanings:

1. Elements marked "No Exceptions Taken” indicate that CONTRACTOR may commence with construction, fabrication or purchase of such items provided CONTRACTOR.

2. Elements marked "Note Markings" indicate that the CONTRACTOR may commence with construction, fabrication or purchase of such items provided the CONTRACTOR.

   a. Proceeds in strict accordance with ENGINEER’s notes and/or required corrections/deletions/additions indicated thereon;

   b. Pending appropriate response by CONTRACTOR as further noted.

3. Elements marked “Comments Attached” indicate that further comments or explanations have been affixed to the Submittal, which may require action(s) by CONTRACTOR as further noted.

4. Elements marked "Rejected" indicate that CONTRACTOR must make the required corrections as shown or noted and resubmit such items to ENGINEER for further review.

5. Elements marked “None” indicate that the Submittal requires no further action by CONTRACTOR.

6. Elements marked “Confirm” require CONTRACTOR to provide affirmation to ENGINEER regarding comments, notes, markings, etc. made by ENGINEER, and to affirm that CONTRACTOR will comply with the comments, notes, markings, etc.

7. Elements marked “Resubmit” indicate that CONTRACTOR may not commence with construction, fabrication or purchase of such items, and that CONTRACTOR must resubmit items for review that comply with the Contract Documents in the event that those originally submitted do not, or with any comments, notes, markings, etc. made by ENGINEER.

1.12 Resubmission Requirements

A. CONTRACTOR shall make all corrections or changes in the Submittals required by ENGINEER and resubmit. CONTRACTOR shall indicate any changes which have been made other than those requested by ENGINEER.

1.13 Manufacturer's Operation and Maintenance Data

A. CONTRACTOR shall submit one (1) electronic copy in PDF format and one (1) bound copy of all operation and maintenance data required per the various Specification sections.

1. Prior to 50% completion of the Project, CONTRACTOR shall have submitted one (1) acceptable copy to ENGINEER for review.

B. Final copies of the operation and maintenance data shall be bound in a suitable number of 3-inch or 4-inch, 3-ring hard cover binders. Permanently imprinted on the cover shall be the words "Manufacturer's Operation and Maintenance Data", Project title, location of the Project, and the date. A table of contents shall be provided in the front of each binder to list the various sections in the manual.

C. The information to be provided in each section of the manual, for each piece of equipment and project component shall include, but not be limited to, detailed equipment drawings; sections cut through all of the major equipment and subassemblies; installation and operational procedures; complete wiring and piping schematics; lubrication materials and procedures; maintenance procedures; and parts lists complete enough to permit identification of parts by nomenclature, manufacturer’s part number and use.

D. At the front of each section a maintenance schedule shall be provided for each piece of equipment in the section.

1. The schedule shall display the daily, weekly, monthly, semi-annual, annual or fraction thereof, lubrication and preventative maintenance required in order to meet warranty conditions and the manufacturer's recommendations for optimum performance and life of the unit.

2. A common schedule format is to be developed and used for all of the sections. Photocopies or reproductions of the manufacturer's literature will not be accepted.

1.14 Audio/Video Route Survey

A. When required in the Summary of Work, Section 01 1100, or the Proposal, CONTRACTOR shall furnish ENGINEER with an "Audio/Video Route Survey" record of the existing conditions prior to the start of construction. CONTRACTOR must enlist the services of a firm having a minimum of one (1) year experience in audio/video recording of construction projects.

B. Prior to beginning the audio/video recording, CONTRACTOR shall review with ENGINEER the Project requirements to ensure that the audio/video is adequate for its intended purpose.

C. OWNER shall have the authority to designate areas for which coverage may be added or omitted. The audio/video recording shall be done prior to placement of materials or equipment on the construction area and furnished one (1) week prior to the pre-construction meeting.

D. Format:

1. Audio/Video route survey shall be submitted in the format(s) as specified in Section 01 1100, Summary of Work.

(1) Audio/video route survey submission shall be on USB media

(2) Format: USB – Video

(3) Video Encoding: Highest available bit rate (6-9 Megabit), 60 fields per second interlaced video

(4) Audio Encoding: Uncompressed stereo wave or stereo Dolby Digital (256 kilobit or better)

(5) Aspect Ratio: 4x3 (720x480 pixels)

(6) No Macrovision or other copy protection encoding. No region code or region code 1.

E. Complete coverage shall include all surface features located within the public right-of-way, easement areas and adjacent private properties up to building line when such properties lie within the zone of influence of construction and will be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culvert, headwalls, retaining walls, and buildings located within such zone of influence. Video coverage shall be clear enough to identify cracks, depressions, holes and other defects in existing surfaces.

F. Houses and buildings shall be identified visually by house number, when visible, in such a manner that structures of the proposed system can be located by reference. In all instances, however, location shall be identified by audio or visual means at intervals not-to-exceed 100 linear feet (30 m) in the general direction of travel.

G. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall be not less than 12 feet (3.5 m) to ensure proper perspective. The rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 30 feet/minute (10 m/min). Panning rates and zoom-in, zoom-out rates shall be controlled sufficiently such that stop action during play-back will produce clarity of detail of the object viewed.

H. Video recordings must, by electronic means, display continuously and simultaneously generated transparent digital information in the upper left hand third of the screen to include the date and time of recording, as well as the corresponding engineering stationing numbers as shown on the Contract Drawings.

1. The date information will contain the month, day, and year. For example, mm/dd/yy, and be placed directly below the time information.

2. The time information shall consist of hours, minutes, and seconds, separated by colons. For example, hh:mm:ss.

I. Engineering stationing numbers must be continuous, accurate and correspond to the Project stationing and must include the standard engineering symbols. For example, Station 14+84.

J. Recording shall be done during times of good visibility. No recording shall be done during periods of visible precipitation, or when more than ten (10) percent of the ground area is covered with snow or standing water, unless otherwise authorized by OWNER.

K. In some instances, audio/video coverage may not be suitable for recording necessary details. In such instances, OWNER may specify still photographs to provide coverage. One (1) color photograph shall be provided in accordance with Article 1.15 of this Section with a suitable description of the photograph's location.

L. Any portion of the Audio/Video Route Survey of insufficient quality as determined by ENGINEER shall be redone by CONTRACTOR at no additional cost to OWNER.

M. Each USB shall be properly identified with the Project Title, location, time, and date in a manner acceptable to OWNER.

1.15 Photographs

A. When required in the Summary of Work, Section 01 1100, or the Proposal, Section 00 4243, CONTRACTOR shall furnish ENGINEER with a total of 6 to 10 digital color photographs each month during construction of the Project, unless some other number and times is specified in the Summary of Work.

B. Photos shall be in digital format (i.e., JPEF, TIFF, GIF, PNG or PDF) and shall have a minimum resolution of 300 dpi.

C. The following information shall be placed on the photo itself or embedded in the digital file:

1. Project Title
2. Contract Number
3. Description of photo's content
4. Date and Time of photo

D. CONTRACTOR shall submit photographs monthly along with the Application for Payment as described in Article 14 of the General Conditions.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 4500
Quality Control

Part 1 General

1.01 General Requirements

A. Sampling of materials will be made by ENGINEER in accordance with the methods designated by the Specifications. CONTRACTOR shall furnish such facilities as ENGINEER may require for collecting, storing, and forwarding samples to the Laboratory. CONTRACTOR in all cases shall furnish the required samples to OWNER without charge.

1.02 Control of Installation

A. Monitor quality control over Suppliers, manufacturers, products, materials, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in the sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from ENGINEER before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Work shall be performed by persons qualified to produce workmanship of specified quality.

F. Secure products and materials in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 Tests of Materials

A. Materials in the Work shall meet the requirements of the Contract Documents.

B. Tests of materials will be made as specified herein. CONTRACTOR will appoint, employ, and pay for specified services of an independent firm to perform inspecting and testing, as required for concrete testing, soils compaction density and gradation testing, and asphalt density testing.

1. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by ENGINEER or OWNER.

2. Inspecting, testing, and source quality control may occur on or off the project site. Perform off site inspecting or testing as required by ENGINEER or OWNER.

C. Reports will be submitted by the independent firm to ENGINEER, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

D. ENGINEER shall have access to materials intended for use in the Work as well as to the plants where such materials are produced. Plant inspection may be made if the quantities are sufficient to warrant such inspection and if it is to the best interest of OWNER. In any case materials may be either inspected or tested when received on the Project.

E. Materials shall not be used until approval has been received from ENGINEER. Approval of materials at the producing plant does not constitute a waiver of ENGINEER's right for re-examination at the Project site.

F. Standards for testing materials, unless otherwise specified, shall be as established by the American Society for Testing and Materials (ASTM). Tests of materials will be made in accordance with the methods described or designated in the Specifications.

G. Sampling and testing of materials not specifically mentioned shall be done by generally accepted methods, unless otherwise specified by ENGINEER.

H. Notify ENGINEER and independent firm 48 hours prior to expected time for operations requiring services.

I. Testing or inspecting does not relieve CONTRACTOR of performing Work to Contract requirements.

J. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by ENGINEER. Payment for retesting will be charged to CONTRACTOR by deducting inspecting or testing charges from the Contract Price.

1.04 Certification of Materials

A. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the standards referred to in the Contract Documents.

1.05 Source Quality Control

A. Testing identified in the Specifications as Source Quality Control, which is required to establish quality of materials, equipment or fabricated items, shall be paid for by CONTRACTOR.

1.06 Inspector Days

A. Resident Project Representative(s) will be assigned to the Project by ENGINEER, as necessary (in the opinion of ENGINEER) to adequately monitor CONTRACTOR’s work.

1. When multiple CONTRACTOR crews are working on the Project, multiple Resident Project Representatives may be assigned to the Project.

B. If the quantity of Work under the Contract is changed, the number of "Inspector Days" shall be increased or decreased as determined by Article 10 or 11 of the General Conditions. This revision in the number of Inspector Days shall be agreed upon at the time the Contract quantities are revised.

C. CONTRACTOR shall give ENGINEER at least 48 hours notice, exclusive of Saturdays, Sundays or holidays, when the Project requires an increase or decrease in the number of Resident Project Representatives.

1. Failure to observe this requirement will either necessitate the charging of 4 hours show-up time if the Resident Project Representative appears on the Project, or the halting of all additional operations until a Resident Project Representative is available.

D. Unless the Resident Project Representative is notified in advance, Inspector days will be charged when a Resident Project Representative appears on a project and CONTRACTOR decides not to work.

E. A separate Inspector Day or a partial Inspector Day shall be charged for each and every Resident Project Representative working on a project for monitoring purposes.

1.07 Mockups

A. Tests will be performed under provisions identified in this Section and identified in the respective specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mockups are representative of the quality required for the Work.

D. Where mockups have been accepted by ENGINEER and is specified in specification section(s) to be removed, CONTRACTOR shall remove mock up and clear area when directed to do so.

1.08 Manufacturers' Field Services and Reports

A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report in duplicate within 30 days of observation to Engineer for information.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 4523.15
Request for Final Inspection

Part 1 General

1.01 Final Inspection

A. Prior to CONTRACTOR demobilizing from the project, CONTRACTOR shall submit a written request for final inspection to ENGINEER.

B. Upon completion of the final inspection, representatives from both CONTRACTOR and ENGINEER shall sign the following form, agreeing that the Work is substantially complete, as defined by Section 00 7200 and Section 01 1000, and establish completion dates for developing and completing preliminary and final punch list items, and processing of the final payment request.

See Next Page for Final Inspection Form

The project to which this request applies has been inspected by authorized representatives of CONTRACTOR and ENGINEER, and the Work is hereby declared to be substantially complete to a point that a project punch list should be prepared in accordance with the following schedule:

Develop Preliminary Punch List **Date:** _____

Responsibility: Owner, Contractor and Engineer
Engineer shall have 2 weeks to prepare the punch list.

Complete Preliminary Punch List Items **Date:** _____

Responsibility: Contractor
Contractor shall have 2 weeks to complete the items on the punch list.

Develop Final Punch List (if needed) **Date:** _____

Responsibility: Owner, Contractor and Engineer
If needed, a second and final punch list will be prepared within 2 weeks by Engineer.

Complete Final Punch List Items **Date:** _____

Responsibility: Contractor
Contractor shall have 2 weeks to complete the items on the second and final punch list.

Process Final Payment **Date:** _____

Engineer will have 2 weeks to review and submit final pay request documents from Contractor to the Owner for final payment upon satisfactory completion of punch list items by Contractor.

This notice signed and dated through mutual agreement of CONTRACTOR and ENGINEER will initiate the time sequence for the approved execution of finalizing _____

Contract in _____, Michigan, dated _____.

COPY: OWNER

Date: _____

_____
ENGINEER's Representative

Date: _____

_____
CONTRACTOR's Representative

Section 01 5000
Temporary Facilities and Controls

Part 1 General

1.01 Site Access and Parking

A. CONTRACTOR shall locate roads, drives, walks and parking facilities to provide uninterrupted access to construction offices, mobilization, Work, storage areas, and other areas required for execution of the Contract. Access drives and parking areas shall be hard surfaced unless otherwise approved by ENGINEER.

B. CONTRACTOR shall maintain driveways a minimum of 15 feet (5 m) wide between and around combustible materials in storage and mobilization areas.

C. CONTRACTOR shall maintain traffic areas as free as possible of excavated materials, construction equipment, products, snow, ice, and debris.

D. CONTRACTOR shall not utilize existing parking facilities for construction personnel or for CONTRACTOR's vehicles or equipment, unless written permission from owner of parking facility is obtained.

1.02 Trucking Route and Public Road Maintenance

A. Prior to the start of construction, CONTRACTOR shall submit for review a schedule and list indicating the streets and roads within the municipality that his equipment will use off the Project site.

B. CONTRACTOR shall comply with all safety requirements, weight restrictions and speed limits.

C. Gravel and dirt roads or streets used shall be maintained by grading, placing dust palliatives and maintenance gravel in sufficient quantities to eliminate dust and maintain traffic.

D. Paved streets shall be maintained in a reasonable state of cleanliness and CONTRACTOR shall remove accumulations of debris, dirt or mud caused by his operations. Removal shall be done in such a manner as to prevent the release of dust. This shall be done at least every day at the close of each day's operation or additionally when requested by ENGINEER.

E. Roads or streets damaged by CONTRACTOR’s operations, shall be repaired or removed and replaced to satisfactions of the agency having jurisdiction at no additional cost to the Project.

F. In order to ensure adequate street maintenance and restoration as outlined above, CONTRACTOR may be required to deposit with the Agency having jurisdiction a cash Road Protection Bond.

1. This Bond, if required, will be held in escrow until final release is given by the Agency having jurisdiction. In the event CONTRACTOR fails or neglects to maintain or restore the streets to the satisfaction of the Agency having jurisdiction, the Agency having jurisdiction shall have the required maintenance or restoration work done and the cost incurred shall be deducted from the Road Protection Bond.

2. At the completion of the Project, the Agency having jurisdiction shall return the Road Protection Bond less any monies expended by the Agency having jurisdiction and shall render to CONTRACTOR an accounting of all monies so expended.

G. CONTRACTOR shall not store any equipment, supplies, construction material or excess excavated material on any roads or streets unless otherwise approved by ENGINEER.

1.03 Emergency Access

A. CONTRACTOR shall provide emergency access to property in the vicinity of the construction for police vehicles, fire equipment, ambulances or other emergency vehicles to protect life, health and property. Any areas damaged by emergency vehicles shall be restored by CONTRACTOR at no additional cost to OWNER.

1.04 Private or Public Roads, Sidewalks, and Parking Areas

A. Where public roads, driveways, parking areas and sidewalks are encountered throughout the community, CONTRACTOR shall maintain those portions affected by the construction operations in a passable condition until such time as final restoration of these improvements can be made as specified.

1. If, in the opinion of ENGINEER, the public safety is in danger or the necessity exists for maintaining traffic, ENGINEER may direct that backfilling be completed immediately.

2. In the event that the necessary backfill material and equipment are not available when direction is given for immediate backfill, the trench shall be backfilled with native material to provide for the necessary maintenance of traffic and safety; however, the native material shall be removed within 48 hours and the trench properly backfilled as specified.

B. Where private roads are encountered throughout the community, CONTRACTOR shall maintain those portions affected by its construction operations in a passable condition. These roads shall be maintained by the use of 21A road maintenance gravel, stone or slag.

1. In the event the original subbase has been destroyed, CONTRACTOR shall furnish and install 1-inch to 2-inch (25 to 50 mm) aggregate to stabilize the existing subbase.

2. Upon completion of the construction activities, CONTRACTOR shall shape and regrade these roads leaving them in a condition as good as or better then original, and adequate for normal travel.

1.05 Work Within Railroad Company Right-of-Way

A. CONTRACTOR shall be responsible for complying with the requirements of the Railroad Company for Work of the Project and/or temporary crossings for trucking routes.

B. Unless otherwise provided by an item of these Specifications, CONTRACTOR shall bear costs and expenses incidental thereto, including, but not limited to, protection, flagmen, construction engineering inspection by the railroad, and incidental work such as drainage facilities and removal, alteration and replacement of railroad fences.

1.06 Road Closing

A. No street, road or section thereof shall be closed to through traffic unless otherwise provided for on the Plans, Specifications, or authorized by the agency with jurisdiction over the roads. Prior to closing a street, road, or section thereof, CONTRACTOR shall provide ENGINEER with a copy of a detour plan approved by the agency having jurisdiction over the roads.

B. In the event roads or streets are to be closed, CONTRACTOR shall notify the local fire department, police department, local road authority, ambulance and emergency services, Department of Public Works, public transit authority and public school system daily as to what streets will be partly blocked or closed, the length of time the streets will be blocked or closed and when the streets will be reopened to traffic. CONTRACTOR shall designate one responsible employee to carry out the requirements of this condition.

C. During the time that the road is closed, CONTRACTOR shall make provision for trash, leaf, and rubbish pickup.

1.07 Maintaining Traffic

A. CONTRACTOR shall provide access for local traffic to property along the Project by means of temporary roads, drives, culverts or other means approved by ENGINEER. CONTRACTOR shall grade, add surfacing materials, and dust palliatives to such temporary roads and drives as necessary for the proper maintenance of traffic.

B. Where the shoulder is used to maintain traffic, the shoulder shall be graded, surfaced, treated for dust, constructed, or reconstructed, as specified herein or as shown on the Plans.

1. If the construction work is suspended due to weather conditions, winter shut down or for any other reason, sufficient labor, materials and equipment shall be ready for immediate use at all times for the proper maintenance of traffic.

2. Surfacing materials and dust palliatives shall be applied at such times and locations and in such amounts as necessary to safely maintain traffic and as determined by ENGINEER.

C. Where shoulders are low, high, soft or rough, adequate provisions shall be taken to inform and protect the traveling public by means such as construction warning signs, barricades, lighted devices, etc. Such shoulder hazards shall be eliminated as soon as practicable.

D. CONTRACTOR shall furnish, erect and maintain all signs, barricades, lights, and traffic regulators, in accordance with the requirements of the current "Michigan Manual of Uniform Traffic Control Devices." Furnish flagmen and watchmen as are necessary to maintain and safeguard traffic along the entire Project.

1. Failure to comply with these requirements may be cause for the OWNER to issue a Stop Work Order, which shall remain in effect until all necessary devices are in place and operational.

2. The issuance of a Stop Work Order shall not be reason for granting additional compensation or an extension to the Contract Time.

3. Furnishing, installing, and maintaining traffic control devices shall be incidental to the Project unless otherwise provided for in the Proposal.

1.08 Existing Signs

A. No stop sign, traffic control or warning device or sign shall be taken down until the agency having jurisdiction over the roads has been notified and arrangements for the immediate reinstallation has been made.

B. CONTRACTOR shall provide temporary signs, traffic control devices, warning devices, or watchmen continuously from the time the item is removed until it is reinstalled.

C. Signs removed shall be replaced with signs meeting requirements of the agency having jurisdiction over the roads.

1.09 Temporary Electricity and Lighting

A. CONTRACTOR shall be responsible for and pay all costs for the installation and removal of circuit and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords and shall pay all costs of electrical power used.

B. Electrical wiring and distribution shall conform to the National Electrical Code as adopted by the State of Michigan.

1.10 Telephone

A. CONTRACTOR is required by MIOSHA regulations to provide telephone service for contacting emergency services. Such emergency telephone service shall also be available for the use of OWNER and ENGINEER whether or not a field office is required for the Project. Emergency phone numbers are required to be posted per MIOSHA regulations.

B. CONTRACTOR shall pay all costs for installation, maintenance and removal, and service charges for local calls to provide service for his construction site office as well as for ENGINEER's field office. Toll charges for calls relating to Project business shall be at CONTRACTOR'S expense.

1.11 Use of Water

A. CONTRACTOR shall acquire any and all permits, post any bonds and pay all fees required by the local agency having jurisdiction prior to using any hydrant or any other source of water. CONTRACTOR shall reimburse the local community for water consumed during course of the Project at the current rate as set by the agency having jurisdiction.

1.12 Sanitary Provisions

A. CONTRACTOR shall be responsible for installation, maintenance and removal of temporary sanitary facilities per MIOSHA regulations for use of construction personnel including OWNER and ENGINEER. All rules and regulations of the State and local health officials shall be observed, with precautions taken to avoid creating unsanitary conditions.

1.13 Potable Water

A. CONTRACTOR shall furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including OWNER and ENGINEER.

1.14 Medical Services and First Aid

A. CONTRACTOR shall furnish first aid supplies and a person trained in first aid with a valid first aid certificate, per MIOSHA requirements, available for use of construction personnel including OWNER and ENGINEER. CONTRACTOR shall also furnish a communication system for contacting emergency services. Telephone numbers of the physician, hospital, or emergency services shall be conspicuously posted at the job site.

1.15 Postal Service

A. Several or all residents of this Project area may receive their mail at roadside mailboxes. Since the postal service will not deliver mail to a resident without a mailbox or a mailbox that is not in its proper position, CONTRACTOR shall relocate, replace and repair all mailboxes and posts in a condition and height acceptable to the post office within 24 hours of the removal.

B. If required, CONTRACTOR shall furnish new posts for the mailboxes if the existing posts are broken or rotted to the extent that they cannot be reused.

C. Mailbox damaged by CONTRACTOR while carrying out his operations or by anyone else while the box is down due to CONTRACTOR's operation, shall be replaced by CONTRACTOR with a new mailbox meeting the postal officials' specifications and the resident's name and address neatly lettered with paint or other acceptable means to the satisfaction of the resident and postal authorities. Cost for relocating mailboxes shall be incidental to the Project unless otherwise specified in the Proposal.

1.16 Newspaper Delivery

A. Residents of this Project area may receive their newspapers at roadside tubes. Since the resident arranges for newspaper delivery, CONTRACTOR shall notify the resident 24 hours prior to removal of any newspaper tube. Newspaper tubes damaged by CONTRACTOR while carrying out his operations or by anyone else while the tube is down due to CONTRACTOR's operation, shall be replaced as agreed between CONTRACTOR and the newspaper who owns the damaged tube. Cost shall be incidental to the Project.

1.17 Bus Stops and Shelters

A. Prior to the start of any construction, CONTRACTOR shall notify the transit authority that has any bus stops within the area of the Work. Removal, relocation and/or replacement of signs and/or benches shall be the responsibility of CONTRACTOR in accordance with any requirements of the transit authority. Cost shall be incidental to the Project.

1.18 Bypass Pumping

A. CONTRACTOR shall maintain flow in existing sewers at all times by pumping, bypassing, or fluming as necessary.

1. During wet weather events, the flow in the sewer will rise rapidly and may become surcharged.

2. CONTRACTOR shall maintain flow in such a manner as the existing flow can be adequately transported including wet weather flow.

3. CONTRACTOR shall furnish, install, operate, and maintain temporary pumping facilities to service the upstream area including piping, temporary channels, pumps, sumps, controls, temporary plugs, and bulkheads.

B. For sanitary sewerage, by-pass piping shall be PVC Schedule 80, ABS truss pipe, or equivalent with solvent welded joints, or HDPE with butt fused joints.

1. Flexible hoses of whatever types are not acceptable.

2. By-passed flow shall be discharged to a sanitary sewer of acceptable size to handle the bypassed and existing flows.

3. CONTRACTOR shall plan his operation such that there will be no backups, leaks, or discharges of pollutants.

C. CONTRACTOR shall also furnish and have available onsite, redundant pumping facilities in case of any failure of the pumping system including pumps, piping, electrical, connections, etc.

1. Redundant pumping facilities also include having a backup power generator in case the primary power source fails.

2. CONTRACTOR shall provide an adequate labor force to oversee the by-pass pumping including providing labor to maintain 24 hour per day operation and emergency backup service.

D. Costs for pumping and bypassing flow shall be included in the unit price bid for other items of Work unless otherwise specified in the Proposal.

E. CONTRACTOR shall submit a by-pass pumping/diversion scheme to ENGINEER for approval not less than 15 days prior to any anticipated bypass pumping/diversion. Bypass plan shall include pumping capacity and expected flow rates.

Part 2 Products

2.01 Barricades, Arrow Boards, Temporary Pavement Markings, and Temporary Signs

A. Barricades, Arrow Boards, Temporary Pavement Markings, Temporary Signs, and other traffic control devices shall be in accordance with the current edition of the MDOT Standard Specifications for Construction, and the current edition of the Michigan Manual of Uniform Traffic Control Devices.

Part 3 Execution (Not Used)

End of Section

Section 01 5713
Temporary Erosion and Sediment Control

Part 1 General

1.01 Scope of Work

A. This Section includes furnishing, installing, maintaining, and removing at project completion, Soil Erosion and Sedimentation Control devices. Devices include silt fence, straw bales, turbidity barriers, temporary gravel construction entrance/exits, inlet filters, ditch sediment traps, etc.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2200: Grading
D. Section 31 2313: Subgrade Preparation
E. Section 31 2319: Dewatering
F. Section 31 2333: Trenching and Backfilling
G. Section 31 3500: Slope Protection
H. Section 32 9219: Seeding
I. Section 32 9223: Sodding
J. Section 33 1100: Water Utility Distribution Piping
K. Section 33 3000: Sanitary Utility Sewerage Piping
L. Section 33 3400: Sanitary Utility Force Mains
M. Section 33 4100: Storm Utility Drainage Piping

1.03 Reference Standards

A. ASTM American Society for Testing and Materials

1.04 Requirements of Regulatory Agencies

A. CONTRACTOR, at his expense, shall secure all permits, and post all bonds or deposits required to comply with the "Soil Erosion and Sedimentation Control," requirements, being Part 91 of PA 451 of 1994 as amended and the National Pollution Discharge Elimination System (NPDES) Rules for storm water discharges from construction activity.

B. Comply with requirements of the agency having jurisdiction. OWNER may withhold payment to CONTRACTOR equivalent to any fines resulting from non-compliance with applicable regulations.

1.05 Performance Requirements

A. Employ Best Management Practices as defined by standard EPA 832-R-92-005.

B. Put preventative measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.

C. Control increased storm water runoff due to disturbance of surface cover due to construction activities for this Project.

D. Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this Project.

E. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall event that might occur in 10 years.

F. Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this Project. Prevent windblown soil from leaving the project site. Comply with fugitive dust ordinances of agencies having jurisdiction. Prevent tracking or flowing of mud and sediment onto public or private roads, sidewalks or pavements outside of the site.

G. Prevent sedimentation of waterways on or off the project site, including rivers, streams, lakes, ponds, open drainage ditches, storm sewers, and sanitary sewers. If sedimentation occurs, install or correct preventative measures immediately at no cost to OWNER. Comply with requirements of agencies having jurisdiction.

H. Maintain temporary preventative measures until permanent measures have been established. Remove temporary measures when permanent measures have been established.

I. If erosion or sedimentation occurs due to non-compliance with these requirements, remove deposited sediment or restore eroded areas at no cost to OWNER.

1.06 Submittals

A. Submit schedule of Soil Erosion and Sedimentation Control activities to agency having jurisdiction. Include events (with days and/or dates of the various activities) for review and approval prior to obtaining a permit.

B. CONTRACTOR must provide evidence of Storm Water Operator license.

Part 2 Products

2.01 Silt Fence

A. Polypropylene geotextile fabric, resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; meeting the following requirements:

1. Average Opening Size: 30 U.S. Std. Sieve 600 μm), maximum; ASTM D4751.

2. Permittivity: 0.05 sec^{-1}, minimum; ASTM D4491.

3. Ultraviolet Resistance: Retaining at least 70% of tensile strength; ASTM D4355 after 500 hours exposure.

4. Tensile Strength: 100 lb-f (445 N) minimum, in cross-machine direction; 124 lb-f (551 N) minimum in machine direction; ASTM D4632.

5. Elongation: 15 to 30%; ASTM D4632.

6. Tear Strength: 55 lb-f (244 N) minimum; ASTM D4533.

B. Posts shall be 2 by 2-inch (50 mm x 50 mm) cross section hardwood stakes, minimum 3-feet (1.0 m) long.

2.02 Turbidity Barrier

A. Geotextile fabric curtain suspended from flotation devices at the water surface and held in a vertical position by a ballast chain in the lower hem. Turbidity barrier curtain shall meet the following minimum requirements unless otherwise specified on the plans.

1. Consist of vinyl laminate on 1000 denier polyester fabric weighing 18 ounce per square yard (610 g/m^2) minimum.

2. Tensile strength of fabric shall be 220 lbs (100 kg) minimum.

3. Edges of fabric to be reinforced with minimum 5/8-inch (16 mm) diameter polypropylene rope.
4. Ballast chain minimum 5/16-inch (8 mm) galvanized steel.

5. Buoyancy blocks providing buoyancy of 18lbs/l.f (27 kg/m).

6. Length of curtain (water depth) 5-feet (1.5 m).

2.03 Dewatering Discharge Filter Bag

A. UV-stabilized, non-woven geotextile bag to filter sediment from water prior to discharging. Geotextile fabric shall meet the following minimum average roll requirements:

1. Tensile Strength: 180 lb-f (200 N) minimum; ASTM D4632
2. Elongation: 50 percent minimum; ASTM D4632
3. CBR Puncture Strength: 300 lb-f minimum; ASTM D6241
4. Trapezoidal Tear: 70 lb-f (310 N) minimum; ASTM D4533
5. Flow Rate: 80 gal/min/sf. (54 l/s/m^2) Minimum; ASTM D4491
6. Permittivity: 1.4 sec^{-1} minimum; ASTM D4491
7. Apparent Opening Size: 80 U.S. Std. Sieve maximum; ASTM D4751
8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.04 Erosion Control Blankets

A. Machine produced blanket with a consistent thickness of evenly distributed straw or coconut fiber as specified. Unless otherwise specified on the Plans, the erosion control blanket shall have the following minimum properties:

1. Double net 100% straw blanket.

2. Top and bottom photodegradable polypropylene netting, 1.64 lbs./1,000 sft. (0.8 kg/ m^2) approximate weight.

3. 100% agricultural straw 0.5 lbs/sy (.27 kg/m^2).

4. Stitch spacing: 1.5 inches (40 mm) on centers.

B. Pegs shall be 6-inch (150 mm) long, hardwood pegs.

2.05 Bonded Fiber Matrix

A. Bonded fiber matrix (BFM) shall consist of long strand, residual, softwood fibers joined together by a high-strength, non-toxic adhesive. BFM shall be 100% biodegradable, and be non-toxic to fish, wildlife, and humans. Upon drying the matrix shall form a high strength, porous and erosion resistant mat that shall not inhibit the germination and growth of plants. BFM shall retain its form despite re-wetting.

B. Bonded fiber matrix shall consist of:

1. Seed and Fertilizer per Section 32 9219, Seeding.

2. Wood Fiber Mulch: Thermo-mechanically defibrated long, softwood fibers manufactured from select northern softwood wood chips.

3. Polyacrylamide Binder: Site specific, fully biodegradable, polyacrylamides (PAM's) binders, with cross-linking long organic jute fibers

C. Materials shall be mixed at the rate of 80 lbs/acre (90 kg/Ha) of PAM binder and 2500 lbs/acre (2800 kg/Ha) of wood fiber mulch.

2.06 Inlet Filter Fabric

A. Filter fabric shall be constructed of 100% continuous polyester needle-punched non-woven engineering fabric. Filter fabric shall be fabricated to provide a direct fit with the drainage structure cover. Filter fabric shall have the following minimum physical properties.

1. Tensile Strength: 80 lb-f (.355 kN) minimum; ASTM D4632
2. Elongation: 50 percent minimum; ASTM D4632
3. CBR Puncture Strength: 300 lb-f minimum; ASTM D6241
4. Trapezoidal Tear: 70 lb-f (310 N) minimum; ASTM D4533
5. Flow Rate: 80 gal/min/sf. (54 l/s/m^2) Minimum; ASTM D4491
6. Permittivity: 1.4 sec^{-1} minimum; ASTM D4491
7. Apparent Opening Size: 100 U.S. Std. Sieve (150 µm) maximum; ASTM D4751
8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.07 Acceptable Manufacturers

A. Acceptable manufacturers include the following:

1. Turbidity Barrier: Tough Guy Type II by Aer-flo Canvas Products, Inc.
2. Wood Fiber Mulch: EcoFibre by Canfor Corporation.
3. Polyacrylamide Binder: HydroTurboNet by Straw Net, Inc.

Part 3 Execution

3.01 Examination

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to the greatest extent possible.

B. Except in areas to be cleared, do not remove, cut, deface, injure or destroy trees or shrubs without ENGINEER's approval. Protect existing trees or shrubs that are to remain, and which may be injured, bruised, defaced, or otherwise damaged by construction operations, with suitable fences or other means as approved by ENGINEER.

3.02 Preparation

A. Review the drawings and Storm Water Pollution Prevention Plan (SWPPP).

B. Revise SWPPP as necessary to address potential pollution from site identified after issuance of the SWPPP at no additional cost to Owner.

C. Conduct storm water pre-construction meeting with Site Contractor, all ground-disturbing Subcontractors, site Engineer of record or someone from their office familiar with the site and SWPPP, and state or local agency personnel in accordance with requirements of the special conditions.

D. Schedule work so that the soil surfaces are left exposed for the minimum amount of time. Place permanent soil and sedimentation control measures as soon as practical.

3.03 General

A. Do not discharge excavation ground water to the sanitary sewer, storm sewer, or to rivers, streams, etc. without authorization from the agency having jurisdiction. Construction site runoff will be prevented from entering any storm drain, river, stream, etc. directly by the use of silt fences or other suitable methods. CONTRACTOR shall provide erosion protection of surrounding soils.

B. Sedimentation control devices shall be installed prior to CONTRACTOR beginning Work. Soil erosion and sedimentation control devices shall be maintained in an effective functioning condition at all times during the course of the Work.

C. Immediately bring earthwork to final grade and protect sideslopes and backslopes from erosion. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

3.04 Installation - General

A. Install silt fences, ditch sediment traps, check dams, inlet filters, temporary gravel construction entrance/exits, turbidity barriers, erosion control blankets and other soil erosion control devices in accordance with the drawings and Storm Water Pollution Prevention Plan, or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.

B. Deficiencies or changes on the drawings or SWPP shall be corrected or implemented as site conditions change. Changes during construction shall be noted in the SWPP and posted on the drawings.

C. OWNER has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct CONTRACTOR to provide immediate permanent or temporary pollution control measures.

D. Remove temporary control devices after permanent measure are established. Remove and replace temporary control devices if they become ineffective at no additional cost to OWNER.

E. CONTRACTOR shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.

F. CONTRACTOR shall permanently seed and mulch cut slopes as excavation proceeds to extent considered desirable and practical.

3.05 Dust Control

A. Keep dust down at all times, including during non-working periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming is not permitted.

3.06 Installation of Erosion Control Blankets

A. Erosion control blankets shall be pegged at the pattern and rate as recommended by the manufacturer, however, at a minimum, blankets shall be pegged at the rate of 1.75 pegs per square yard (2pegs/m^2) of blanket, unless otherwise indicated on the plans.

3.07 Application of Bonded Fiber Matrix

A. The slope shall be prepared and graded prior to application of bonded fiber matrix (BFM). Mixture of wood fiber mulch and polyacrylamide binder shall be blended, with the appropriate amount of seed and fertilizer per Section32 9219, Seeding, according to manufacturer's recommendations.

B. BFM shall be hydraulically applied to the soil as a viscous mixture, crating a continuous, three-dimensional blanket that adheres to the soil surface. BFM shall be mixed and applied at the rate as specified in Article 2.06 unless otherwise indicated on the Plans.

C. The resulting coverage must be at least 1/8 inch (3 mm) thick over the entire surface area. BFM shall be applied in two applications from alternate directions to eliminate shadowing and shall be applied when no rain is expected for 12 hours.

3.08 Dewatering Discharge

A. Should it be necessary for CONTRACTOR to do any dewatering during the course of construction, CONTRACTOR shall filter all discharge through a discharge filter bag or other sediment control device that will filter all discharge water.

B. No dewatering discharge shall be allowed to flow unfiltered from the construction site.

3.09 Maintenance

A. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or OWNER to control sediment until final stabilization.

B. CONTRACTOR shall respond to maintenance or additional work ordered by OWNER or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to OWNER.

3.10 Inspection

A. General:

1. CONTRACTOR is responsible to obtain and/or serve as the Certified Operator.

2. Weekly inspections are to be conducted by CONTRACTOR as a minimum, and after every rainfall event. A copy of the inspection report shall be submitted to the agency having jurisdiction, as well as OWNER and ENGINEER.

3. Inspections shall be performed by a person familiar with the site, the nature of the major construction activities, and qualified to evaluate both overall system performance and individual component performance.

4. Inspector must either be someone empowered to implement BMPs in order to increase effectiveness to an acceptable level or someone with the authority to cause such things to happen.

5. Inspector must be certified as a "Storm Water Professional" through the MDEQ storm water training program. Additionally, the inspector shall be properly authorized in accordance with the applicable General Permit to conduct the certified site storm water inspections.

B. Inspection Frequency Reduction:

1. Inspection frequency may be reduced under the following conditions:

a. No active onsite construction activities.

b. Temporary cover has been provided across the entire site and no BMPs remain. Situation: waiting for grass to grow, but grass is dormant.

c. Ground is frozen and/or snow covered.

2. Weekly Storm Water Meeting:

a. A weekly storm water meeting will be held by CONTRACTOR with those involved in ground-disturbing activities to review the requirements of the permits, the SWPPP, and address any problems that have arisen in implementing the SWPPP or maintaining the BMPs.

b. CONTRACTOR shall maintain a log of weekly meetings and document the issues addressed in the meetings on site.

3. Agency Storm Water Inspections:

a. A log of inspections by federal, state, or local storm water or other environmental agencies shall be kept in CONTRACTOR's SWPPP.

b. The log form should include the date and time of visit and whether a report was issued or will be issued as a result of the inspection.

c. Any reports issued will be sent to ENGINEER within 24 hours.

3.11 Project Completion

A. Remove temporary soil erosion and sedimentation control devices as soon as permanent measures have been established and agency having jurisdiction has approved removal of said devices.

End of Section

Section 01 6000
Product Requirements

Part 1 General

1.01 Transportation and Handling

A. CONTRACTOR shall provide for expeditious transportation and delivery of materials and equipment to the Project site in an undamaged condition and on a schedule to avoid delay of the Work. Materials and equipment shall be delivered in original containers or packaging with identifying labels intact and legible.

B. CONTRACTOR shall provide equipment and personnel at the site to unload and handle materials and equipment in a manner to avoid damage. Materials and equipment shall be handled only at designated lifting points by methods to prevent bending or overstressing.

1.02 Storage and Protection

A. CONTRACTOR shall store materials and equipment immediately on delivery and protect it until installed in the Work.

B. Products subject to damage by elements shall be stored in weather-tight enclosures with temperature and humidity ranges as required by manufacturer's instructions.

C. Loose granular materials shall be stored on solid surfaces to prevent mixing with foreign matter.

D. The place of storage shall be located so as to minimize interference with traffic and to provide easy access for inspection. No material shall be stored closer than five (5) feet (1.5 m) to the edge of a pavement or traveled way open to the public.

E. Materials that have been stored shall be subject to retest and shall meet the requirements of their respective specifications at the time they are to be used in the Work.

F. CONTRACTOR shall provide protection of stored or installed materials and equipment as necessary to prevent damage from traffic and subsequent operations.

1.03 Manufacturer's Instructions

A. When the Contract Documents require that installation of Work shall comply with manufacturer's instructions, CONTRACTOR shall obtain and distribute copies of such instructions to parties involved in the installation including two (2) copies to ENGINEER.

B. CONTRACTOR shall handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements. Should Project conditions or specified requirements conflict with manufacturer's instructions, consult with ENGINEER for further instructions.

1.04 Products List

A. Within four (4) days of request, CONTRACTOR shall submit a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor, if applicable, to ENGINEER.

1.05 Contractor's Product Options

A. For products specified only by reference standard, CONTRACTOR shall select any product meeting that standard.

B. For products specified by naming several products or manufacturer's CONTRACTOR shall select any one of the products or manufacturers named, which complies with the specifications.

C. For products specified by naming one or more products or manufacturers and "or equal," CONTRACTOR must submit a Substitution Request Form for any product or manufacturer not specifically named, in accordance with the General Conditions.

D. For products specified by naming only one product and manufacturer, there is no option.

1.06 Equipment Startup and Testing

A. CONTRACTOR shall perform a comprehensive startup and demonstration of equipment performance and compliance with the design requirements. When there is more than one mode of operation, the equipment shall be operated in every mode to verify proper operation.

B. When equipment is to operate in conjunction with other equipment as a system, each piece of equipment shall be operated both by itself and automatically as a system to verify its proper operation.

C. CONTRACTOR is to provide to ENGINEER, in advance of startup, a schedule and listing of startup and testing procedures for review by ENGINEER. Checklists and diagrams may be required to ensure adequate startup and testing. ENGINEER may recommend changes to the startup procedure as necessary.

D. Equipment is to be inspected prior to operation for debris or other obstructions. Equipment is to be properly lubricated and calibrated prior to operation. CONTRACTOR shall make all adjustments necessary to assure correct operation. When required, equipment installation and operation is to be witnessed and checked by manufacturer.

E. When required, CONTRACTOR shall train OWNER’s operation and maintenance personnel in the proper operation and maintenance of each piece of equipment and the system as a whole.

F. Equipment startup is to be witnessed by OWNER and ENGINEER.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 7123
Construction Layout

Part 1 General

1.01 Responsibility for Staking

A. OWNER, OWNER's Representative or ENGINEER will set stakes and markers showing the locations on the surface of various parts of the Work one (1) time, unless otherwise specified herein. Additional stakes shall be provided at the expense of CONTRACTOR.

B. It shall be the responsibility of CONTRACTOR to transfer surface line and grade to the bottom of any tunnel or to the bottom of any other subsurface operations where ordinary surface line and grade is not feasible.

C. CONTRACTOR shall utilize lasers, or surveying instruments run by qualified competent personnel to control the construction installation Work. If the method being used by CONTRACTOR fails to give proper alignment and grade control to the Work, OWNER, OWNER's Representative or ENGINEER shall be empowered to order the CONTRACTOR to use such other method(s) as will provide adequate control.

D. OWNER, OWNER's Representative or ENGINEER may require CONTRACTOR, at CONTRACTOR's expense, to provide such masts, scaffolds, batter-boards, straightedges, templates, or other devices as may be necessary to facilitate laying out, observing and constructing the Work.

1.02 Staking Schedule

A. CONTRACTOR shall submit a completed staking schedule on the form provided by OWNER, OWNER's Representative or ENGINEER showing the order in which CONTRACTOR proposes to conduct the construction operation prior to the preconstruction meeting. The schedule shall be submitted to OWNER, OWNER's Representative or ENGINEER a minimum of three (3) working days prior to the start of construction.

B. During construction CONTRACTOR shall to the extent possible, limit unnecessary staking requests and coordinate his construction schedule to provide for the efficient and effective use of the OWNER, OWNER's Representative or ENGINEER's survey crew and eliminate excessive survey crew trips to the site.

1.03 Line and Grade

A. CONTRACTOR shall request, three (3) working days in advance, additional line and grade stakes as CONTRACTOR may reasonably protect and preserve. Such request by CONTRACTOR shall be on a staking request form.

1.04 Relocation and Re-Establishment

A. Construction Stakes:

1. Where change of location of stakes has been requested by CONTRACTOR, or where CONTRACTOR fails to properly preserve construction survey stakes, such resetting or relocations of stakes shall be done by OWNER, OWNER's Representative or ENGINEER and paid for by CONTRACTOR on the basis of time and materials for such restaking.

B. Survey Control Points:

1. CONTRACTOR shall bear all expense involved in re-establishing and/or resetting any survey control point, land survey point or monument lost or disturbed during his construction operation. Such Work shall be done under the direct supervision of a licensed land surveyor. Such survey control points shall be marked and flagged by OWNER, OWNER's Representative or ENGINEER prior to construction.

1.05 Staking Pipelines Laid to Grade

A. One (1) staking: Line and grade points at each structure and at not less than 100-foot (30 m) intervals, with benchmarks at maximum 1/4-mile (400 m) intervals.

1.06 Staking Pipelines Not Laid to Grade

A. One (1) staking: Line points at each structure with 100-foot (30 m) intermediate line points.

1.07 Staking Tunnels

A. First staking: Line and grade to sink the shaft.
B. Second staking: Line and grade on top of the shaft prior to tunneling.

1.08 Staking Bores

A. One (1) staking: Line and grade points at each end.

1.09 Staking Existing Drainage

A. Unless otherwise indicated on the Contract Drawings or specified herein, CONTRACTOR shall bear all expenses including the staking of line and grade required to restore proper grading of surface drainage, including swales and ditches disturbed during the construction operation.

1.10 Staking Earth Work

A. Parks, Parking Lots, or Site Improvement:

1. First staking: Line points at 300-foot (100 m) intervals for clearing and grubbing.
2. Second staking: Final grade points on 100-foot (30 m) grid and grade changes.

B. Site Improvement Paving:

1. First staking: Line points at 300-foot (100 m) intervals for clearing and grubbing.

2. Second staking: Final grade points at 50-foot (20 m) intervals on centerline, perimeter and at grade changes.

C. Ponds:

1. First staking: Line points at 300-foot (100 m) intervals for clearing and grubbing.

2. Second staking: Perimeter dike or bank alignment points offset at corners with two (2) benchmarks onsite.

1.11 Staking Open Drains

A. New Drain Improvements:

1. First staking: Line points at 300-foot (100 m) intervals and angle points for clearing and grubbing.

2. Second staking: Line and grade points at 100-foot (30 m) intervals, angle points, grade changes, and structures.

B. Drain Cleanouts:

1. One (1) staking of grade points at 300-foot (100 m) intervals, angle points, grade changes, and structures.

1.12 Staking Roadway Without Curb and Gutter

A. One (1) staking: Line and grade points for road centerline finish surface at 50-foot (20 m) intervals and at grade changes, points of curve and at 25-foot (10 m) intervals on curves.

1.13 Staking Roadway with Curb and Gutter

A. One (1) staking: Line and grade points for top of curb at 50-foot (20 m) intervals and at grade changes, points of curve and at 25-foot (10 m) intervals on curves.

1.14 Staking Buildings and Structures

A. One (1) staking: Two (2) intersecting base lines and a minimum of two benchmarks on the site.

B. Two (2) benchmarks each side of watercourse to be provided for bridges.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 7700
Closeout Procedures

Part 1 General

1.01 Cleaning

A. CONTRACTOR shall perform periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and wind-blown debris, resulting from construction operations.

B. Waste material, debris and rubbish shall be periodically removed from the site and disposed of at legal disposal areas away from the site.

C. Prior to OWNER acceptance CONTRACTOR shall conduct an inspection of sight-exposed interior and exterior surfaces, and all Work areas, to verify that the entire Work is clean.

D. CONTRACTOR shall broom clean exterior paved surfaces and rake clean other exterior surfaces of the site.

E. Clean and repaint with matching color scratched, marred or otherwise damaged painted surfaces of equipment and enclosures.

1.02 Project Record Documents

A. On completion of the Work, prior to CONTRACTOR's application for final payment, and as a condition to its approval by ENGINEER and OWNER, CONTRACTOR shall arrange such site records in order in accordance with the various sections of the specifications bind them together and index them and deliver them to ENGINEER.

B. CONTRACTOR shall request a complete set of reproducible Contract Drawings and transfer all as-built revisions and changes to them and deliver them to the ENGINEER. These drawings shall be dated and marked "RECORD DOCUMENTS".

C. Reproducible tracings made by CONTRACTOR, Subcontractors, equipment manufacturers, and/or Suppliers shall be corrected to show the Work as actually completed or installed and a reproducible copy of these drawings shall then be turned over to ENGINEER.

D. Written approval or other evidence satisfactory to ENGINEER of the final conditions of the work shall be obtained from:

1. Public authorities or agencies having jurisdiction over any portion of the work
2. Others as requested by ENGINEER in writing.

E. Public authorities or agencies having jurisdiction over any part of the work shall be determined, and all the requirements of these authorities or agencies with respect to but not limited to inspection, permits, fees, approval, and the like regardless of whether they are listed above or not shall be met.

F. CONTRACTOR shall deliver one (1) copy of all Specifications, Plans, Addenda, Shop Drawings, Samples, Certificates, approvals, etc. annotated to show all changes made during the construction process, to ENGINEER upon completion of the Work and prior to CONTRACTOR's application for final payment. Submittal of the record documents shall be made with a transmittal letter containing:

1. Date
2. Project Title and Number
3. CONTRACTOR's Name and Address
4. Title and Number of each Record Document
5. Certification that each Document as submitted is complete and accurate
6. Documents shall be submitted in good order and in a legible condition.

1.03 Operation and Maintenance Data

A. Prior to final inspection or acceptance, CONTRACTOR shall fully instruct OWNER's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems specified.

B. Operation and maintenance data required by the individual Specification sections and the manufacturer's operation and maintenance data required in Section 01 3300, Submittal Procedures, shall constitute the basis of such instruction.

1.04 Spare Parts and Special Tools

A. Spare Parts:

1. As soon as practicable after approval of the list of equipment, CONTRACTOR shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies with current unit prices and source of supply.

2. CONTRACTOR shall also furnish a list of parts and supplies that are either normally furnished at no extra cost with the purchase of the equipment or specified to be furnished a part of the Contract and a list of additional items recommended by the manufacturer to assure efficient operation for a period of one (1) year at the particular installation.

3. The foregoing shall not relieve CONTRACTOR of any responsibilities under the guarantee provisions of these Specifications.

4. CONTRACTOR shall deliver all spare parts required by this contract to ENGINEER or as directed by ENGINEER.

B. Special Tools:

1. CONTRACTOR shall furnish at no additional cost to OWNER with each piece of equipment, one complete set of suitably marked special tools and appliances which may be needed to adjust, operate, maintain, or repair the equipment.

2. CONTRACTOR shall submit for approval by ENGINEER a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases properly labeled and equipped with good grade cylinder locks and duplicate keys.

3. CONTRACTOR shall deliver all special tools required by this contract to ENGINEER or as directed by ENGINEER.

1.05 Start-Up

A. Equipment start-up period for the training of plant personnel shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for that part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.

B. During the equipment start-up period, CONTRACTOR shall furnish at no additional cost to OWNER the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:

1. Assist in the start-up and operations of the equipment.

2. Assist in the training of facility personnel, designated by OWNER, in the proper operation and maintenance of the equipment.

C. OWNER shall:

1. Provide the necessary personnel to be instructed in the operation and maintenance of the equipment. OWNER's personnel shall operate all equipment.

2. Pay for all fuel, power and chemicals consumed beyond quantities specified or in the Contract Documents or required due to CONTRACTORs fault. CONTRACTOR shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.

D. CONTRACTOR shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total facility operation.

E. In the event a system, equipment, or component proves defective or is unable to meet specified performance criteria, CONTRACTOR shall replace the defective item and the one (1) year guarantee period for the item shall start after satisfactory replacement and testing of the item.

1.06 Substantial Completion

A. When CONTRACTOR considers that the Work, or portion thereof which the OWNER agrees to accept separately, is substantially complete, the CONTRACTOR shall prepare and submit to ENGINEER a comprehensive list of items to be completed or corrected.

B. CONTRACTOR shall proceed promptly to complete and correct items on the list. Failure to include an item on such list does not alter the responsibility of CONTRACTOR to complete all Work in accordance with the Contract Documents.

C. Upon receipt of CONTRACTOR's list, ENGINEER will make an inspection to determine whether the Work or designated portion thereof is substantially complete.

D. If ENGINEER’s inspection discloses any item, whether or not included on CONTRACTOR's list, which is not in accordance with the requirements of the Contract Documents, CONTRACTOR shall complete or correct such item upon notification by ENGINEER. CONTRACTOR shall then submit a request for another inspection by ENGINEER to determine Substantial Completion.

E. When the Work or designated portion thereof is substantially complete, ENGINEER will prepare a Certificate of Substantial Completion which shall establish responsibilities of OWNER and CONTRACTOR for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the CONTRACTOR shall finish all items on the list accompanying the Certificate. The Certificate of Substantial Completion shall be submitted to OWNER and CONTRACTOR for their written acceptance of responsibilities assigned to them in such Certificate.

F. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

1.07 Warranties

A. CONTRACTOR shall submit duplicate copies of all warranties prior to final Application for Payment. CONTRACTOR shall also execute, assemble and submit transferable warranty documents from Subcontractors, suppliers, and manufacturers.

B. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten (10) days after acceptance, listing date of acceptance as start of warranty period.

C. All parts of the work or equipment which is in the opinion of ENGINEER prove defective in material, workmanship, or operation within the warranty period shall be removed and replaced or repaired in a manner satisfactory to ENGINEER and at no cost to OWNER.

D. Service material or equipment required because of the defect shall be supplied without charge.

E. Work specified to be designed by CONTRACTOR shall be guaranteed to perform as specified.

F. Warranty period shall be one year from the date of Substantial Completion unless:

1. a greater period is specified elsewhere.

2. OWNER chooses to take over and use a portion of the Work as provided for in the Specifications; in which case the warranty shall be one (1) year from said takeover and use.

G. Equipment or work replaced and/or repaired during the warranty period shall be guaranteed for one year from the date of acceptance of the repair or replacement or until expiration of the original warranty period whichever comes later.

1.08 Final Payment and Acceptance

A. The final inspection, final application for payment and acceptance shall be in accordance with the General Conditions.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 7900
Demonstration and Training

Part 1 General

1.01 Requirements Included

A. Instruct and train OWNER's personnel in maintenance and operation of equipment for systems supplied and/or installed under this Contract, including the following items:

1. Process, mechanical, service and other equipment.
2. System instrumentation or control.
3. Primary switchgears.
4. Motor control centers.

B. Incorporate the following maintenance and operation data and training services into the training program:

1. Shop Drawings.
2. Equipment Operation and Maintenance Manuals.

C. Prepare instruction training materials, and student notes/guides for complete classroom and hands-on training of all individuals requiring training.

1.02 Related Requirements

1. Section 01 3300, Submittal Procedures
2. Section 01 7700, Closeout Procedures
3. Division 26, Electrical
4. Division 40, Process Interconnections

1.03 Quality Assurance

A. Preparations of training materials and instruction to be provided shall be performed by personnel trained and experienced in maintenance and operation of equipment and systems to be installed under this Contract.

1.04 Schedule of Conducting Training

A. Classroom and field training programs shall be conducted after performance testing begins but prior to substantial completion.

B. Training programs shall be planned and conducted for:

1. Operations Personnel.
2. Maintenance Personnel.

C. All scheduling shall be coordinated through ENGINEER.

1.05 Training for Maintenance of Instrumentation

A. Train OWNER's maintenance personnel as follows:

1. Describe the overall function of each piece of equipment, instrument and/or control loop installed under this Contract.

2. Locating the probable source of malfunction, determining the symptoms of the trouble, establishing the probable cause and effecting a solution.

3. Appropriate preventive and corrective maintenance procedures necessary to keep the equipment, instrument and/or control loop system in proper operating condition, including calibration and testing, if necessary.

B. Course materials to be used for training OWNER's maintenance personnel shall include pertinent portions of the submittals specified in the Specifications such as diagrams, trouble-shooting guides, maintenance instructions, special calibration test and procedures and other relevant documentation provided by the manufacturer.

C. Method of training OWNER's personnel shall include CONTRACTOR using OWNER's equipment to demonstrate troubleshooting, preventive and corrective maintenance procedures.

D. The training program shall not include the time required for start-up instructions or the field acceptance test.

1.06 Training for Electrical and Mechanical Maintenance

A. Train OWNER's maintenance personnel as follows:

1. Describe the functions of the equipment installed under this Contract.

2. Locating the probable source of malfunction, determining the symptoms of the trouble, establishing the probable cause and effecting a solution

3. Appropriate preventive and corrective maintenance procedures necessary to keep the equipment in good operating conditions, including calibration and testing, if necessary.

B. Course materials to be used for training OWNER's electrical and mechanical maintenance personnel to include pertinent portions of the submittals specified in the Specifications such as diagrams, alignment tolerances, lubrication schedules, vibration analysis instruction and parameters, trouble-shooting guides, maintenance instructions, special calibration test and procedures and other relevant documentation provided by the manufacturer.

C. Method of training OWNER's personnel shall include CONTRACTOR using OWNER's equipment to demonstrate troubleshooting, preventive and corrective maintenance procedures.

D. The field training program shall not include the time required for system start-up instructions or the acceptance test.

1.07 Operational Training

A. Train OWNER's operations personnel as follows:

1. Describe the functions of the equipment installed under this Contract, including how the components of a system are controlled together and what the effects of the control methods are on the system and on other upstream and downstream processes installed under this Contract.

2. Implement start-up and shutdown procedures for each piece of equipment individually, as well as the start-up and shutdown of the systems comprising the equipment. This instruction shall include normal operation, alternative operations, and emergency operations.

3. Understand the functions of the equipment installed under this Contract, describing the individual components and how each component is used in monitoring and/or controlling equipment and/or processes installed under this Contract.

4. Discuss the operating modes possible as a result of the modifications and installations made under this Contract.

5. Locating the probable source of system trouble determining the symptoms, establishing the probable cause, and re-stabilizing system efficiency or systems installed under this contract.

6. Demonstrate necessary precautions for safe operation of the equipment, instrumentation, and control system installed under this Contract.

7. Demonstrate emergency procedures for equipment and systems installed under this Contract.

B. Course materials to be used for training OWNER's operation personnel include pertinent portions of the Operations and Maintenance Manuals, including start-up and shutdown procedures; descriptions of equipment and instrumentation functions and modes of operations, control and monitoring; trouble-shooting instructions and process control instructions.

C. Methods of training OWNER's operations personnel shall include a field training program at OWNER's site consisting of classrooms and hands-on training using OWNER's equipment and systems.

D. The field training program shall not include the time required for system start-up instructions or the field acceptance test.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

Section 01 8900
Site Construction Performance Requirements

Part 1 General

1.01 Scope of Work

A. This Section includes general performance requirements for earthwork complete with, reimbursement for crop damage, removal and disposal of structures and obstructions, protection of existing sewers, tiles and mains; protection of existing building and improvements, protection of trees and other types of vegetation, protection of utility lines, requirements for pavement replacement, restoration of driveways and parking areas, restoration of sidewalks, restoration of lawns and disturbed areas, transportation, and disposal of excess excavation.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion and Sediment Control
B. Section 31 2200: Grading
C. Section 31 2313: Subgrade Preparation
D. Section 31 2319: Dewatering
E. Section 31 2316: Structural Excavation and Backfill
F. Section 31 2333: Trenching and Backfilling
G. Section 32 1216: Bituminous Paving
H. Section 32 1313: Concrete Paving
I. Section 32 1315: Sidewalks and Driveways
J. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition.

1.04 Requirements of Regulatory Agencies

A. CONTRACTOR shall comply with Section01 5713, Temporary Erosion and Sediment Control. CONTRACTOR, at his expense, shall secure all permits, and post all bonds or deposits required to comply with the "Soil Erosion and Sedimentation Control," requirements, being Part 91 of PA 451 of 1994 as amended.

B. CONTRACTOR shall comply with all requirements of the National Pollutant Discharge Elimination System (NPDES) Storm Water Program for Construction Activities, Part 31 of PA 451 of 1994 as amended.

C. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

1. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

2. Measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.

1.05 Submittals

A. Written permission for the use of all disposal and borrow sites shall be obtained and copies shall be furnished to ENGINEER.

1.06 Protection of Plant Life

A. Trees, shrubs, and other types of vegetation not within the limits of the Work or not designated on the Plans or by ENGINEER to be removed, shall be carefully protected from damage or injury during the various construction operations.

B. Any tree, shrub or other type of vegetation not designated to be removed but which is damaged by CONTRACTOR's operation shall be repaired or replaced by CONTRACTOR, at his expense, as determined by ENGINEER.

1.07 Protection of Existing Structures and Improvements

A. existing culverts, sewers, drainage structures, manholes, water gate wells, hydrants, water mains, utility poles, overhead lines, underground conduits, underground cables, pavement, or other types of improvements within the construction limits, not designated on the Plans to be removed, shall be carefully protected from damage during the construction operations.

B. Existing structure or improvement not designated to be removed, but which is damaged by CONTRACTOR's operations shall be repaired or replaced by the CONTRACTOR, to the satisfaction of the owner, at his expense.

C. Deposits of dirt or debris in sewers, culverts, tiles, drainage structures, manholes, gate wells, etc. caused by CONTRACTOR shall be cleaned out at the CONTRACTOR’s expense.

1.08 Maintaining Drainage

A. Existing open drains, field and roadway ditches, drainage tile, sewers, enclosed drains, natural and artificial watercourses, surface drainage or any other types of drainage within the limits of the Work shall be maintained and free to discharge during construction.

B. Drainage facility not designated to be abandoned, but which is damaged, or any drainage interrupted by the CONTRACTOR's operation shall be immediately repaired, replaced, or cleared by the CONTRACTOR.

C. Costs incurred shall be incidental to the excavating, backfilling and compacting or grading operations.

Part 2 Products

2.01 Granular Material

A. Bank run sand meeting the requirements of MDOT, Granular Material Class II.

2.02 Aggregate for Shoulders, Parking Areas, Driveways or Roads

A. Crushed Limestone, Natural Aggregate or Slag and meeting the requirements of MDOT Section 902.

Part 3 Execution

3.01 Dewatering

A. The area within the vicinity of the new Work shall be dewatered prior to commencing any construction activities. The depth of the dewatering shall be sufficient to allow the Work area to remain in a dry condition during the various construction operations.

B. Costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at CONTRACTOR's expense.

C. Refer to Section 31 2319, Dewatering, for additional requirements.

3.02 General

A. The various construction operations shall be restricted to the existing right-of-way or the areas indicated on the Plans. If CONTRACTOR requires additional area, CONTRACTOR shall furnish the ENGINEER with written permission obtained from the property owner for any part of the operations he conducts outside of the right-of-way or limits indicated.

3.03 Existing Improvements

A. CONTRACTOR shall expose existing sewers and structures to which the new Work is to be connected and notify ENGINEER of same. ENGINEER will verify the vertical and horizontal locations of the existing system and shall inform CONTRACTOR as to the necessary adjustments required to align the new Work with the existing system.

3.04 Existing Utilities

A. When existing utilities are shown on the Plans, their locations are approximate only, as secured in the field investigation and/or from available public records. CONTRACTOR, prior to the start of construction, shall contact Miss Dig and the public agency or utility having jurisdiction to request the verification of all utilities within the construction area.

B. When existing utility lines, structures or utility poles are encountered during the performance of the Work, CONTRACTOR, at his expense, shall perform his operations in such a manner that the service will be uninterrupted.

C. CONTRACTOR shall expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. CONTRACTOR shall be responsible for any relocation required as a result of any conflict of existing utilities shown on the plans, with the proposed improvement.

D. Should it become necessary to move any utility structure, line or pole shown on the Plans or otherwise found necessary to be moved, CONTRACTOR shall make all arrangements with OWNER of the utility for the moving. costs incurred for such moving shall be at CONTRACTOR's expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, CONTRACTOR shall furnish ENGINEER with satisfactory evidence, in writing, that proper arrangements have been made with the owner of the utility.

3.05 Utility Poles

A. CONTRACTOR shall be responsible for any removal or relocation required as a result of any conflict of existing utility poles (including streetlight poles, guy poles, telephone poles, etc.) with proposed improvements.

B. CONTRACTOR shall make all arrangements for removing or relocating utility poles with the owner of the utility pole.

C. Prior to disturbing any utility pole, CONTRACTOR shall provide ENGINEER with written evidence that proper arrangements have been made with the owner of the utility pole.

D. When required by the Work, CONTRACTOR shall temporarily support poles in the vicinity of the Work at no additional cost to OWNER. Support shall be in accordance with and to the satisfaction of the utility company.

3.06 Existing Sewers, Tile, and Mains

A. Existing sanitary sewers, storm sewers, drain tile, septic tank bed tiles, water mains or building services or leads, that are encountered during the performance of the Work that require relocation or are damaged, shall be restored with new materials equal in quality and type to the materials encountered.

B. New material shall be installed as specified in the Contract Documents and per the requirements of the local agencies. Bedding and backfill material, unless otherwise specified, shall be an approved Class II granular material, compacted to 98% of its maximum unit weight.

C. Seepage bed tile and water mains shall be replaced in accordance with the requirement of the agency having jurisdiction.

D. Relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall be at CONTRACTOR's expense, unless otherwise indicated in the Contract Documents.

3.07 Existing Structures

A. Existing surface and subsurface structures may be shown on the Plans, in locations considered most probable from information secured in the field investigation or from available public records.

B. Neither the correctness nor completeness of such information is guaranteed or implied.

C. Structures shall be protected, preserved or restored by CONTRACTOR, to the satisfaction of the structure owner, at no additional cost to the Project.

3.08 Existing Buildings

A. Existing buildings or structures may be encountered throughout the Project within limits of the presently established right-of-way or easement. Good construction methods and procedures shall be employed by CONTRACTOR, at his expense, to protect the structures.

B. When it becomes necessary for CONTRACTOR to move one of these buildings or structures in order to proceed with construction, CONTRACTOR, at his expense, shall exercise all due care in moving the building or structure to prevent undue damage.

C. Prior to moving an existing building or structure, CONTRACTOR shall furnish ENGINEER with satisfactory evidence, in writing, that proper arrangements have been made with the owner.

D. Unless otherwise specified in the Contract Documents, the length of the move shall be maintained to a minimum which will allow for construction of the improvement.

3.09 Removal of Sewers and Culverts

A. Unless otherwise specified in the Contract Documents, CONTRACTOR, at his expense, shall remove any abandoned culvert, pipe, sewer, structure or part of a structure which is to be replaced or rendered useless by the new construction.

B. When a sewer or culvert is removed at a structure, ONTRACTOR shall install a masonry bulkhead in the structure.

C. Removal of a culvert or sewer also includes the removal and disposal of end treatments or headwalls.

3.10 Removal of Structures

A. Removal of existing structures shall consist of removing and salvaging the existing frame and cover. The ends of the existing pipe shall be plugged and braced. The complete structure shall be removed entirely and disposed of. The excavation shall be backfilled with sand and compacted to 98% of its maximum unit weight. Maximum unit weight shall be determined by ASTM D698, Method B.

B. If a structure is to be removed from a system that is to remain in service, a bypass system, approved by ENGINEER, shall be installed and maintained by the CONTRACTOR, during the rebuilding period.

3.11 Abandoning Structures

A. Structure shall be broken down to at least 30 inches (750 mm) below the subgrade.

B. Pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead approved by ENGINEER.

C. Structure shall be backfilled with flowable fill to 1-foot (300 mm) above the pipes and the remainder of the structure backfilled with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1-foot (300 mm) below finished grade.

D. The remainder of the excavation shall be backfilled with a granular material, compacted to 98% of its unit weight, and shall meet with the approval of ENGINEER.

E. Maximum unit weight shall be determined by ASTM D698, Method B.

3.12 Salvaged Material

A. Salvaged materials shall become the property of CONTRACTOR unless otherwise specified in the Contract Documents, and shall be disposed of by CONTRACTOR, at his expense.

3.13 Crop Damage

A. In areas where crops are encountered along the route of the construction, a written agreement shall be arrived at by CONTRACTOR and the crop owner as to the type and nature of the crop concerned prior to any construction within the area.

B. CONTRACTOR shall be responsible for making full reimbursement to the owner of the crop damage on the basis of the following procedure:

1. Area of the crop damage shall be determined by measurements taken by ENGINEER, and this area shall include those portions of the crop which may extend into the public right-of-way.

2. Average yield of the crop shall be established by the County Office of the U.S. Agricultural Extension Service.

3. Cost of the crop shall be determined by using the prevailing price at the time of harvest as furnished by the U.S. Agricultural Extension Service.

C. CONTRACTOR shall furnish ENGINEER with satisfactory evidence that payment for crop damage was made, prior to receiving final payment on the Project.

3.14 Trees

A. Trees excepting those specified on the Plans to be removed, shall be effectively protected by CONTRACTOR during his construction operations.

1. If in the opinion of ENGINEER, the methods of protection employed by CONTRACTOR are not adequate, CONTRACTOR shall carry on his operation by tunneling, or by other approved means, which will not cause undue damage to the trees.

B. The requirements for tree tunneling are as follows:

1. Depth of Cover:

a. Tunnels shall be placed at a minimum depth of 30 inches (0.75 m), measured from the ground surface to the top of the tunnel.

2. Length of Tunnel:

a. Tunnel length in feet (meters) shall be in direct proportion to diameter of tree in inches (millimeters) for trees eight (8) inches (200 mm) or larger in diameter. One (1) foot of tunnel shall be constructed for each inch of tree diameter whenever the trench or any portion thereof approaches the tree trunk a distance in feet equal to one-half the tree diameter in inches.

b. Example: A tree 12 inches in diameter shall require a 12-foot tunnel whenever the trench or any portion thereof approaches within six (6) feet of said tree.

3. Measurements:

a. Trees under 8 inches in diameter will require the same length of tunnel as 8-inch trees. Measurements of tree diameters shall be taken four (4) feet above the ground surface.

C. Where the Plans indicate areas allowing the cutting of minor trees, care should be used to keep damage to adjacent trees to an absolute minimum. Where these areas are specifically indicated on the Plan, they are to be cleared and all trunks and branches shall be disposed of by CONTRACTOR. Debris shall not be bulldozed on to adjacent private property.

D. Trees damaged by the construction operation shall be repaired so not to inhibit growth or replaced at the expense of CONTRACTOR. Repair or replacement shall be contingent upon agreement between the damaged tree owner and CONTRACTOR. In any event, limbs, branches and roots damaged by CONTRACTOR shall be properly pruned to the satisfaction of ENGINEER.

E. Costs incurred for protection of trees, including tunneling, repair and replacement, if necessary, shall be at CONTRACTOR's expense.

3.15 Remove and Replace Tree

A. Tree removal and replacement may be accomplished in two ways:

1. CONTRACTOR may completely remove and dispose of the existing trees, and after the new improvement has been completed, tested, accepted and rough grading has been completed, CONTRACTOR shall plant new trees, in approximately the same location as the existing trees, of size and species per the following (existing trees to be replaced with like specie):

   a. "Acer Rubrum" October Glory Red Maple, 2 ½-inch B&B (min)
   b. "Malus Centzam" Centzam Crabapple, 2-inch B&B (min)
   c. "Crataegus Phaenaopyrum" Washington Hawthorn, 8-foot B&B (min)
   d. "Pinus Nigra" Austrian Pine, 6-foot B&B (min)
   e. "Picea Pungens" Colorado Spruce, 5-foot B&B (min)
   f. "Quercus Rubra" Red Oak, 2 ½-inch B&B (min)
   g. "Pyrus Calleryana" Redspire Pear, 2-inch B&B (min)

2. CONTRACTOR may remove and preserve the existing trees.

   a. Trees shall be properly cared for and maintained in a healthy condition.

   b. After the new improvement has been installed, tested, accepted and rough grading completed, the trees shall be replanted in approximately the same location. Any trees damaged, destroyed or which die, shall be replaced at no additional cost.

B. Trees, whether replanted or planted new, shall be guaranteed for a period of two years from the date of substantial completion.

3.16 Removing Pavement

A. Removal of concrete and bituminous pavement as called for on the Plans shall consist of removing and disposing of pavement and shall include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.

B. Pavement shall be removed to an existing joint or cut parallel to the existing pavement joints.

C. Cutting shall be accomplished by using a power-driven concrete saw approved by ENGINEER. Depth of the saw cut shall be a minimum of 6-inches, to insure that the removal of the old pavement will not disturb or damage the section of pavement remaining in place.

D. Residual concrete pavement shall not be less than five feet measured transversely, nor less than 6 feet longitudinally measured from a joint.

E. In removing a concrete base course, where part of the existing bituminous surface is to remain in place, the bituminous surface shall be cut the full depth by the use of a power-driven saw, approved by ENGINEER along a line parallel to and at least one foot from either side of the base course removal.

F. Old pavement with a concrete cap shall be considered as only one (1) pavement, whether or not there is a separation layer of earth, aggregate, or bituminous material between the old material and the concrete cap.

1. Removal of Curb for Curb Drop:

a. Where curb is to be removed for a curb drop, the operation shall be performed by saw cutting or by cold milling, approved by ENGINEER, so as to leave a neat surface with a maximum 1-inch lip, without damage to the underlying pavement.

2. Removal of Curb and Gutter:

a. Where curb and gutter are to be removed, the operation shall be performed by saw cutting. The limits of the removal shall be as called for on the Plans, or as approved by ENGINEER. However, in no case shall the width of removal be less than 18 inches for sections with rolled or straight curb or less than 24 inches for mountable curbs.

G. If during the pavement removal operation any concrete or bituminous pavement or surfacing is damaged beyond the removal limits designated, the damaged pavement or surfacing shall be removed and replaced at CONTRACTOR's expense.

H. Earth which may be removed during the pavement removal operation shall be replaced by backfilling to the proposed subgrade with a suitable material, approved by ENGINEER, at CONTRACTOR's expense.

3.17 Guardrail

A. Beam guardrail shall be relocated or shall be removed as specified on the Plans or as determined by ENGINEER. If any of the existing material is damaged or destroyed, CONTRACTOR shall replace the material at his expense.

B. Where guardrail is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at CONTRACTOR's expense, to a condition comparable to that prior to construction.

C. After the guardrail removal or relocation operations are complete, all surplus material shall be removed and disposed of by CONTRACTOR, at his expense, unless otherwise called for in the Contract Documents.

D. Any holes or voids resulting from the guardrail removal operation shall be backfilled with a Class II granular material, approved by ENGINEER.

3.18 Fences

A. Fences shall be removed and replaced or shall be removed as indicated on the Plans. If any of the existing material is damaged or destroyed, CONTRACTOR shall replace the material at his expense.

B. Where fencing is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at CONTRACTOR's expense, to a condition comparable to that prior to construction.

C. After the fence removal or relocation operations are complete, all surplus material shall be removed and disposed of by CONTRACTOR, at his expense, unless otherwise called for in the Contract Documents.

D. Any holes or voids resulting from the fence removal operation shall be backfilled with a suitable material, approved by ENGINEER.

E. Where fences are encountered that are being used to confine livestock or to provide security, the fence shall be immediately replaced following construction. During construction, CONTRACTOR, at his expense, shall provide, install and maintain a temporary fence, meeting the approval of ENGINEER.

3.19 Holes

A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material. Material shall be placed by the controlled density method or other effective means having the approval of ENGINEER and shall be compacted to 95% of maximum unit weight.

B. Furnishing, placing and compacting of the backfill material shall be at CONTRACTOR's expense.

3.20 Restoration in Right-of-Way and Yard Areas

A. Right-of-way and yard areas not paved or aggregate surfaced shall be restored in accordance with the type and location specified herein unless indicated otherwise on the Plans. Disturbed areas may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans. Areas where slopes are 1 on 4 or flatter shall be restored with topsoil, seed and mulch. Slopes steeper than 1 on 4 shall be restored with sod.

B. Excess material from the restoration operation shall be disposed of by CONTRACTOR at his expense.

C. Disturbed areas shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding, or Section 32 9223, Sodding.

D. CONTRACTOR, at his expense, shall furnish, place, and compact any additional fill, meeting the approval of ENGINEER, needed to restore the disturbed areas to the cross sections called for on the Plans or as determined by ENGINEER.

3.21 Restoration of Aggregate Surfaces

A. Shoulders:

1. Shoulder shall be regarded as the area between the edge of pavement and the ditch, or the area within 10 feet of the pavement, whichever is the lesser.

2. Backfilling of trenches in the shoulder area shall be carried to within 5 inches of the existing surface as specified under Trench “A" or Trench "B." The remaining depth shall be backfilled with a minimum of 5 inches of compacted 22A or 23A aggregate with calcium chloride applied, at the rate of 6 pounds per Ton of aggregate .

3. CONTRACTOR, at his expense, shall furnish, place and compact all materials necessary to complete the backfilling and restoration operation within the shoulder area.

B. Driveways and Parking Areas:

1. Aggregate driveway areas shall be regarded as the area from the right-of-way line to the edge of the traveled roadway and shall include the shoulder area.

2. Backfilling of trenches crossing aggregate surfaced driveways and parking areas shall be carried to the bottom of the proposed base course as specified under Trench “B”. The remaining depth shall be backfilled with a minimum of 6 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate.

3. Aggregate surfaced areas beyond the limits of the actual excavation which are disturbed, as determined by ENGINEER, by such operations as temporary storage of materials or passage of equipment, shall be resurfaced, at CONTRACTOR's expense.

   a. Upper 3 inches of disturbed areas shall be removed as necessary to allow the final elevation of the resurfacing course to be at the elevation of the drive or parking area which existed prior to excavation.

   b. Disturbed area shall be resurfaced with a minimum of 3 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate

4. CONTRACTOR, at his expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the driveway and parking area.

C. Roads and Streets:

1. Backfilling of trenches crossing aggregate surfaced roads or streets shall be carried to within 12 inches of the existing surface as specified under Trench "B." The remaining depth shall be backfilled with two 6-inch layers of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per Ton of aggregate.

2. CONTRACTOR, at his expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the roadway or street area.

3. Also, any settlement of the aggregate surface shall be restored by placing additional aggregate, up to the original grade, and shall be done at the CONTRACTOR's expense.

D. Compaction:

1. Compaction of all aggregate shall be performed by a pneumatic-tired roller or a vibratory compactor until the material forms a stable surface.

3.22 Restoration of Paved Surfaces

A. CONTRACTOR, at his expense, shall provide the materials necessary to complete the backfilling and restoration operations, which shall include furnishing, compacting, forming, placing, rolling, floating, jointing, finishing, curing and providing protection against elements.

B. Restoration of any roadways that are partially damaged shall include a minimum replacement of one (1), full width lane of roadway. The length of replacement shall be at least equal to the width.

C. Concrete:

1. Backfilling of trenches crossing concrete driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the proposed pavement as specified under Trench "B"

2. Unless otherwise specified on the Plans or as determined by ENGINEER, the concrete removed shall be replaced with 3,500 psi concrete of the thickness removed and shall include reinforcing equal to the existing, if the existing pavement was reinforced.

a. The construction of concrete pavements shall be in accordance with Section 32 1313, Concrete Paving.

3. Restoration of sidewalks shall also include the construction of sidewalk ramps at the intersection of the curb and shall conform to the current rules and regulations of Act 8, Michigan PA 1973, as amended and to Section 32 1315, Sidewalks and Driveways, and unless otherwise indicated in the Proposal, shall be considered incidental to the Project.

D. Bituminous:

1. Backfilling of trenches crossing bituminous driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the base course as specified under Trench "B."

2. Bituminous pavement or bituminous surface course with an aggregate base shall be replaced in accordance with Section 32 1216, Bituminous Paving.

3. Bituminous surfaced areas beyond the limits of the actual excavation which are disturbed by such operations, as temporary storage of materials or passage of equipment, shall be resurfaced with an approved bituminous mixture the same thickness as removed, but in no case less than 2 inches in thickness. Replacement material shall extend to smooth-cut edges, shall be uniform in direction and shall be at an elevation which provides a uniform surface between the undisturbed abutting surfaces.

4. Restoration of any bituminous chip seal shoulders that are damaged or partially damaged, as determined by ENGINEER, shall include complete replacement full width and length (extending a minimum of 25 linear feet beyond the damaged area both ways). Existing bituminous chip seal shoulders shall be brought to proper grade with compacted 22A or 23A aggregate and resurfaced with a double chip seal per Section 32 1216, Bituminous Paving.

3.23 Soil Erosion and Sedimentation Control

A. CONTRACTOR shall comply with the requirements of Section 01 5713, Temporary Erosion and Sediment Control. Prior to commencing any type of earthwork, CONTRACTOR shall obtain a Soil Erosion and Sedimentation Control permit from the local enforcing Agency.

B. CONTRACTOR, at his expense, shall obtain all approvals, secure all permits and post all bonds and deposits required to comply with the Soil Erosion and Sedimentation Control Act, Part 91 of PA 451 of 1994, as amended, and those of the enforcing agency.

C. CONTRACTOR shall provide ENGINEER with a copy of the soil erosion permit issued by the local enforcing agency for the Project, prior to commencing any type of earthwork on the Project.

3.24 Excess Excavation

A. Excess excavation shall be defined as all surplus earth material realized from the construction that is free of brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material.

B. CONTRACTOR, when requested by OWNER, shall transport all excess excavation to a site(s) designated by OWNER.

1. Excess excavation shall be graded by CONTRACTOR to provide positive surface drainage of the site(s).

2. Grading shall be done such that adjacent properties are not damaged or affected. The grading shall include removal of all surface irregularities to provide a smooth surface (± 0.25 foot).

C. When the excess excavation has not been requested by e OWNER, CONTRACTOR shall remove and properly dispose of the material at no additional cost to OWNER.

D. Proper disposal of all excess excavation, including transportation, grading, and protection of adjacent properties shall be considered as a final cleanup item. No additional payment will be made for this item.

E. Brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material from the construction shall become the property of CONTRACTOR, and shall be disposed of per all applicable Laws, rules or regulations. Removal and disposal of this material shall be considered as part of final cleanup. No additional payment will be made for this item.

F. OWNER approval of the final site(s) condition in writing will be required prior to final payment authorization.

End of Section

Division 02
Existing Conditions

Section 02 4100
Selective Demolition

Part 1 General

1.01 Section Includes

A. This section includes the selective removal and subsequent disposal of utilities, pavement, portions of buildings, and other items indicated to be removed

1.02 Description of Work

A. Unless directed otherwise in the Contract Documents, CONTRACTOR shall:

1. Remove and properly dispose of all structures, trash, rubbish, basement walls, floors, foundations, sidewalks, steps and driveways from the specified parcel.

2. Remove fuel tanks, outdoor toilets and septic tanks, cisterns, meter pits, and plug or abandon wells.

3. Remove materials from the demolition site in accordance with federal, state and local regulations.

4. Remove and dispose of appliances and other items that may contain refrigerants in accordance with 40 CFR, Part 82. Appliances and other items that may contain refrigerants include, but are not limited to, refrigerators, freezers, dehumidifiers and portable or central air conditioners.

5. Remove and legally dispose of mercury-containing materials including fluorescent, high-pressure sodium, mercury vapor, metal halide light bulbs, and thermostats containing a liquid filled capsule. PCB-containing materials include capacitors, ballasts, and transformers where the component is contained within a metal jacket and does not have a specific, legible label stating no PCBs are present.

6. Disconnect utility services before demolition.

7. Perform site clearance, grading and restoration.

8. Complete the demolition work in accordance with the plans and these technical specifications and any special provisions included in the Contract Documents.

1.03 Protection of the Public and Properties

A. Littering Streets:

1. CONTRACTOR shall be responsible for removing any demolition debris or mud from any street, alley or right-of-way resulting from the execution of the demolition work. Any cost incurred by OWNER in cleaning up any litter or mud shall be charged to CONTRACTOR and be deducted from funds due for the work.

2. Littering of the site shall not be permitted.

3. Waste materials shall be promptly removed from the site.

B. Street Closure:

1. If it should become necessary to close any traffic lanes, it shall be CONTRACTOR's responsibility to acquire the necessary obstruction permits and to place adequate barricades and warning signs as required the agency having jurisdiction.

2. Street or lane closures shall be coordinated with the appropriate agency having jurisdiction.

C. Protection of the Public by CONTRACTOR:

1. Sidewalks: CONTRACTOR shall be responsible for any damage to public sidewalks abutting or adjacent to the demolition properties resulting from the execution of the demolition work.

a. Cost of repair or replacement shall be considered incidental to the work and CONTRACTOR shall obtain permits and pay fees.

2. Pedestrian Access: It shall be CONTRACTOR's responsibility to place and construct the necessary warning signs, barricades, fencing and temporary pedestrian sidewalks, as directed by ENGINEER; and to maintain alternate pedestrian access for sidewalks around the demolition site.

a. Cost of these items shall be considered incidental to the work.

3. Temporary Fence: Temporary fence shall be erected around areas of excavation, dangerous building(s) or structure(s) to prevent access to the public. Such fence shall be at least four feet high, consistently restrictive from top to grade, and without horizontal openings wider than two inches. Fence shall be erected before demolition and shall not be removed until the hazard is removed.

D. Demolition Hours:

1. CONTRACTOR shall comply with any restrictions to working hours as included in the Contract Documents.

2. CONTRACTOR shall comply with all applicable ordinances and restrictions of the agency having jurisdiction.

E. Noise Pollution:

1. Construction equipment used in conjunction with this project shall be in good repair and adequately muffled. CONTRACTOR shall comply with noise pollution requirements of the agency having jurisdiction.

F. Dust Control:

1. CONTRACTOR shall comply with applicable air pollution control requirements of the agency having jurisdiction.

2. CONTRACTOR shall take appropriate actions to minimize atmospheric pollution.

3. To minimize atmospheric pollution, ENGINEER shall have the authority to require that reasonable precautions be taken to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, but not be limited to:

a. The use of water or chemicals for control of dusts in the demolition of existing buildings or structures, construction operations, the grading of roads, or the clearing of land.

b. Covering, when in motion, open-bodied trucks transporting materials likely to give rise to airborne dusts.

G. Requirements for the Reduction of Fire Hazards:

1. Removal of Material:

a. Before demolition of any part of any building, CONTRACTOR shall remove volatile or flammable materials, such as gasoline, kerosene, benzene, cleaning fluids, paints or thinners in containers, and similar substances.

2. Fire Extinguishing Equipment:

a. CONTRACTOR shall be responsible for having and maintaining the correct type and class of fire extinguisher on site.

b. When a cutting torch or other equipment that might cause a fire is being used, a fire extinguisher shall be placed close at hand for instant use.

3. Fires:

a. No fires of any kind will be permitted in the demolition work area.

4. Hydrants:

a. No material obstructions or debris shall be placed or allowed to accumulate within fifteen feet of any fire hydrant.

b. Fire hydrants shall be accessible at all times.

5. Debris:

a. Debris shall not be allowed to accumulate on roofs, floors, or in areas outside of and around any structure being demolished.

b. Excess debris and materials shall be removed from the site as the work progresses.

6. Telephone Service:

a. CONTRACTOR shall arrange for access to and use of, during working hours, one or more telephones in the vicinity of the work site for the purposes of making calls in case of fire or other emergencies, and shall keep all personnel on the job, and the local emergency response agency informed of the location of such telephones.

b. CONTRACTOR's foreman, or at least one regular member of each shift, shall be charged with the responsibility of promptly calling emergency services when necessary. The same person shall be required to inspect the building and the site frequently for possible fires or fire-producing conditions and to apply appropriate corrective action, particularly at the close of work each day.

H. Protection of Public Utilities:

1. CONTRACTOR shall not damage existing fire hydrants, street lights, traffic signals, power poles, telephone poles, fire alarm boxes, wire cables, pole guys, underground utilities or other appurtenances in the vicinity of the demolition sites.

2. CONTRACTOR shall pay for temporary relocation of utilities, which are relocated at CONTRACTOR's request for his convenience.

I. Protection of Adjacent Property:

1. CONTRACTOR shall not damage or cause to be damaged any public right-of-way, structures, parking lots, drives, streets, sidewalks, utilities, lawns or any other property adjacent to parcels released for demolition whether or not the property is scheduled for future demolition.

2. CONTRACTOR shall provide such sheeting and shoring, fencing, or other temporary barricades, as required, to protect adjacent property during demolition. Care must also be taken to prevent the spread of dust and flying particles toward adjacent properties.

3. CONTRACTOR shall restore existing agricultural drain tiles or roadway subdrains that are cut or removed, including drainable backfill, to original condition

a. Repairs shall be subject to approval by the property owner where applicable, and by ENGINEER.

1.04 Risk of Loss

A. CONTRACTOR shall accept the site in its present condition and shall inspect the site for its character and the type of structures to be demolished.

B. OWNER assumes no responsibility for the condition of existing buildings, structures, and other property within the demolition area, or the condition of the property before or after the solicitation for proposals.

C. No adjustment of proposal price or allowance for any change in conditions that occur after the acceptance of the lowest responsible, responsive proposal will be allowed.

1.05 Property Ownership

A. Title:

1. Property address, legal description, and ownership will be included in the Contract Documents.

2. Upon execution of the contract for the work of demolition and site clearance on all or any part of the demolition area, all rights, title, and interest of OWNER in and to buildings, structures and other property to be demolished and/or removed by CONTRACTOR on part or all of said project area as described in the Contract Documents and contract addenda thereto, shall be deemed to be vested in CONTRACTOR.

B. Land:

1. No property rights, title, or interest of any kind whatsoever, in or to the land or premises upon which such buildings or structures stand, is created, assigned, conveyed, granted, or transferred to CONTRACTOR, or any other person or persons, except only the license and right of entry to remove such buildings and structures in strict accordance with the Contract Documents.

2. CONTRACTOR shall not use the land or premises, or allow any other party to use the land or premises, for any purpose other than activities in direct support of the demolition of the building.

1.06 Vacating of Buildings

A. Structure(s) identified in the Contract Documents shall be vacated before a Notice to Proceed is issued and CONTRACTOR begins work.

B. In case CONTRACTOR finds that any structure is not vacated, CONTRACTOR shall immediately notify ENGINEER and shall not begin demolition or site clearance operations on such property until further directed by ENGINEER.

1. CONTRACTOR's responsibility for such buildings will not begin until ENGINEER issues a Notice to Proceed with the demolition.

2. No claim for extension of time or increase in price will be considered because of occupancy of any buildings.

3. In case such occupancy is prolonged, OWNER reserves the right to delete the structure from the work.

1.07 Release of Buildings

A. The demolition area shall be released to CONTRACTOR upon Award of Contract and Notice to Proceed. Said Notice to Proceed shall give any sequence of the demolition and the portion of work that is available to be released if all areas are not ready at the same time. ENGINEER shall approve any change in the sequence. CONTRACTOR shall have full control of the demolition progress and clearance of the site, subject to the provisions of the Contract Documents.

1.08 Permits and Fees

A. CONTRACTOR shall obtain all the necessary permits and pay all permit fees that are required as a direct result of the demolition work specified herein.

1.09 Submittals

A. The submittals shall be in accordance with Section 01 3300, Submittal Procedures, as well the requirements listed herein.
B. Submittals shall include, but not be limited to, the following:

1. Demolition Schedule:

a. Indicate overall schedule and interruptions required for utility and building services.

b. Indicate demolition and removal sequence.

c. Indicate location of items designated for reuse and OWNER's retention.

d. Indicate location and construction of temporary work.

1.10 Quality Assurance

A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

Part 2 Products (Not Used)

Part 3 Execution

3.01 General

A. CONTRACTOR shall be responsible for providing ENGINEER with a minimum of 24 hours advance notification prior to beginning the execution of demolition of any structure.

3.02 Salvage of Demolition Materials

A. CONTRACTOR shall be allowed to salvage demolition materials only from property owned by OWNER. Property ownership will be shown in the Contract Documents.

B. No salvage will be permitted on privately owned property. Privately owned property included for demolition under this contract will be strictly to abate a public nuisance as authorized by the property owner or as directed by the Courts.

1. OWNER has the authority to abate the nuisance, however, OWNER does not have the right to salvage any materials.

2. CONTRACTOR may recycle demolition debris at a licensed or permitted recycling center, however, all other debris must be disposed of at a licensed or permitted disposal facility.

C. CONTRACTOR may salvage demolition materials on properties owned by OWNER as long as demolition is completed within the completion provisions included in the Contract Documents. Buildings, building materials, and equipment resulting from this work shall become the property of CONTRACTOR, and shall be removed from the premises at once. Salvaged material shall be removed immediately from the premises, right-of-way, streets or alleys.

D. OWNER reserves the right to remove salvage items for use by OWNER. These items shall be identified in the Contract Documents or shall be removed by OWNER prior to the issuance of the Notice to Proceed.

3.03 Examination

A. Examine existing equipment and structures indicated to be demolished before demolition.

B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.

C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings or structures indicated to remain.

1. Identify measures required to protect adjacent buildings and structures from damage.

2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings and structures indicated to remain in structurally sound and weathertight and watertight condition.

D. Verify hazardous material abatement is complete before beginning demolition, where applicable.

3.04 Demolition and Removals

A. Structural Parts of Buildings:

1. No wall or part thereof shall be permitted to fall outwardly from any building except through chutes or by other controlled means or methods, which will ensure safety and minimize dust, noise and other nuisance.

2. Subject to site restrictions, outside chimneys or outside portions of chimneys shall be raised in advance of general demolition of each building. Any portion of a chimney inside a building shall be razed as soon as it becomes unsupported by reason of removal of other parts of the building.

3. Any part of a building, whether structural, collateral, or accessory, which has become unstable through removal of other parts, shall be removed as soon as practicable, and no such unstable part shall be left free-standing or inadequately braced against all reasonably possible causes of collapse at the end of any day's work.

B. Basements and Foundation Walls:

1. Basement floors, footings, and foundations shall be completely removed from the site unless specifically stated in the special provisions. The basement area is to be inspected and approved by ENGINEER before backfilling is started.

2. CONTRACTOR shall ensure that no basement excavation will remain open and exposed for more than 24 hours.

3. CONTRACTOR shall contact ENGINEER when removal is complete to schedule this basement inspection. Failure to do so may result in re-excavation of the basement area at CONTRACTOR's expense.

C. Concrete Slabs:

1. CONTRACTOR shall remove all concrete slabs, asphalt, surface obstructions, masonry slabs and appurtenances.

D. Retaining Walls:

1. Retaining walls or curbs near the perimeter of parcels shall be removed unless otherwise indicated in the Contract Documents.

2. CONTRACTOR shall employ hand labor or other suitable tools and equipment necessary to complete the work without damage to adjacent public or private property.

3. Where such retaining walls or curbs are removed, the embankment shall be graded to a slope of not greater than 3:1 horizontal: vertical or as directed by ENGINEER.

4. Cost of tree or brush removal due to the removal and grading out of the retaining wall shall be considered incidental and shall be included in pay item for demolition.

E. Fences:

1. Fences, guardrails, bumpers, signs, clotheslines, and similar facilities shall be completely removed from the site, except fences on the apparent boundary between a contract parcel and an improved non-contract parcel shall not be removed unless specifically stated in the special provisions.

2. Posts for support shall be pulled out or dug up so as to be entirely removed.

F. Partially Buried Objects:

1. Piping, posts, reinforcing bars, anchor bolts, railings and other partly buried objects protruding from the ground shall be removed. Remaining void shall be filled with soil and compacted in accordance with these specifications.

G. Vegetation:

1. CONTRACTOR shall remove all dead trees, trees identified for removal, stumps, trees which are not an asset to the property, bushes, vegetation, brush and weeds, whether standing or fallen, unless specifically stated otherwise by ENGINEER.

2. CONTRACTOR shall protect trees not removed from damage by the demolition operation. In the event that CONTRACTOR damages a tree, it shall be repaired or removed by CONTRACTOR as directed by ENGINEER.

H. Fuel Tanks:

1. Fuel tanks, above or below ground, shall be carefully removed and disposed of in a safe manner in accordance with local, state and federal regulations.

a. Fuel tanks, above or below the ground, or tanks which have been used for storage of gasoline, kerosene, benzene, oils or similar volatile materials shall be carefully removed and disposed of in a safe manner.

The time, place and manner of disposal will be as set forth in the Contract Documents.

b. Other tanks or receptacles shall be pumped out or emptied in a safe manner, and then shall be flushed out immediately with water, carbon dioxide or nitrogen gas until they are gas-free when checked with a "Explosimeter" or another equally efficient instrument, before the work of removal is begun. Checking with the "Explosimeter" shall be done in the presence of ENGINEER by competent personnel.

I. Outdoor Toilets and Septic Tanks:

1. Outdoor toilets and septic tanks shall be pumped out by a licensed company.

2. Toilet building or septic tank shall be demolished and removed from the site.

a. Excavation or pit shall be backfilled and compacted in accordance with these specifications.

b. Septic tanks shall be broken up and removed from the site and the excavation filled in accordance with local, state, and federal regulations.

J. Cisterns and Meter Pits:

1. Cisterns and meter pits shall be demolished and removed. Excavations shall be backfilled and compacted in accordance with these specifications.

3.05 Well Plugging and Abandonment

A. Wells shall be plugged and abandoned in accordance with local, state and federal regulations.

3.06 Disposal of Demolition Debris and Solid Waste

A. Debris:

1. Materials, rubbish, and trash shall be removed from the demolition area leaving the basements and demolition area free of debris.

2. Cost incurred by the OWNER in cleaning up such materials and debris left behind shall be deducted from funds due CONTRACTOR under this contract.

B. Tires:

1. CONTRACTOR shall visit the site to determine the number of tires that have been abandoned on site.

2. If any additional tires are found on site prior to commencing demolition activity, CONTRACTOR shall immediately notify ENGINEER of the quantity of additional tires found on site so a change order can be prepared for additional removal.

C. Disposal of Demolition Debris and Solid Waste:

1. Debris and solid waste shall be delivered by CONTRACTOR to designated disposal facilities, or to an approved disposal facility licensed in accordance with state and/or local regulations, laws, and zoning.

2. CONTRACTOR shall be responsible to pay all fees for waste disposal.

3. CONTRACTOR shall submit to ENGINEER copies of all disposal tickets for each structure demolished, where available, which identify the specific address of the origin of the debris associated with each ticket.

4. Cost of disposal fees shall be considered incidental to the demolition.

D. Asbestos Abatement:

1. Handling of asbestos material is subject to all applicable state and federal mandates.

2. Asbestos removal is not required on privately owned property that may be included in this work as part of a public nuisance abatement court order; however, CONTRACTOR shall comply with applicable regulations regarding its handling and disposal.

3. Asbestos will be removed by a licensed abatement contractor by a separate contract or in accordance with special provisions on properties owned by OWNER.

4. In the event that asbestos is discovered on a property owned by the OWNER during demolition, CONTRACTOR shall notify ENGINEER and the asbestos shall be removed by a licensed abatement contractor by contract or in accordance with the special provisions.

E. Demolition of Structures with Transite Siding:

1. Privately owned properties containing transite siding shall be listed in the Contract Documents, and all demolition debris from these structures shall be disposed of at an approved landfill.

2. CONTRACTOR shall be responsible for notifying said landfill prior to commencing demolition on these structures to allow for authorization to dispose of material at the landfill.

3. CONTRACTOR shall assume responsibility for the landfill fees for disposing of the demolition debris.

4. Structures with transite siding shall be thoroughly sprayed with water during the execution of the demolition to contain airborne particles.

5. Debris shall be thoroughly wetted prior to transporting to the landfill.

F. Freon Removal and Disposal:

1. Handling of Freon containing appliances is subject to applicable state and federal mandates and regulations.

2. CONTRACTOR shall be responsible for the identification and removal and disposal of the material in accordance with applicable regulations.

3. Costs associated with said removal and disposal shall be considered incidental and shall be included in the lump sum bid for demolition.

G. PCB and Mercury Removal and Disposal:

1. Handling of any fluorescent lighting fixtures and ballasts containing PCB or mercury is subject to applicable state and federal mandates and regulations.

2. CONTRACTOR shall be responsible for the removal and disposal of the material in accordance with applicable regulations.

3. Costs associated with said removal and disposal shall be considered incidental and shall be included in the lump sum bid for demolition.

3.07 Sanitary Sewer and Water Service Disconnections

A. Sanitary Sewer Service Disconnection: Sanitary sewer services shall be disconnected and plugged in conformance with the requirements of the local jurisdiction.

B. Water Service Disconnection: Water services and stubs for the buildings or properties within the demolition work shall be disconnected in conformance with the requirements of the local jurisdiction.

3.08 Backfill, Grading, and Clean Up

A. Backfill:

1. When site conditions permit, as determined by ENGINEER, on-site soil shall be used as backfill material. The top 9 to 12 inches of topsoil shall be stripped and stockpiled on site for use as final topsoil and grading material. If adequate topsoil is not available on site, CONTRACTOR shall bring in enough topsoil from off-site to place a minimum 8-inch cover on the entire site. Excess excavation materials shall be removed from the site.

2. Topsoil material shall not be permitted as deep fill material. Any borrow or fill material shall be approved by ENGINEER before and during the placing of the material.

3. Depressions on the property shall be filled, compacted, and graded to a uniform slope with adequate drainage.

B. Compaction:

1. Excavations shall be backfilled with acceptable material and compacted in accordance with Article 3.06 of Section 31 2316, Structural Excavation and Backfilling.

2. CONTRACTOR shall notify ENGINEER 24 hours in advance of placing any backfill or original backfill material so a soil sample can be obtained.

3. It shall be the responsibility of CONTRACTOR to run a density test during and after the placement of the backfill material.

C. Additional Fill Material:

1. Additional fill material shall be of equal quality to the soil adjacent to the excavation, and free of rubble or organic matter.

2. CONTRACTOR shall provide for a minimum depth of 8 inches of topsoil over the excavated area.

3. There shall be no payment for additional fill material, which shall be considered incidental to the demolition bid price. Additional fill material shall be acceptable fill material that meets the requirements of Section 2010.

D. Hand Labor:

1. CONTRACTOR shall employ hand labor where the use of power machinery is unsafe or unable to produce a finished job. Hand labor shall also be used to clean the site of any debris.

E. Grading:

1. The site shall be graded to conform to all surrounding areas and shall be finished to have a uniform surface that shall not permit ponding of water.

2. CONTRACTOR shall grade and shape the site to drain, complete fine grading and final clean up as part of the lump sum price for demolition.

F. Final Cleaning Up:

1. Before acceptance of the demolition work, CONTRACTOR shall remove all unused material and rubbish from the site of the work, remedy any objectionable conditions CONTRACTOR may have created on private property, and leave the right-of-way in a neat and presentable condition.

2. CONTRACTOR shall not make agreements that allow salvaged or unused material to remain on private property.

3. Ground occupied by CONTRACTOR in connection with the work shall be restored. Restoration shall include appropriate smoothing to its original condition and seeding of the area.

4. On demolition sites where seeding will be delayed because of the allowable seeding dates, CONTRACTOR shall complete fine grading and shaping of the site to leave the site in a neat and presentable condition subject to the approval of ENGINEER.

5. Final cleaning up shall be subject to approval of ENGINEER and in accordance with applicable regulations.

3.09 Safety and Fencing

A. Safety:

1. CONTRACTOR shall comply with all applicable current federal, state and local safety and health regulations.

B. Safety Fencing:

1. CONTRACTOR shall furnish and place a safety fence around the site of the work adequate to secure the demolition site, including any resulting debris or excavation, and to prevent pedestrian access. Fencing shall be considered incidental to the demolition.

2. Safety fence shall remain in place until the demolished materials are removed from the site and all holes or excavated areas are backfilled. The fencing material shall remain the property of CONTRACTOR.

3.10 Authorized Workers

A. Only CONTRACTOR and its employees are allowed to demolish, dismantle, detach or dispose of any part of the demolition structure or its contents.

3.11 Daily Clean Up of Right-Of-Way And Private Property

A. At the end of each workday, CONTRACTOR shall clean sidewalks, streets, and private property of any debris caused by the demolition operation.

End of Section

Section 02 8100.26
Transportation and Disposal of Hazardous & Non-Hazardous Waste Materials

Part 1 General

1.01 Scope of Work

A. CONTRACTOR shall ensure that all vehicles entering and leaving the site comply with safety requirements and licensing requirements of the local, state and federal regulations, prepare vehicles to prevent spillage or contamination, inspect vehicles before leaving the site, transport equipment to and from the site, transport liquids, sludge and other hazardous or non-hazardous materials from the site to an approved and licensed facility for final disposal.

B. During the performance of the earthwork for this Project, CONTRACTOR shall anticipate encountering the following soil conditions:

1. Reusable soil;
2. Contaminated Materials (excluding Hazardous Waste); and
3. Hazardous Waste (including RCRA and Non-RCRA Hazardous) Waste).

C. This specification provides procedures and requirements for handling soils segregated during earthwork activities and includes furnishing all labor, equipment, materials, transportation, and incidentals for performing the following work, to the lines, grades, and elevations as specified and shown and as directed by ENGINEER:

1. CONTRACTOR shall segregate excavated material by loading, hauling, and placing surplus and stained or odorous material at designated stockpile locations within the site, per the Contract Documents. Stockpiled, segregated material shall be characterized by CONTRACTOR to determine disposition in accordance with the requirements of the Contract Documents.

2. CONTRACTOR shall utilize reusable material on the site as directed by ENGINEER.

3. CONTRACTOR shall load, haul, and dispose of waste material in accordance with the Contract Documents.

1.02 Definitions

A. Soil: Sand, silt, or clay mixture or other solid material (e.g., gravel or rock) serving as subsurface fill within the work area below the ground surface, asphalt, or concrete section excluding any crushed miscellaneous base layer.

B. Surplus Soil: Soil within the work area not needed to achieve specified lines and grades.

C. Reusable Soil: Soil characterized as non-hazardous waste and approved for reuse within the site, per the specifications and soil characterization screening protocol (per Paragraph 3.8 of this Section.

D. Non-Hazardous Waste: Soil or liquid not characterized as a Resource Conservation and Recovery Act (RCRA) hazardous waste per 40 CFR Parts 260 – 265, a Toxic Substances Control Act (TSCA), or Polychlorinated Biphenyl (PCB) hazardous waste per 40 Code of Federal Regulations (CFR) Part 761.

E. Hazardous Waste: Soil or liquid characterized as a RCRA hazardous waste, per 40 CFR Parts 260 – 265, or a Toxic Substances Control Act (TSCA) Polychlorinated Biphenyl (PCB) hazardous waste, per 40 CFR Part 761

F. Waste: Solid, liquid, or gaseous material that is not needed or not suitable for its original intended purpose or a material classified as waste by a regulatory authority.

1.03 Submittals

A. Submit the names of the disposal facilities to ENGINEER for review and comment at least one (1) week before the disposal operation is conducted.

B. Submit the transportation routes to the selected solid and liquid disposal facilities to ENGINEER for review and comment.

C. Submit to ENGINEER for review and comment, a Spill Contingency Plan for transportation of solids and liquid. The Plan shall address all the potential hazards, necessary actions to follow in case of spills and emergency phone numbers enroute.

D. Submit copies of all manifests and bill of lading to ENGINEER.

E. If necessary, submit a plan to decontaminate the vehicle wheels. These procedures could be identified in the overall decontamination plan.

1.04 Project Record Documentation

A. Record weight, volume and character of material disposed.

B. Provide documentation that measuring devices used, are certified by the appropriate state inspection agency.

C. CONTRACTOR shall provide to ENGINEER written documentation and records verifying receipt and the quantity received of each load at the disposal facility and verification of proper disposal. Copies of the actual receipt must be provided.

D. CONTRACTOR shall prepare and maintain accurate manifests or bill of lading for each batch of the waste materials being transported and disposed of. CONTRACTOR shall coordinate with ENGINEER to obtain OWNER's signatures on manifests for transportation and disposal purposes.

E. Materials shall be sampled and analyzed in accordance with the disposal requirements as directed by ENGINEER. Testing parameters shall be determined based on the potential for presence of the respective contaminants.

Part 2 Products

2.01 Equipment

A. CONTRACTOR shall provide equipment, personnel and facilities necessary to handle and load materials for transport.

Part 3 Execution

3.01 Loading and Hauling

A. Inspect haul vehicles for soil adhesion to wheels and under carriage. Soils shall be removed and properly handled by CONTRACTOR before leaving site. Decontamination procedures shall be carried out at the decontamination zone.

B. At a minimum, provide wheel wash down using high pressure water and steam. Rinse waters are to be collected for temporary storage prior to disposal. CONTRACTOR will sample collected rinse waters to ensure proper disposal. CONTRACTOR shall be responsible for the disposal and any associated testing.

C. No transport vehicles shall be allowed to leave the site which are leaking or spilling materials.

D. Transport vehicles shall be in strict conformance with all the applicable federal, state and local laws.

E. CONTRACTOR shall keep accurate records for the following information:

1. Type and quantity of materials and liquids removed from the site, and analytical testing results.

2. ENGINEER's approval is required before any liquid or material leaves the site.

F. CONTRACTOR shall provide ENGINEER with copies of the above records, all permits required, manifests, waste hauling permits, and necessary affidavit regarding the waste materials, including liquid disposal.

G. Transport vehicles shall be cleaned before filling with waste material.

H. Prior to transportation, all of the established pre-transportation requirements shall be met.

I. Waste shall be transported by a certified waste hauler in approved containers.

3.02 Disposal

A. Disposal shall conform to Federal, State and local government regulations.

B. For hazardous or non-hazardous contaminated wastes, CONTRACTOR shall utilize a State of Michigan approved manifest, (such as the uniform hazardous waste manifest form (8700-22) so that the waste can be tracked from generation to ultimate disposal.

1. Manifest shall comply with all the provisions of the transportation and disposal regulations.

2. Transporters must sign the appropriate portions of the manifest and must comply with all of the provisions established in the applicable regulations.

3. Contaminated waste manifests must be signed by OWNER.

C. Hazardous and non-hazardous materials shall be disposed of at an approved licensed disposal facility.

D. Arrangements for disposal shall be performed by CONTRACTOR.

E. Disposal of any material at a non-licensed facility or at private property is strictly prohibited under this contract. Written approval from ENGINEER, the Resident Project Representative, and OWNER shall be necessary prior to any deviation from this requirement.

3.03 Spills

A. CONTRACTOR is responsible for cleaning up all the leaks, spills from containers and other items related to the project that occur on site or off site during the time of the contact, whether due to CONTRACTOR's negligence or not.

B. Immediate containment actions shall be taken as necessary to minimize the effect of any spill or leak. CONTRACTOR shall notify ENGINEER and appropriate governmental authorities of the incident.

C. Cleanup shall be in accordance with applicable Federal, State, and local laws and regulations at no additional cost to OWNER.

End of Section

Division 03
Concrete

Section 03 1100
Concrete Forming

Part 1 General

1.01 Scope of Work

A. This Section includes formwork for cast-in-place concrete, complete with furnishing, preparation, installation, coating, protection, adjustment, removal and accessories.

1.02 Related Work Specified Elsewhere

A. Section 03 1500: Concrete Accessories
B. Section 03 2000: Concrete Reinforcing
C. Section 03 3000: Cast-In-Place Concrete
D. Section 31 2316: Structural Excavation and Backfill

1.03 Design Standards

A. Formwork shall be designed for the loads, lateral pressure, and allowable stresses outlined in "Recommended Practice for Concrete Formwork" ACI 347 and for design considerations, wind loads, allowable stresses and other applicable requirements of the local building code. Design and construction of the formwork shall be the responsibility of CONTRACTOR.

B. Formwork shall be true in every respect to produce hardened concrete to the required shape, size, grade and alignment as indicated on the Plan, and of sufficient strength, bracing and rigidity to maintain their position and shape under the loads and operations incidental to placing and curing the concrete, as well as other forces resulting from the movement of the forms.

C. Forms shall be mortar-tight at the time concrete is placed in them and shall be so constructed that the surfaces of the finished concrete will be reasonably free from ridges, fins, offsets, or similar defects. A

D. Adequate and suitable means for removing the forms without injury to the surfaces or edges of the finished concrete shall be provided.

1.04 Allowable Tolerances

A. Formwork shall be constructed such that the hardened surfaces shall conform to the tolerance limits of ACI 347, except as modified below:

1. Variation from plumb in lines and surfaces of piers, walls, or columns:

   a. In any ten (10) feet (3 m) of length: 1/4 inch (5 mm)
   b. Maximum for entire length: 1-inch (25 mm)

2. Variation from the level or from the grades:

   a. In any ten (10) feet (3 m) of length: 1/4 inch (5 mm)
   b. Maximum for entire length: 3/4 inch (20 mm)

3. Variation of distance between walls, columns and beams:

   a. In any ten (10) feet (3 m) of distance: 1/4 inch (5 mm)
   b. Maximum for entire distance: 1-inch (25 mm)

4. Variation of the linear lines from established position as indicated on the Plans:

   a. In any 20 feet (6 m) of length: 1/2 inch (10 mm)
   b. Maximum for entire length: 1-inch (25 mm)

5. Variation in sizes and locations of sleeves, floor openings, and wall openings:

   a. Minus: 1/4 inch (5 mm)
   b. Plus: 1/2 inch (10 mm)

6. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls:

   a. Minus: 1/4 inch (5 mm)
   b. Plus: 1/2 inch (10 mm)

7. Variations of footing dimensions from plan dimensions:

   a. Minus: 1/2 inch (10 mm)
   b. Plus: 2 inches (50 mm)

8. Thickness ± 5%, up to maximum of 1 inch (25 mm)

1.05 Reference Standards

A. ACI - American Concrete Institute
B. ASTM - ASTM International

1.06 Submittals

A. Submit manufacturer's literature for form coating.

B. Submit formwork layout plans, design data and procedures if requested by ENGINEER.

1.07 Storage and Handling

A. Store and handle form coating to prevent contamination of coating in accordance with manufacturer's recommendations.

1.08 Sequencing

A. Sequence installation of formwork with the Work of Section 03 2000, Concrete Reinforcing; Section 03 1500, Concrete Accessories; and Section 03 3000, Cast-In-Place Concrete.

Part 2 Products

2.01 Form Materials

A. Use lumber that is straight, uniform width and thickness, free from knots, offsets, holes, dents, warpage and other surface defects.

B. Use plywood product of standard psi, waterproof, resin-bonded, exterior-type Douglas Fir, face adjacent to concrete shall be Grade B or better.

C. Metal forms to be smooth metal plate free of surface irregularities.

D. Chamfer Strips: Use clear white pine, surface against concrete planed, 1-inch (25 mm) bevel width or cant strip.

2.02 Form Coating

A. Use nonstaining form oil or other mineral oil which will neither discolor nor otherwise injuriously affect the concrete.

2.03 Form Ties

A. Use permanently embedded body type with removable end cones on outer ends, permanently embedded portion 1-inch (25 mm) back from concrete face.

2.04 Forms - General

A. Use forms that conform to ACI 347. Fabricate with facing materials that produce the specified tolerance requirements of Article 1.04 of this Section; produce true surfaces, sharp corners and true lines; and are free of offsets, ridges, bulging, waves and concave or convex areas.

2.05 Layout

A. Use regular and uniform pattern; long dimension of panels vertical; joints horizontal, vertical and aligned; form ties uniformly spaced and aligned in horizontal and vertical rows.

Part 3 Execution

3.01 Preparation

A. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms and embedded materials shall be cleaned of any mortar from previous concreting and of all other foreign material or water before coating is placed in them.

B. Forms shall be coated in accordance with manufacturer's recommendations before the form or reinforcement is placed in final position. Surplus coating on form surfaces, or any coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.02 Installation of Forms

A. Forms shall be sufficiently tight to prevent loss of mortar from the concrete, set true to the lines and elevations indicated on the Plans, tied and braced to remain true during and after concrete placement within tolerances of Article 1.04 of this Section. ENGINEER may at any time condemn any section or sections of forms found deficient in any respect, and such form shall be promptly removed and replaced.

B. No wooden spreaders shall be allowed to remain in the concrete. No metal shall be within 1-inch (25 mm) of any surface.

C. Place chamfer strips in forms to bevel all corners, edges, joints and other structural elements exposed to view, including use of dummy chamfer and false joints to provide neat and uniform appearance. Exposed corners and edges shall have 3/4" x 3/4" - 45° chamfers (20 mm x 20 mm x 45 degree), unless otherwise indicated on the Plan.

D. Provide temporary openings at the base of wall forms and at the other points when necessary to facilitate cleaning and inspection immediately before depositing concrete.

E. Secure in position wedges used for final alignment and items to be embedded in concrete.

F. Forms for keyways shall be prepared in advance of pouring concrete. Keyway forms in slab edges and vertical wall joints shall be rigidly secured in place before the concrete is poured. Forms for keyways for horizontal joints in walls may be placed at the conclusion of the pour, but proper provision shall be made for obtaining and holding the full depth and form of the keyway.

3.03 Adjustment of Forms

A. Positive means of adjustment should be provided to permit realignment or readjustment of shores if excessive settlement occurs.

B. A pair of wedges may be used at the top or bottom of shores, but not at both ends, to facilitate vertical adjustment, to correct uneven settlements, or to facilitate dismantling of the formwork.

C. Screw jacks for pipe shores or scaffold-type shoring may be used at both top and bottom so long as they are secured by the shore or scaffold leg against loosening or falling out, to avoid lateral deflections.

D. During and after concreting, but before initial set of the concrete, the elevations, camber, and plumbness of formwork systems shall be checked, using telltale devices. Appropriate adjustments shall be promptly made where necessary. If, during construction, any weakness develops and the formwork shows any undue settlement or distortion, the Work shall be stopped, the affected construction removed if permanently damaged, and the formwork strengthened.

3.04 Removal of Forms

A. Forms, wedges or shoring shall not be removed or disturbed until the concrete has attained sufficient strength to safely support superimposed dead, temporary construction, and live loads.

B. When forms or shoring are removed, there shall be no excessive deflection or distortion of the concrete.

C. Forms shall be removed in an orderly fashion; with care to avoid surface gouging, corner or edge breakage, or other damage or injury to the concrete surface or physical property; and without impact or shock, to permit the concrete to carry its share of the loads gradually and uniformly.

D. Form removal shall not impair the safety and serviceability of the structure or concrete members.

E. Forms and shoring in the formwork used to support the weight of concrete in beams, slabs, and other structural members shall remain in place a minimum of 14 days or until the concrete has reached a minimum of 75% of the design compressive strength. Cylinder strength shall be based on test specimens cured in the field, as described in ASTM C31, under conditions which are not more favorable than the most unfavorable conditions for the portions of the concrete which the test specimens represent and shall be determined in accordance with Section 03 3000, Cast In Place Concrete.

F. Formwork for columns, walls and other vertical members shall remain in place a minimum of five (5) days or until the concrete has attained a minimum of 75% of its design strength.

Where such formwork also supports the formwork of beams and slabs, the removal times of the latter shall govern. Face and edge forms shall be removed as soon as practicable and permitted by ENGINEER in order to facilitate effective repair of voids or broken corners before the surface has dried.

G. Forms and shoring in the formwork shall not be removed without the approval of ENGINEER. Minimum in-place times are for ordinary conditions and represent cumulative number of days, not necessarily consecutive, after the concrete was placed, during which the temperature of the air surrounding the concrete is above 50°F (10°C). The times may be increased or decreased as directed by ENGINEER, dependent on air temperatures, cement type, concrete additives or other conditions of the Work in accordance with ACI 347.

3.05 Reshoring

A. When removing forms before structural members are strong enough to carry dead load and/or construction loads, reshores shall be installed to assure safe distribution of loading. Reshoring operations shall be planned in advance and shall be subject to ENGINEER's review.

B. During reshoring, no construction loads shall be permitted on the new construction.

C. Reshores shall be placed as soon as practicable after form removal, but in no case later than the end of the working day on which form removal occurs and shall remain in place until the concrete has acquired the required strength.

End of Section

Section 03 1500
Concrete Accessories

Part 1 General

1.01 Scope of Work

A. This Section includes joint fillers, joint sealants, waterstops, and miscellaneous embedded items in concrete.

1.02 Related Work Specified Elsewhere

A. Section 03 1100: Concrete Forming
B. Section 03 2000: Concrete Reinforcing
C. Section 03 3000: Cast-In-Place Concrete

1.03 Reference Standards

A. ASTM - American Society for Testing Materials
B. CRD - U.S. Army Corps of Engineers Handbook for Concrete and Cement Specifications

1.04 Submittals

A. Submit certified manufacturer's affidavits for expansion joint filler, joint sealant and waterstops to verify compliance with the applicable Specifications.

B. Submit a schedule of concrete pouring and indicate locations of proposed construction and expansion joints. This schedule is subject to approval of ENGINEER.

1.05 Environmental Requirements

A. Environmental requirements relative to temperature for placing joint sealants are specified in article 3.04 of this Section.

1.06 Sequencing

A. CONTRACTOR shall sequence installation of miscellaneous embedded items with the Work of Section 03 1100 Concrete Forming; Section 03 2000, Concrete Reinforcing; and Section 03 3000 Cast-In-Place Concrete.

Part 2 Products

2.01 Joint Filler

A. Preformed Expansion Joint Filler for Concrete (Bituminous Type) ASTM D994.

B. Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) ASTM D1751.

C. Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Concrete ASTM D1752.

2.02 Joint Sealer

A. Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements ASTM D6690 Type II.

B. Joint Sealants, Hot-Poured, Elastomeric Type, for Portland Cement Concrete Pavements ASTM D3406.

2.03 Waterstops

A. PVC waterstops shall conform to CRD-C572 polyvinyl chloride (PVC) or CRD-C513 styrene-butadiene rubber (SBR). Flat ribbed type shall be used in joints in walls and slabs where shown on the plans. Center bulb type shall be used in expansion joints.

B. Bentonite waterstops shall be a compound of 75% high swelling sodium bentonite and 25% butyl rubber. Bentonite waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.

C. Hydrophilic rubber waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. Hydrophilic rubber waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.

2.04 Concrete Anchors

A. General:

1. Select type and size to achieve required loading capacity using information provided by manufacturer. If required type is not indicated, select type appropriate to conditions and item being fastened.

2. Maintain critical edge distance and spacing per manufacturer's recommendations for all anchors. Provide tamper proof hardware when called for on the plans.

B. Adhesive Anchors:

1. Combination capsule adhesive and insert system; chisel pointed threaded rod with hex nut/washer, reinforcing bar, or internally threaded insert, installed into pre-drilled anchor hole using rotary hammer drill, crushing glass capsule containing two part epoxy acrylate resin (vinyl ester) with quartz aggregate and hardening agent, forming adhesive mortar.

2. Threaded rod: ASTM A 193 Grade B7, ASTM A 194 Grade 2H or ASTM A 563 Grade DH nuts, and ASTM F 436 washers; plated in accordance with ASTM B 633, SC1, with Type II yellow chromate treatment or Type 304 stainless steel when specified on the plans.

3. Threaded Insert: Carbon steel tubular insert, internally threaded, plated in accordance with ASTM B 633, SC1.

C. Wedge Type Anchors:

1. One-piece body with expansion mechanism installed in pre-drilled hole using matching tolerance bit.

2. Carbon steel anchor body, washers, nuts and wedges, plated in accordance with ASTM B 633, SC1, Type III or Type 304 stainless steel anchor body, washers, nuts and wedges when so indicated on plans.

Part 3 Execution

3.01 Contractor's Verification

A. Inspect the locations and surfaces to receive joint filler, joint sealer, waterstops, or miscellaneous embedded items and correct defects or conflicts which will affect the proper performance of the item to be placed.

3.02 Preparation

A. Accessories to be embedded into concrete shall have contact surfaces free of dirt, curing compound, protrusions of hardened concrete or any other foreign material which would affect bond with concrete.

B. Prime surfaces in accordance with manufacturer's recommendations.

3.03 Installation of Joint Fillers

A. Details, including materials and methods of installation of joint fillers shall be as indicated on the Plans and as approved by ENGINEER.

3.04 Installation of Joint Sealants

A. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40°Fahrenheit (4°Celsius). Bond breaker and backup material shall be installed where required as indicated on the Plans or manufacturer's recommendations.

3.05 Installation of Waterstops

A. Waterstops shall be of maximum practicable length to minimize joints.

B. Waterstops shall be positioned as indicated on the Plans in a manner to permanently retain flexibility.

C. Splice in length or at intersections shall be performed by heat sealing and in accordance with manufacturer's recommendations.

D. Reform splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. When cooled and bent by hand in as sharp as an angle as possible, the splice shall show no sign of separation.

E. Provide support and protection of the waterstops during the progress of the work. Any waterstop punctured or damaged shall be replaced or repaired at CONTRACTOR's expense. Concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

3.06 Concrete Anchors

A. Do not begin installation until substrates have been properly prepared. Do not proceed with installation if substrate preparation is unsatisfactory.

B. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Install in accordance with manufacturer's instructions and recommendations and as required by applicable code. Anchor applied items neatly, with item mounted plumb and level unless otherwise indicated.

D. ENGINEER reserves the right to require the anchor manufacturer's representative to demonstrate proper installation procedures for post-installed anchors and to observe CONTRACTOR's installation procedures, at no extra cost to OWNER. ENGINEER reserves the right to require pullout or shear tests to determine adequacy of anchors, at no extra cost to OWNER.

3.07 Miscellaneous Embedded Items

A. All sleeves, inserts, anchor bolts, and other embedded items required for adjoining Work or for its support shall be placed prior to concreting.

B. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

End of Section

Section 03 2000
Concrete Reinforcing

Part 1 General

1.01 Scope of Work

A. This Section includes the furnishing, fabrication, placement and care of material used as concrete reinforcement.

1.02 Related Work Specified Elsewhere

A. Section 03 1100: Concrete Forming:
B. Section 03 1500: Concrete Accessories
C. Section 03 3000: Cast-In-Place Concrete

1.03 Reference Specifications

A. Latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein. Copies of standards can be obtained from the American Concrete Institute.

1.04 Testing Agency

A. Testing agencies shall meet the requirements of Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as Used in Construction, ASTM E329.

1.05 Allowable Tolerances

A. Fabrication:

1. Sheared length: ± 1-inch (25 mm).
2. Depth of truss bars: +0, -1/2 inch (+0, -10 mm).
3. Stirrups, ties, and spirals: ± 1/2 inch (±10 mm)
4. All other bends: ± 1-inch (±25 mm).

B. Placement:

1. Concrete cover to form surfaces: ± 1/4 inch (±5 mm).
2. Minimum spacing between bars: -1/4 inch (-5 mm).
3. Top bars in slabs and beams:

    a. Members eight (8) inches (200 mm) deep or less: ± 1/4 inch (5 mm).

    b. Members more than eight (8) inches (200 mm) but not over two (2) feet (600 mm) deep: ± 1/2 inch (±10 mm).

    c. Members more than two (2) feet (600 mm) deep: ± 1-inch (±25 mm).

4. Crosswise of members: Spaced evenly within two (2) inches (50 mm) of stated separation.

5. Lengthwise of members: ± 2 inches (±50 mm).

6. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 1-bar diameter, with approval from ENGINEER.

1.06 Source Quality Control

A. Reinforcing steel shall be subject to inspection at the source of supply, fabricator, or after delivery to the Project Site at the discretion of ENGINEER.

B. CONTRACTOR may be required to furnish additional test of reinforcing steel for each 100 tons (90 metric ton) or fraction thereof. Testing for bend, pull, elongation and weight to assure compliance with Specifications shall be in accordance with ASTM A370.

1.07 Reference Standards

A. ACI - American Concrete Institute
B. ASTM - ASTM International
C. CRSI - Concrete Reinforcing Steel Institute

1.08 Submittals

A. CONTRACTOR shall submit Shop Drawings indicating the size and dimensions for fabrication and placing of reinforcing steel, including bar schedules, stirrup spacing, and diameter of bend bars. Bar supports type and grade shall be indicated.

B. CONTRACTOR shall submit test certificates of the manufacturer's laboratory, identifying chemical and physical analysis of each load of reinforcing steel delivered.

C. CONTRACTOR shall submit test certificates of a qualified independent testing agency evaluation of the mechanical splice devices to assure compliance with ACI 318.

1.09 Delivery, Storage, and Handling

A. Deliver reinforcement to Project site in bundles tagged and marked in accordance with "Manual of Standard Practice" of the CRSI.

B. Reinforcing steel shall be stored above ground on platforms or other supports, in an orderly manner to facilitate inspection and checking, and be protected from physical injuries or contamination.

1.10 Sequencing

A. CONTRACTOR shall coordinate placement of the reinforcing in a manner which will not prevent the proper and timely completion of dependent construction phases.

Part 2 Products

2.01 Reinforcing Bars

A. Reinforcement shall be of the grade and type as specified herein unless otherwise indicated on the Plans or Shop Drawing.

B. Bars:

1. Deformed and Plain Billet-Steel Bars: ASTM A615, Grade 60.
2. Rail-Steel Deformed and Plain Bars: ASTM A616-96a, Grade 60.

3. Axle-Steel Deformed and Plain Bars: ASTM A617-96a, Grade 60.
4. Low Alloy Steel Deformed Bars: ASTM A706.

C. Mats:

1. Fabricated steel bar or rod mats of the clipped type shall conform to ASTM A184.

2.02 Welded Wire Fabric

A. Welded wire fabric shall be in flat mats only.

B. Plain:

1. Conform to ASTM A185, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

C. Deformed:

1. Conform to ASTM A496, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

2.03 Tie Wire

A. Plain:

1. Conform to Cold Drawn Steel Wire for Concrete Reinforcement, ASTM A82, 16-gage minimum size.

B. Deformed:

1. Conform to Deformed Steel Wire for Concrete Reinforcement, ASTM A496, size D-4 minimum.

2.04 Bar Supports

A. Metal bar supports shall be fabricated from cold-drawn steel wire in accordance with current CRSI Standards.

B. Stainless steel supports shall be of Type 1, with stainless steel wire conforming to ASTM A493 attached to the tips of the support so the nonstainless wire will lie no closer than 1/4 inch (5 mm) from the form surface.

C. Plastic coated supports shall be of Type 1, with plastic coating of polyethylene conforming to ASTM D1248 on the legs and tips.

D. Precast concrete brick supports shall conform to ASTM C55, Type 1, Grade N.

2.05 Fabrication

A. Bars shall be bent cold to the shapes and dimensions as indicated on the Plans, or as required by the current "Manual of Standard Practice" of the CRSI.

B. Steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or improper bends shall not be used.

C. The diameter of bend measured on the inside of the bar for standard hooks, other than stirrups and tie hooks, shall not be less than the values of the following table.

Minimum Diameters of Bend	
Bar Size	**Minimum Diameter**
#3 through #8 (#10M - #25M)	6 bar diameters
#9, #10, and #11 (#29M - #36M)	8 bar diameters
#14 and #18 (#43M - #57M)	10 bar diameters

D. Bends for stirrups and ties with number 5 (#16M) bar and smaller shall not be less than four bar diameters. For bars larger than No. 5 (#16M), shall be according to the "Minimum Diameter of Bend" table above.

E. Bends for stirrups and ties for welded wire fabric shall not be less than 4-bar diameters for deformed wire larger than D-6 and 2-bar diameters for all other wires. Bends with inside diameter of less than 8-bar diameters shall not be less than 4-bar diameters from nearest welded intersection.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall examine the areas in which the reinforcing steel is to be placed to assure proper lines and levels.

3.02 Preparation

A. Remove dirt, grease, oil, loose mill scale, excessive rust, and foreign matter that will reduce bond with concrete or splicing method.

B. The ends of bars to be butt spliced shall be cut square and smooth.

3.03 Installation - General

A. Reinforcing shall be placed as indicated on the approved Shop Drawings, within allowable tolerances. Bar supports, as indicated on approved Shop Drawings, or in Specifications, shall be used for proper separation and support of reinforcing steel.

3.04 Minimum Spacing

A. Unless otherwise indicated on the Plans, the minimum spacing of bars shall be the following:

B. Footings and other principal structural members in which the concrete is deposited against the ground shall have 3 inches (75 mm) of concrete between the bar and the ground contact surface.

C. Concrete surfaces which, after removal of the forms, are to be exposed to the weather or in contact with the ground or liquids, shall be protected with 2 inches (50 mm) of concrete.

D. The concrete protective covering for any reinforcement at surfaces not exposed directly to the ground, liquids or weather shall be 3/4 inch (20 mm) for slabs and walls and 1-1/2 inches (40 mm) for beams and girders.

E. Column spirals or ties shall be protected everywhere by a covering of concrete cast monolithically with the core and shall be at least 1-1/2 inches (40 mm).

F. Concrete protection for reinforcement shall in all cases be at least equal to the diameter of bars, except for concrete slabs as noted above.

G. The minimum center to center distance between parallel bars shall be 2-1/2 times the diameter of the bars. In no case shall the clear spacing between bars be less than one inch (25 mm) nor less than 1-1/3 times the maximum size of the coarse aggregate. The maximum center to center distance in parallel bars shall be 18 inches (450 mm). Where reinforcement in beams and girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1-inch (25 mm), and the bars in the upper layers shall be placed directly above those in the bottom layer.

H. Welded wire fabric designated as load-carrying reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches (50 mm). It shall be supported as required for reinforcing bars.

3.05 Splicing

A. Splices shall be avoided at points of maximum stress. Splicing of bars shall be in accordance with ACI 318.

B. Splicing of bars shall be done by overlapping in accordance with ACI Detailing Manual SP-66, and securely laced with wire unless indicated otherwise on the Plans or approved Shop Drawing.

C. Lap adjoining wire mesh by no less than one (1) full mesh and lace securely with wire. Offset end laps in adjacent widths to prevent continuous splice.

D. Welded wire fabric reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than one full mesh spacing plus 2 inches (50 mm). The fabric shall extend across supporting beams and walls and to within 4 inches (100 mm) of concrete edges. It may extend through contraction joints where alternate wires are field cut. It shall be adequately supported during placing of concrete to insure its proper position in the slab either by the methods of Article 3.06 of this Section or by laying the fabric on a layer of the fresh concrete of the correct depth before placing the upper layer of the slab.

E. Vertical bars in columns shall be offset at least 1-bar diameter at lapped splices. To insure proper placement, templates shall be furnished for all column dowels.

F. Bars of size 14, 18 or larger (#43M #57M or larger), where size 11 (#36M) bars are butt spliced to larger sizes and/or when approved by the ENGINEER shall be welded in accordance with ACI 301 by full penetration butt welds. Adequate jigs and clamps or other devices shall be provided by the CONTRACTOR to support, align and hold the longitudinal centerline of the bars in a straight line.

G. Bars larger than size eleven (#36M) may be butt spliced by mechanical devices approved by ENGINEER, in accordance with ACI 318. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories to support, align and hold the longitudinal centerline of the bars in a straight line.

3.06 Securing Reinforcement

A. Reinforcement shall be securely laced with wire to supports or reinforcing to prevent displacement during the concrete placement, as required by the current "Manual of Standard Practice" of the CRSI.

3.07 Field Quality Control

A. ENGINEER shall inspect the reinforcing steel after it has been installed, and the reinforcing steel placement shall be approved by ENGINEER prior to placement of concrete.

B. CONTRACTOR shall avoid displacement of the reinforcing steel during concrete placement.

End of Section

Section 03 3000
Cast-in-Place Concrete

Part 1 General

1.01 Scope of Work

A. This Section includes all monolithic cast-in-place concrete work complete with materials, mixes, installation and testing.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 03 1100: Concrete Forming
C. Section 03 1500: Concrete Accessories
D. Section 03 2000: Concrete Reinforcing
E. Section 04 0511; Mortaring and Grouting
F. Section 05 1200: Structural Steel Framing
G. Section 05 5000: Metal Fabrications
H. Section 07 1000: Dampproofing and Waterproofing
I. Section 31 2319: Dewatering

1.03 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ACI - American Concrete Institute

2. ASTM - ASTM International

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Reference Specifications

A. The latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein.

1.05 Testing Agency

A. Inspections and tests required by this Section shall be performed by organizations acceptable to ENGINEER.

1.06 Allowable Tolerances

A. See Section 03 1100, Concrete Forming, for the allowable tolerances for concrete surfaces.

1.07 Design Criteria

A. Mixes shall be designed and tested for each size and gradation of aggregates and for each consistency intended for use. Design quantities and test results of each mix shall be submitted for review.

B. Necessary construction joints are shown on the Plans. Modification of location or placement of construction joints not indicated on the Plans shall be subject to approval of ENGINEER. In general, they shall be located within the middle one-third of the span of slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam.

C. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

D. Expansion joint locations and details shall be as shown on the Plans. In no case shall any fixed metal be continuous through an expansion joint.

E. Keyways shall be provided in all joints where required to provide for either shear or watertightness. Unless otherwise required, the width of keys shall be at least one-third the thickness of the section at that point and their depth at least one-third their width.

1.08 Source Quality Control

A. Furnish tests of cement and aggregates. Material sampling shall conform to the following ASTM Standards:

1. Cement C183
2. Aggregates D75

B. Testing shall be in accordance with applicable ASTM Standards to assure compliance with Specifications.

C. Make tests for the following quantities, or fraction thereof:

1. Cement ..... 550 tons (500 metric ton)
2. Fine Aggregate ..... 2,000 Tons (1800 metric ton)
3. Coarse Aggregate ..... 2,000 Tons (1800 metric ton)

D. Use same brand cement for any given structure produced by a single mill unless otherwise provided by authorization of ENGINEER.

1.09 Submittals

A. Submit Shop Drawings showing the location of joints. Included shall be a schedule of the concrete pouring. The location of joints and pouring schedule shall be subject to approval by ENGINEER.

B. CONTRACTOR shall submit test reports for cement and aggregates to assure compliance with the Specifications.

C. Concrete mixture designs and test data shall be submitted for review by ENGINEER with a written request for approval. No concrete shall be placed until CONTRACTOR has received such approval in writing. Each mixture report shall include:

1. Slump on which design is based.
2. Total gallons of water per cubic yard (l/m^3).
3. Brand, type, composition, and quantity of cement.
4. Brand, type, composition, and quantity of pozzolan or other mineral admixtures.

5. Brand, type, composition, and quantity of ground granulated blast furnace slag.
6. Specific gravity and gradation of each aggregate.
7. Ratio of fine to total aggregates.
8. Weight (surface dry) of each aggregate, lbs./c.y. (kg/m^3).
9. Brand, type, ASTM, active chemical ingredients, and quantity of each admixture.
10. Air content.
11. Compressive strength based on 7-day and 28-day compression tests.
12. Time of initial set.

D. Submit manufacturer's literature of abrasive wear resistant floor finish and of chemical curing compound for review by ENGINEER.

E. Submit a sample concrete delivery ticket for review by ENGINEER.

F. Submit tickets collected at the site of concrete placement accompanying each load of concrete. A printout system for producing these tickets in connection with automatic batching will be permitted.

1. Each ticket shall be serially numbered, show the charging time, quantity and grade of concrete, location of delivery and the signatures of inspectors at the plant and site. Transit mixed concrete tickets shall also include revolution counter reading at charging and mixing completion.

G. Submit reports of the sampling and testing of slump, air content and strength performed.

H. Submit reports of nondestructive, core and/or liquid retention testing required for acceptance of concrete in place.

1.10 Material Storage and Handling

A. Materials shall be stored and handled in accordance with ACI 304 and as specified below.

B. When permission is given to store cement in the open, a floor at least six (6) inches (150 mm) above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain.

C. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by CONTRACTOR by cleaning sacks mechanically or otherwise, or from discarded sacks of cement, shall not be used in the Work. The use of a fractional sack of cement will not be permitted unless the fractional part is measured by weight. At the time of its use in the Work, the cement shall be free from lumps.

D. No aggregates which have become intermixed prior to proportioning shall be used. Sufficient aggregate shall be available at the site to preclude the possibility of damaging delays while placing the concrete.

E. Cars used for shipping aggregates shall be clean and in good repair. The use of straw, marsh, hay or other similar materials for closing cracks or holes in cars will not be tolerated.

F. Pozzolans and other cementitious materials shall be stored and handled in the manner of cement.

G. Store and handle curing compound in a manner to prevent contamination.

1.11 Environmental Requirements

A. Environmental requirements shall be in accordance with ACI 305 for hot weather concreting, and ACI 306 for cold weather concreting. Specific temperature requirements are contained in Article 2.10 of this Section for mixing and Article 3.13 of this Section for placing.

Part 2 Products

2.01 Materials - General

A. Materials shall meet the requirements of ACI 301, ACI 318, and MDOT Specification, Division 9.

B. Concrete materials shall be tested and inspected as the Work progresses. The review and/or check-test of the proposed materials, securing of production samples of materials at plant stockpiles and/or review of the manufacturer's reports for compliance will be performed at no cost to CONTRACTOR.

C. Testing and inspection required due to substitution or change of materials requested by CONTRACTOR shall be at CONTRACTOR's expense.

2.02 Cement

A. Cement shall be the type as indicated on the Plans or as specified.

B. Type I and IA, conforming to ASTM C150, air-entraining Portland cement when special properties are not specified.

C. Type III and IIIA, conforming to ASTM C150, air-entraining Portland cement for use when high-early strength is specified.

D. Type IS and IS-A, conforming to ASTM C595, air-entraining Portland blast-furnace slag cement for use in general concrete construction.

E. Type IP and IP-A, conforming to ASTM C595, air-entraining Portland-Pozzolan cement for use in general construction. The addition of suffix (MS) signifies that moderate sulfate resistance is specified. The addition of suffix (MH) signifies that moderate heat of hydration is specified.

2.03 Aggregates

A. Washing will be required to eliminate the dust, clay, or silt coating. Aggregates which have been washed shall not be used sooner than 24 hours after washing, unless approved by the ENGINEER.

B. Coarse aggregate shall be gravel or crushed rock, conforming to MDOT Section 902.03. Class 17A for members eight (8) inches (200 mm) or less in thickness and Class 6AA for other construction.

C. Gravel shall consist of hard, clean, durable particles of rock or pebbles and shall be free from lumps of clay.

D. Crushed rock shall consist of angular fragments of crushed hard heads or boulders or crushed igneous rock free from weathered rock and of uniform quality.

E. Sieve and screen analyses determination of clay, silt, and dust content and percentages of objectionable particles will be based on dry weights and conform to MDOT Section 902.03, Table 902-1, "Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open Graded Aggregates" and Table 902-2, "Physical Requirements for Coarse Aggregate, Dense Graded Aggregates and Open Graded Aggregates."

F. Fine aggregate shall be sand size 2NS, MDOT, Section 902.09.

G. Fine aggregates shall consist of sharp sand which shall be composed of clean, hard, durable grains and shall be free from lumps of clay and organic deleterious substances.

H. Fine aggregates shall conform to MDOT Section 902.09 and Table 902-4, "Grading Requirements for Fine Aggregates."

2.04 Admixtures

A. Admixtures shall be used to achieve concrete as indicated on the Plans or specified herein. Calcium chloride shall not be used.

1. Air-entraining, conforming to ASTM C260.
2. Pozzolan and Fly Ash, conforming to ASTM C618, Class C or F.
3. Water reducing, conforming to ASTM C494.
4. Retarder, conforming to ASTM C494.
5. Plasticizer, conforming to ASTM C494.
6. Ground granulated blast furnace slag conforming to ASTM C989, grade 100.

B. Abrasive wear resistant floor finish shall be packaged, dry combination of Portland cement, graded Quartz aggregate and dispersing agents formulated to produce an abrasive and wear resistant monolithic surface.

2.05 Joint Filler

A. See Section 03 1500, Concrete Accessories.

2.06 Water

A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the Local Board of Health may be used without testing. Water from other sources shall be tested before using.

2.07 Curing Compound

A. Shall be adequate to prevent checking, cracking and loss of moisture, conforming to ASTM C309.

2.08 Mixes

A. Concrete shall consist of a mixture of air-entraining Portland cement, coarse and fine aggregate, and water with admixtures if required. Admixtures shall not be used without ENGINEER's review. The mixture, combined in proportions, shall meet the requirements of MDOT, Specification Section 701, and ACI 211.1.

B. Concrete shall be classified and proportioned on the basis of minimum compressive strength at 28 days when cured in a moist room at a temperature within the range of 65° to 75°F (18° to 24°C). The desired strength of the concrete shall be shown on either the Plans or in the Specifications.

C. Table 1 shows for each grade of concrete the minimum compressive strength, cement content, and the modulus of rupture. Concrete shall be 3,500 psi, Grade 3.5, unless otherwise shown on the plans.

Table 1 - Concrete Mixtures

Concrete Grade	Coarse Aggregate	Min Cement Content				Min. Comprehensive Strength at 28 Days (PSI/MPa)	Min. Modulus of Rupture at 28 Days (PSI/MPa)	% Air
		Type of Cement	lbs/yd^3	Sacks/yd^3	kg/m^3			
4.5	6AA	I, IA, IS, IS-A	658	7.0	390	4,500 / 31.0	725 / 5.0	4 - 6
4.0	6AA or 17A	I, IA, IS, IS-A	611	6.5	362	4,000 / 28.0	700 / 4.8	4 - 6
3.5	6AA or 17A	IS, IS-A, IP, IP-A	564	6.0	335	3,500 / 24.0	650 / 4.5	4 - 6

Notes:

1. Maximum water cement ration shall be 0.45
2. Structural concrete for walls and slabs shall be placed with a slump of four (4) inches (100 mm) maximum.
3. Ground granulated blast furnace slag (GGBFS) may be substituted for cement on a pound for pound basis from a minimum of 25% up to a maximum of 40% GGBFS and 60% cement
4. Fly ash may be substituted for cement on a pound for pound basis up to a maximum of 15% fly ash and 85% cement

D. Aggregates shall be proportioned by weight, except for small structures and for incidental Work requiring less than 10 cubic yards (7 m^3) of concrete, in which case they may be proportioned by volume when approved by ENGINEER.

E. Cement in bulk, when permitted, shall be proportioned by weight.

F. When proportioned by volume, the amount of each aggregate required for a single batch shall be measured separately and accurately. Shovel methods of measuring will not be permitted. The unit of volumetric measurement shall be 1 cubic foot or 1 cubic meter.

G. When proportioned by weight, the amount of each aggregate required for a single batch shall be weighed in a separate container. The equipment for weighing shall be of an approved type, and of such accuracy that there shall not be an error of more than 1 percent in any one batch.

2.09 Batching Admixtures

A. The batching of admixtures to achieve and maintain production of the mix design of concrete shall be in accordance with ACI 212.

B. If the air content is found to be less or greater than the specified amount, CONTRACTOR shall immediately discontinue Work and correct the air content.

C. Decreasing the air content may be accomplished by blending air-entraining Portland cement with Portland cement, manufactured at the same mill, in a ratio which will reduce the air content to a value within the specified limits, this blending shall be reviewed by ENGINEER.

D. Increasing the air content may be accomplished by adding to each batch a sufficient amount of air-entraining admixture to bring the air content up to the designed amount.

E. Pozzolan and ground granulated blast furnace slag shall be proportioned based on the mix design approved by ENGINEER per Article 1.09 of this Section to produce watertight concrete.

F. Water Reducer can be used to reduce the water requirement of concrete to obtain consistency of slump, modify workability, increase strength or any other approved use.

2.10 Temperature Limits of Mixture

A. The temperature of the cement, at the time of delivery to the mixer, shall not exceed 165 degrees F (74□C). It may be required that it be stored at CONTRACTOR's expense until cooled to that temperature.

B. The temperature limits of aggregates and water entering the mixer shall be as follows:

Limits of Temperature		
Component	**Minimum**	**Maximum**
Water	75°F (24°C)	140°F (60°C)
Fine Aggregate	65°F (18°C)	140°F (60°C)
Coarse Aggregate	65°F (18°C)	110°F (43°C)
Concrete (resulting)	60°F (15°C)	90°F (32°C)

2.11 Mixers and Mixing

A. General:

1. Concrete mixing operations shall be in accordance with ACI 304 and MDOT, Section 701, and shall be subject to random inspection during the progress of the Work at no charge to CONTRACTOR.

B. Central Mixed Concrete:

1. Mixers shall be capable of quickly and completely discharging without segregation or loss.

2. Efficiency of the mixers shall be maintained at all times through repair or replacement of worn parts when necessary.

3. Mixers shall be provided with readily adjustable, automatic devices which will measure the cement and water within one (1) percent and admixtures within three (3) percent.

4. Drum of the mixer shall be kept free from hardened concrete and shall be completely emptied before recharging.

5. Retempering or remixing concrete that has partially set will not be permitted.

6. Mixer shall be cleaned thoroughly each time when out of operation for more than 1/2 hour.

7. Recommended mixing time is a minimum time of one (1) minute for one (1) cubic yard (or cubic meter), with an additional 15 seconds for each additional cubic yard (or cubic meter).

8. Concrete shall be delivered to the site in clean, tight truck bodies designed for this purpose and painted with paraffin if necessary for easy dumping. Concrete at the point of delivery shall have the proper consistency and shall be free from segregation. Mechanical agitators in the truck bodies will be required if the period of time from the mixing plant to the point of dumping exceeds 30 minutes.

9. No concrete shall be dumped if the elapsed time from the mixing plant to the point of dumping exceeds 60 minutes.

C. Transit Mixed Concrete:

1. Transit-mix concrete shall be in accordance with ASTM C94. If transit-mix concrete is used, it shall meet all the foregoing requirements specified for central mixed concrete and, in addition, the following:

a. Batched materials shall be properly proportioned and in a dry state. The proper amount of water shall be added to the mixer on the trucks, and no additional water shall be added. No admixtures or accelerators shall be added except as herein noted, without the approval of ENGINEER.

b. Trucks shall not be loaded beyond their rated capacity and shall have mixing drums cleaned of all set-up materials at frequent intervals while in use. Trucks with leaking water valves shall not be used.

c. Recommended mixing speed should be no less than 12 revolutions per minute, with a minimum of 90 revolutions or until the mix is satisfactory.

d. Mixing shall be continuous after water is added to the mix in the drum, but no concrete shall be placed in the forms more than 90 minutes after water is added to the mix.

e. Truck-mixed concrete shall be delivered to the site of the Work and discharged from the mixer within the maximum period of 1-1/2 hours from the first introduction of water to the mix. Concrete which remains in the mixer after this period and any concrete which appears too stiff to be properly workable or which appears to have begun to take its initial set shall be rejected and removed from the site of the Work.

D. OWNER may employ an independent testing laboratory to provide a qualified inspector to be present at the plant where batching of concrete occurs. The inspector shall verify the compliance of the mix with the Specifications and shall sign a form indicating the quantity of concrete and the concrete mixture of each load.

2.12 Change of Mixture

A. If CONTRACTOR requests a change or substitution of approved batch proportioning, mixing, or delivery operations additional testing and/or inspection shall be at CONTRACTOR's expense.

2.13 Acceptable Manufacturers

A. Acceptable manufacturers of abrasive wear resistant floor finish include: Master Builders Company "Mastercon Aggregate," Sonneborn Building Products "Harcol," or equal.

Part 3 Execution

3.01 Verification of Formwork, Reinforcing, and Subgrades

A. CONTRACTOR shall inspect formwork, reinforcement and subgrades to confirm compliance with the related Work specified elsewhere.

3.02 Embedded Items

A. CONTRACTOR shall verify the location, from certified vendor or applicable engineering drawings, of all embedded items including anchor bolts, wall sleeves, wall casting, railing post sleeves and miscellaneous pipes and conduits and shall install the items accurately at the locations determined.

3.03 Building in Other Work

A. CONTRACTOR shall make all necessary provisions in concrete Work for other Work installed by this or other contractors, and build in all required steel beams, frames, curbs, expansion joints, inserts, hangers, pipes, floor drains, pipe trench covers and frames, anchors, sleeves, floor ducts, fiber and steel conduit, pipe hanger sockets, and all other Work furnished by either this or other contractors.

B. CONTRACTOR shall build in all anchors, ties, etc., specified under brick and other Work, in faces of concrete Work which are to be faced with masonry, and any other Work shown or noted to be built into concrete. In addition, CONTRACTOR shall provide all openings and holes in concrete Work as shown or as needed to accommodate other Work.

3.04 Special Concrete

A. CONTRACTOR shall verify the use and/or locations of watertight concrete and/or high-early strength concrete.

3.05 Preparation

A. CONTRACTOR shall notify ENGINEER two (2) working days prior to placement of concrete.

B. Before depositing new concrete on or against existing concrete the existing concrete shall be roughened, thoroughly cleaned of foreign matter and laitance and saturated with water. The cleaned and saturated surface of the hardened concrete, including vertical and inclined surfaces, shall be coated with a bonding agent or slushed with a minimum 2-inch (50 mm) thick coating of concrete without coarse aggregate grout against which the new concrete shall be placed before the mixture has attained its initial set.

C. Before concrete is placed in any unit, the forms and the placing and fixing of all steel and incidental items shall be complete, and the forms, steel and adjacent concrete shall be thoroughly cleaned and wetted down.

D. Where indicated on the Plans, CONTRACTOR shall bridge the subgrade with at least 2,000 psi (13.8 MPa), 3-inch (75 mm) thick lean concrete before placing the reinforcement. This shall be at no extra cost.

E. No concrete shall be deposited in any unit until the area has been completely dewatered in accordance with Section 31 2319, Dewatering, and not until after CONTRACTOR has made satisfactory provisions to eliminate all possibility of water entering or flowing through the concrete while it is being poured or is taking its set. No concrete shall be placed under or on water.

3.06 Conveying

A. Concrete handling equipment shall be of such a nature and shall be so located that the concrete after leaving the mixer will reach its destination with a minimum lapse of time, with no segregation, and loss of slump. Use of drop chutes, except at or in the forms, is prohibited.

B. Interior hopper slope of concrete buckets shall be not less than 60 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum size aggregate and the area of the gate opening shall be not less than 2 square feet (0.2 m^2).

1. Maximum dimension shall not be greater than twice the minimum dimension.

2. Bucket gates shall be essentially grout tight when closed and may be manually, pneumatically or hydraulically operated except for buckets larger than 2 cubic yards (1.5 m^3) shall not be manually operated.

3. Design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

C. Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing.

D. Concrete may be conveyed by positive displacement pump when authorized by ENGINEER. Pumping equipment shall be piston or squeeze pressure type. Pipeline shall be rigid steel pipe or heavy duty flexible rubber hose. Inside diameter of the pipe shall be at least 3 times the nominal maximum size coarse aggregate in the concrete mixture to be pumped. Maximum size coarse aggregate shall not be reduced to accommodate the pumps.

E. Distance to be pumped shall not exceed limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

3.07 Placing

A. Concrete shall be so deposited as to maintain the top surface level, unless otherwise shown on the Plans, and also as to avoid any appreciable flow in the mass.

B. Where placing operations involve dropping the concrete more than 3feet (1 m) in the forms, it shall be deposited through sheet metal or other approved spouts or pipes. These spouts or pipes shall have suitable receiving hoppers at the upper ends, and the lower ends shall be kept within 6 inches (150 mm) of the newly placed concrete so as to prevent segregation and avoid spattering the reinforcing steel with mortar. Under no circumstances shall concrete that has partly hardened be deposited in the Work.

C. Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than 2 feet (600 mm) per hour. Concrete vibrators shall penetrate the initial layer when placing the following layer. Vertical construction joints shall be provided as necessary to comply with these requirements.

D. Concrete shall be placed and compacted in wall or column forms before any reinforcing steel is placed in the system to be supported by such walls or columns. The portion of any wall or column placed monolithically with a floor or roof slab shall not exceed 6 feet (1.8 m) of vertical height. Concrete in walls or columns shall set at least 2 hours before concrete is placed in the structural systems to be supported by such walls or columns.

E. Concrete shall be set when top finished. Laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. Wherever the top of a wall will be exposed to weathering, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.

F. No concrete shall be placed in contact with frozen ground. Time between charging and placement of concrete shall not exceed 1-1/2 hours.

G. Concrete shall be compacted by continuous vibrating, tamping, spading or slicing. Care shall be taken to eliminate all voids and to provide full bond on reinforcing steel and embedded fixtures. Mechanical vibration shall be employed. Concrete shall be compacted and thoroughly worked with suitable tools combined with the use of vibrators applied internally and providing a frequency not less than 7,000 revolutions per minute. All such vibrating, including the methods and equipment, shall be subject to the review of ENGINEER.

H. The time of vibrating in any area shall only be sufficient to get efficient compaction, but shall in no case be carried to the point where there is segregation of the fine and coarse materials of the mix. There shall be an absolute minimum of direct vibration of the steel or forms during the process of vibrating. Vibrators shall be inserted and withdrawn from the concrete at numerous locations, from 18 to 30 inches (450 to 750 mm) apart, but shall not be used to transport concrete within the forms. CONTRACTOR shall have a standby vibrator on the job site during all concrete pouring operations.

3.08 Finishing Unformed Surfaces

A. The unformed surfaces of all concrete shall be screeded and given an initial float finish followed by steel troweling.

B. Screeding shall provide a concrete surface conforming to the proper elevation and contour with all aggregates completely embedded in mortar. All screeded surfaces shall be free of surface irregularities with a height or depth in excess of 1/4 inch (5 mm) as measured from a 10-foot (3 m) straightedge.

C. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working of the surface. Floating shall be performed with hand floats or suitable mechanical compactor floats.

D. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks. The top surface of driveways, and sidewalks shall be given a broomed finish after troweling.

E. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having 1/4 inch (5 mm) corner radius.

3.09 Finishing Formed Surfaces

A. After removal of forms, the finishing of all concrete surfaces shall be started as soon as its condition will permit.

B. Grind all seams, fins or projections flush with the concrete surface.

C. Fill and point all honeycomb, tie holes and voids.

D. Dampen the surface with water and apply a cement and silica sand slurry to the entire surface to fill small defects and air voids.

E. Remove excess slurry from concrete. Surfaces to be finished shall receive an application of dry Portland cement which shall be rubbed into the slightly dampened surface with a suitable cloth.

F. After pointing and removal of projections as specified herein, exposed surfaces of concrete, including walls, columns, beams, pilasters and the undersides of slabs, shall be given a rubbed surface finish.

3.10 Floors

A. Concrete floor finish shall be applied to all building floors not receiving further floor finish. At these locations, the concrete shall be brought to the proper elevation and screeded. The surface shall be given two (2) steel trowelings when the concrete has set sufficiently to finish smoothly. Floors shall be sloped uniformly toward floor drains at a slope of 1/8 inch per foot (10 mm per meter).

B. Concrete finish on steps and loading platforms shall be wood troweled to true and uniform surface and then steel troweled. The surface shall then be slightly roughened with a broom or by dragging burlap across the surface.

C. Concrete floors shall be finished with an abrasive resistant floor finish in the areas noted on the finish schedule on the Plans. Premixed floor hardener shall be applied to the surface of the freshly floated concrete floor, in strict accordance with the manufacturer's directions. Color to be selected by OWNER.

3.11 Expansion Joints

A. Comply with the requirements of Section 03 1500, Concrete Accessories. Expansion joints shall have removable polystyrene joint caps secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces.

B. Joint caps shall be of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant to the size shown on the Plans.

C. Joint caps shall not be removed until after the concrete curing period.

3.12 Concrete Curing

A. Concrete shall be cured for a period not less than 7 consecutive days. CONTRACTOR shall have adequate equipment and curing material on the job site before concrete placement begins, and it shall be adequate to prevent checking and cracking and loss of moisture from all the surfaces of the concrete. Concrete shall be protected from rain, flowing water, wind and the direct rays of the sun. Openings in concrete shall be sealed to prevent drying of the concrete during the curing period.

B. Curing compounds shall not be used on surfaces to which additional concrete or other material are to be bonded.

C. Curing compounds when used shall be applied in strict accordance with the manufacturer's recommendations.

D. Concrete cured with water shall be kept wet by covering with ponded water or fog spraying to keep all surfaces continuously wet.

E. Horizontal construction joints and finished surfaces cured with sand shall be covered a minimum thickness of 1-inch (25 mm), uniformly, and kept saturated during the curing period.

F. Burlap used for curing shall be treated to resist rot and fire and free of sizing or any substances that are injurious to Portland cement or cause discoloration. Strips shall be lapped by half widths. The burlap shall be saturated with water after placement and during the curing period.

G. Straw or hay shall be in a layer no less than 6 inches (150 mm) thick and held in place by screens, wire or other means to prevent dispersion by the wind. Care shall be observed to avoid discoloration of the concrete surface from the vegetable fibers and for the flammability of the material. The straw shall be saturated with water after placement and during the curing period.

3.13 Environmental Conditions

A. General:

1. CONTRACTOR shall provide cold or hot weather protection in accordance with ACI and as specified herein. There shall be no additional cost for hot or cold weather protection of the concrete.

B. Cold Weather Protection:

1. When placing concrete in cold weather, CONTRACTOR shall plan and prosecute his Work in a manner which shall assure results free from damage through freezing, contraction, and loss of concrete strength.

2. No concrete shall be poured when the surrounding temperature is below 40°Fahrenheit (4°Celsius), unless the aggregates and water are properly heated. Concrete which has been poured at higher temperatures but has not attained a strength equal to 75% of the required strength of the class of concrete involved, shall be housed and protected in accordance with the provisions of this Section whenever the surrounding temperature falls below 40° Fahrenheit (4°Celsius).

3. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.

4. Aggregates may be heated only by steam coils or steam jets, except in the case of small quantities of concrete when other methods may be approved by ENGINEER. A sufficient quantity of properly heated aggregates shall be on hand prior to starting the pouring of any unit.

5. Concrete shall be properly housed with canvas, burlap, or other windproof material in such a manner that any necessary removal of the forms or finishing of the concrete can proceed without undue damage to the concrete from the elements.

6. Heating of the housing shall be done in a manner which will maintain a temperature between 50° and 70° Fahrenheit (10° and 20°Celsius), at all times for at least 5 days after the pour is complete and 12 hours before the pour begins.

7. Supplemental heating units shall have exhaust vented to the exterior and shall not cause deleterious reactions or deposits to occur to concrete.

C. Hot Weather Protection:

1. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperature shall be less than 90°Fahrenheit (32°Celsius).

2. In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided.

3.14 Addition of Water

A. To increase workability, adding water to the mix shall be limited to a one time addition of 1 gallon of water per cubic yard of concrete (5 liters per cubic meter) and mixed with a minimum of 30 revolutions at a rate of 12 to 15 revolutions per minute. Addition of water shall be within the slump requirements.

3.15 Concrete Delivery Ticket

A. A ticket system shall be used for recording the transportation of concrete from the batching plant to point of delivery. This ticket shall be issued to the truck operator at the point of loading and given to ENGINEER upon delivery. Ticket shall as a minimum indicate the time of mixer charging, quantity of concrete, type of mixture including amount of cement, and the plant where the concrete was batched.

3.16 Concrete Delivery Rejection

A. Concrete not permitted for inclusion in the Work by ENGINEER shall be removed from the site. Rejection of concrete will be determined through concrete testing and elapsed time from mixer charging to delivery.

3.17 Concrete Testing at Placement

A. General:

1. Tests shall be made of fresh concrete for each 50 cubic yards (40 m^3), or whenever consistency appears to vary. Sampling and testing of slump, air content and strength will be performed at no cost to CONTRACTOR.

2. Composite samples shall be secured in accordance with the Method of Sampling Fresh Concrete, ASTM C172.

B. Slump Test:

1. Slump Test shall be in accordance with ASTM C143. CONTRACTOR shall use the least slump possible consistent with workability for proper placing of the various classifications of concrete.

2. A tolerance of up to 1-inch (25 mm) above the indicated maximum slump shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit.

C. Air Content:

1. Air content of normal weight concrete will be determined in accordance with Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method, ASTM C231.

D. Compressive Strength:

1. A set of cylinders for compressive strength tests will consist of four cylinders per each set.

2. Molding and curing specimens from each set shall be in accordance with Method of Making and Curing Concrete Test Specimens in the Field, ASTM C31. Any deviations from the requirements of this Standard shall be recorded in the test report.

3. Testing specimens will be in accordance with Method of Test for Compressive Strength of Cylindrical Concrete Specimens, ASTM C39. One (1) specimen shall be tested at 7 days for information and 2 shall be tested at 28 days for acceptance.

a. The acceptance test results shall be the average of the strengths of the 2 specimens tested at 28 days. If 1 specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result.

4. The strength level of the concrete will be considered satisfactory so long as the averages of all 28 day strength test results equal or exceed the specified 28-day strength and no individual strength test result falls below the specified 28-day strength by more than 500 psi (3.4 MPa).

5. If the strength test is not acceptable, further testing shall be performed to qualify the concrete.

3.18 Testing of Concrete in Place

A. Additional testing of materials or concrete occasioned by their failure by test or inspection to meet specification requirements shall be at the expense of CONTRACTOR.

B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by ENGINEER to determine relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection.

C. When required by ENGINEER, cores at least two (2) inches (50 mm) in diameter shall be obtained and tested in accordance with Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, ASTM C42.

D. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 80°Fahrenheit (15°-25°Celsius), relative humidity less than 60%) for 7 days before test and shall be tested dry.

E. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C42.

F. At least 3 representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by ENGINEER so as to least impair the strength of the structure. If, before testing, one or more of the cores shows evidence of having been damaged subsequent to or during removal from the structure, it shall be replaced.

G. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 85% of and if no single core is less than 75% of the specified 28-day strength.

H. Core holes shall be filled by low slump concrete or mortar.

3.19 Retention Testing

A. Tanks or structures designed to hold or retain water, wastewater or other liquids shall be retention tested.

B. To test a tank or structure for leakage, CONTRACTOR shall clean, disinfect (if required) and fill the tank or structure with water to its maximum level.

C. The water shall be allowed to remain 24 hours with all associated valves and appurtenances tightly closed.

D. During this 24-hour period, the water level as measured by a hook gage shall show no measurable loss.

E. If this test fails, CONTRACTOR shall dewater the tank or structure, make such repairs as necessary to achieve a watertight tank or structure, clean, disinfect (if required), and retest.

F. Tests and repairs shall be repeated until the tank or structure is accepted by ENGINEER.

3.20 Defective Concrete

A. If, in the opinion of ENGINEER, the defects in the concrete are of such a nature as to warrant condemnation, that portion of the pour may be ordered replaced in its entirety and CONTRACTOR shall promptly replace same without additional compensation.

B. Defective concrete shall be repaired by cutting out the defective area and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely in place.

End of Section

Section 03 4133
Precast Structural Pretensioned Concrete

Part 1 General

1.01 Scope of Work

A. This Section includes precast and precast prestressed structural concrete as indicated on the Plans complete with product design, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage and protection.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 03 1500: Concrete Accessories
C. Section 03 2000: Concrete Reinforcing
D. Section 04 0511: Mortaring and Grouting

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. AASHTO - American Association of State Highway and Transportation Officials
2. ACI - American Concrete Institute
3. AWS - American Welding Society
4. ASTM - American Society for Testing and Materials
5. PCI - Prestressed Concrete Institute

1.04 Qualifications

A. Manufacturer shall be a company specializing in providing precast and/or precast prestressed concrete products and services normally associated with the industry for at least five (5) years.

1. When requested by ENGINEER, submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.

B. Erector shall be regularly engaged for at least five (5) years in the erection of precast structural concrete similar to the requirements of this Project.

C. Welders shall have qualified within the past year in accordance with AWS D1.1.

1.05 Design Criteria

A. Submit design calculations by a registered professional engineer, registered in the state where the Work is located, experienced in precast, prestressed concrete design.

B. Use in the design, applicable codes, ACI 318, or AASHTO Standard Specifications for Highway Bridges.

C. Include in the design loads: all dead and live loads as indicated on the Plans, initial handling and erection stresses, and all other loads specified for members where they are applicable.

D. Watertight Precast reinforced concrete structures shall be designed in accordance with ASTM C890, for A-16 (HS20) loading and installation conditions.

1.06 Reference Specifications

A. Local codes plus the following Specifications, standards and codes are a part of these Specifications:

1. ACI 318 - Building Code Requirements for Reinforced Concrete.
2. AWS D1.1 - Structural Welding Code.
3. AWS D1.4 - Reinforcing Steel Welding Code.
4. AASHTO Standard Specifications for Highway Bridges.

1.07 Allowable Tolerances

A. Design deviations may be permitted only after ENGINEER's review of the manufacturer's proposed design supported by complete design calculations and drawings.

B. Provide an installation equivalent to the basic intent of the Work without incurring additional cost to OWNER.

C. Length: ± 1/8 inch per 10 feet (1 mm per meter), ± 1/4-inch (5 mm) maximum

D. Cross sectional dimensions:

1. Less than 24 inches (600 mm): ± 1/4 inch, (5 mm)
2. 24 to 36 inches (600 to 900 mm): ± 3/8 inch (9 mm)
3. Over 36 inches (900 mm): ± ½ inch (10 mm)

E. Thickness: ± 1/4 inch (5 mm)

F. Position of anchors and inserts: ± ½ inch (10 mm) of centerline location shown on the Plans.

G. Horizontal alignment or sweep: 1/4-inch (5 mm) total or 1/8 inch per 10-foot length (1 mm per meter), whichever is greater. Maximum of ½ inch (10 mm) gap between two (2) adjacent members due to sweep.

H. End squareness: 3/8-inch (9 mm) maximum

I. Blockouts: ± 1/2 inch (10 mm) off centerline locations shown on the Plans.

J. Out of square: 1/8 inch per six (6) feet (5 mm per 3 m) measured on the diagonal.

K. Warpage, after installation: 1/8 inch per 6-foot (5 mm per 3 m) length, or 3/8 inch (9 mm), whichever is greater.

L. Vertical alignment:

1. Bottom edges of members from line established at lower face: ± 1/4 inch (5 mm).
2. Bottom surface from straight line between supports: 1/240 of clear span.

1.08 Source Quality Control

A. Comply generally with applicable provisions of Prestressed Concrete Institute MNL-116, Manual for Quality Control for Plants and Production of Precast, Prestressed Concrete Products.

1.09 Submittals

A. CONTRACTOR shall submit design calculations of products not completed and/or indicated on the Plans in accordance with the provisions of Article 1.05 of this Section.

B. Submit erection or production drawings showing:

1. Drawings/ elevations locating and defining material furnished by manufacturer.
2. Sections/details showing connections, cast-in items and relation to the structure.
3. Description of loose, cast-in and field hardware.
4. Field installed anchor location drawings.
5. Erection sequences and handling requirements.
6. Elevation view of each member.
7. Sections/details to indicate quantities and position of steel, anchors, inserts, etc.
8. Lifting and erection inserts.
9. Dimensions and finishes.
10. Prestress for strand and concrete strengths.
11. Estimated cambers.
12. Method of transportation.

C. Submit test certificates identifying chemical and physical analysis of materials used for fabrication and physical analysis of the precast product.

1.10 Delivery and Handling

A. Perform transportation, site handling, and erection with acceptable equipment, methods, and by qualified personnel.

1.11 Storage

A. Store all units off ground.

B. Place stored units so that identification marks are easily discernible.

C. Separate stacked members by battens across full width of each bearing point.

D. Stack so that lifting devices are accessible and undamaged.

E. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

1.12 Site Access

A. Provide suitable access to the building and firm level bearing for the hauling and erection equipment to operate under its own power.

Part 2 Products

2.01 Portland Cement

A. Shall be Type I or Type III: ASTM C150.

2.02 Aggregates

A. Lightweight aggregates for concrete: ASTM C330.

B. Fine and coarse aggregate, other than lightweight aggregate: ASTM C33.

2.03 Admixtures

A. Air-entraining admixtures: ASTM C260.
B. Water reducing, retarding, accelerating admixtures: ASTM C494.

2.04 Water

A. Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

2.05 Reinforcing Steel

A. Reinforcing bars and wire fabric: Per Section 03 2000, Concrete Reinforcing.

B. Strand Wire or low relaxation strands: Grade 270K, conforming to uncoated 7-wire stress-relieved strand for prestressed concrete: ASTM A416.

2.06 Grout

A. Grout: Per Section 04 0511, Mortaring and Grouting and complying with the following:

1. Cement Grout: One (1) part Portland cement, 2-1/2 parts sand, sufficient water for placement and hydration.

2. Nonshrink Grout: Premixed, packaged nonstaining, nonshrink grout.

2.07 Bearing Pads

A. Use bearing pads of the type recommended by the manufacturer where indicated on the plans.

2.08 Welded Studs

A. Shall be in accordance with AWS D1.1.

2.09 Caulking

A. Shall be a non-staining 1-part polymer acrylic base sealant.

2.10 Concrete Mixes

A. Precast, Prestressed:

1. Mixture and mixing of concrete shall be in accordance with ACI 304. The mixture shall produce concrete with the 28-day compressive strength no less than 5,000 psi (34.4 MPa). The strength at initial prestress or form release shall be no less than 3,500 psi (24 MPa). Use of calcium chloride, chloride ions or other salts is not permitted.

B. Precast:

1. Shall be the same requirements of precast, prestressed, except the mixture shall produce concrete with the 28-day compressive strength no less than 4,000 psi (27.5 MPa).

2.11 Fabrication and Manufacture

A. Fabrication and manufacture of precast and/or prestressed products shall comply with the PCI Manual of Practice, and as specified herein.

B. Provide for those openings ten (10) inches (250 mm) round or square or larger as shown on the Plans. Other openings may be located and field drilled or cut after the precast prestressed products have been erected. Openings shall be approved by ENGINEER before drilling or cutting. No tension reinforcement shall be cut.

C. Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.

D. Manufacturer shall cast in structural inserts, bolts and plates as detailed or required by the Plans or shop drawings.

E. No imperfections, honeycomb, or other defects shall be permitted. Provide smooth and dense surfaces, free of voids and projections.

F. Strands shall be recessed 1-inch (25 mm) and holes grouted. The ends of the member shall receive a smooth finish.

G. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the plans, and the specified design criteria.

2.12 Acceptable Manufacturers

A. Precast concrete decks shall be as manufactured by Price Brothers Company; Concrete Components, Inc.; Precast/ Schokbeton; or equal.

B. Precast concrete steps shall be as manufactured by Unit Step Company; Michigan Precast Concrete; or equal.

Part 3 Execution

3.01 Contractor's Verification

A. Examine the substrates and conditions under which the precast concrete is to be installed and notify CONTRACTOR 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.

3.02 Preparation

A. Providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.

B. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.

C. Shoring required for composite beams and slabs shall conform to all applicable building codes.

3.03 Installation - General

A. Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector subcontracted by CONTRACTOR. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

3.04 Alignment

A. Members shall be properly aligned and leveled as required by the Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to ENGINEER.

3.05 Field Welding

A. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

3.06 Grouting and Caulking

A. After installation of precast units are complete, joints shall be grouted and/or caulked as indicated on the Plans or determined by ENGINEER. Joints shall be completely filled with grout. Any grout which seeps through joints shall be removed and surfaces cleaned before the grout hardens.

B. Caulking shall be used at all underside joints between members and along bearing walls or beams. Concurrently with the caulking and grouting operation, any chipped or damaged sections or areas adjacent to openings or otherwise imperfect surfaces shall be carefully patched to match the precast surface.

3.07 Attachments

A. Subject to the approval of ENGINEER, precast prestressed products may be drilled or shot, provided no contact is made with the prestressing steel.

3.08 Field Quality Control

A. Final inspection and acceptance of erected precast and precast prestressed concrete shall be made by ENGINEER to verify conformance with Plans and Specifications.

3.09 Schedules

A. Precast product quantity, location, surface finish and dimensions shall be as indicated on the Plans.

End of Section

Division 04
Masonry

Section 04 0511
Mortaring and Grouting

Part 1 General

1.01 Scope of Work

A. This Section includes the preparation and installation of mortar and grout used for bond or primer coats, laying and grouting masonry units, filling the inside annular space of pipe joints, general patching, grout for riprap and flagstone slope protection, joints in precast structural members, spaces under leveling plates and equipment bases, supporting structures, grouting dowels and anchor bolts.

1.02 Definitions

A. Mortar is a plastic mixture of cementitious materials, admixtures where specified, fine aggregate and water. Grout is a mixture of sand, water, and fine aggregate mixed to a fluid consistency.

1.03 Reference Standards

A. ACI - American Concrete Institute

B. ANSI - American National Standards Institute

C. ASTM - American Society for Testing and Materials

D. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Reference Specifications

A. Latest or current ACI Standards, and the “Specifications for Masonry Structures," ACI-530.1, shall govern mortar and grout work except where otherwise specified herein.

1.05 Submittals

A. Manufacturer's literature shall be submitted for premixed materials.

1.06 Product Delivery, Storage, and Handling

A. Materials shall be stored and handled as recommended in ACI 304.

B. When cement is stored in the open, a floor at least six (6) inches (150 mm) above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain. At the time of its use the cement shall be free from lumps. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by CONTRACTOR by cleaning sacks mechanically or otherwise, or from discarded sacks of cement shall not be used.

C. Aggregates are to be furnished, stocked and handled so that uniformity of grading will be obtained at the time of batching. The area on which stockpiles are to be built shall be thoroughly cleaned of all foreign materials and shall be firm, reasonably level, and well drained. No aggregates which have become intermixed prior to proportioning shall be used.

D. The premixed mortar or grout shall be stored and handled in strict accordance with the manufacturer's recommendations.

1.07 Job Conditions

A. Environmental requirements relative to temperature for mixing and placing mortar or grout shall be in accordance with Articles 2.08 and 3.08 of this Section.

Part 2 Products

2.01 Premixed Mortar or Grout

A. Premixed mortar or grout shall be a complete packaged mixture to which water is to be added at the job site. Mortar and grout shall be nonshrink, nonstaining.

2.02 Cement

A. The type of cement to be used shall be as indicated on the Plans or as specified below:

1. Portland cement: Types I, IA or III: ASTM C150.
2. Masonry cement: Type N, S, or M: ASTM C91.
3. Mortar: Type M or S: ASTM C270.
4. Hydrated lime: Type S: ASTM C207.

2.03 Aggregate

A. Fine aggregate: Type 2MS, per MDOT Section 902.08.

2.04 Admixtures

A. Integral waterproofing compounds, accelerators, retarders or other admixtures not definitely mentioned in the Specifications shall not be used in mortar or grout without the approval of the ENGINEER. Use no admixtures containing calcium chloride.

2.05 Water

A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the State Board of Health may be used without testing. Water from other sources shall be tested before using.

2.06 Mixes

A. General:

1. Water shall be added to premixed mortar or grout in strict accordance with manufacturer's recommendations to prepare a stiff or plastic mix, depending on workability needed for application.

2. For job mixed mortar or grout, a mixture of cement, aggregate, water and admixtures, if required, shall be combined in proportions meeting the requirements of MDOT Section 702 to produce mortar or grout for the use indicated on the Plans and as specified herein.

3. For job mixed mortar and grout the cement and aggregate shall be proportioned by weight for cubic yard (or cubic meter) batches or by volume for small batches. Shovel method of volume measuring will not be permitted. When materials are measured by volume, water shall be added in amounts necessary for the consistency required for the Work.

B. Standard Mortar and Grout:

MDOT Designation	General Use
R-1 (Grout)	Bond or Primer Coat
R-2 (Mortar)	Laying masonry units, caulking pipe joints, general patching
R-3 (Mortar)	Filler between slope protection and riprap

C. Non-shrinking Mortar and Grout:

1. Unless otherwise indicated on the Plans or Specifications, the cement shall be Portland Type I. The materials shall be proportioned by weight, with water added in amounts to obtain necessary consistency required for the Work.

MDOT Designation	General Use
Type H-1	Joints in precast structural members
Type H-2	Spaces under leveling plates, supporting structures, grouting dowels, anchor bolts

2.07 Mixing

A. Minimum mixing time shall be five (5) minutes. Consistency of mortar shall be adjusted to provide the best workability. If the mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be retempered by adding water and remixing. Consistency of the grout shall be such that at the time of placement, it will completely fill all spaces intended to receive grout.

2.08 Mix Temperature

A. The temperature of the mix shall be between 40 degrees and 120 degrees Fahrenheit (4 degrees to 49 degrees Celsius).

2.09 Acceptable Manufacturers

A. Acceptable manufacturers of premixed, nonshrink, nonmetallic grout include: Sonneborn "Sonogrout"; L and M Construction Chemicals "Duragrout"; Master Builders "Masterflow 713"; Five Star Products “Five Star Grout”, or equal.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall verify the elevation of structural member or equipment bases to be grouted, and/or location of anchoring devices as indicated on the Plans or approved Shop Drawings.

3.02 Preparation

A. Surfaces to receive mortar or grout shall be prepared as follows, unless otherwise specified:

1. Remove laitance down to sound concrete.

2. Surface shall be properly wet cured, being free of chemical curing compound, oil, grease, dirt and loose particles.

3. Clean bolt and/or tie holes, anchor bolts and underside of bearing plates.

4. Saturate concrete including holes prior to grouting.

B. When a premixed mortar or grout is used, preparation of surfaces shall be in strict accordance with manufacturer's recommendations.

3.03 Installation - General

A. All mortar and grout shall be used within 2-1/2 hours of initial mixing. No mortar or grout shall be used after it has begun to set.

B. Premixed mortar or grout shall be used in strict accordance with the manufacturer's recommendations.

3.04 Installation of Masonry Units

A. Mortar joints to bond brick or block shall be no less than 3/8 inch (9 mm) and no greater than 1/2 inch (10 mm) thick. Surface of the joint shall be struck to be flush with the masonry units.

3.05 Surface Finishing Applications

A. Non-shrink mortar shall be thoroughly compacted into all voids, holes, honeycombs, or other defects in the finish surface of concrete. Mortar shall be flush with the surrounding concrete and matching in color and texture.

3.06 Grouting Anchoring Devices

A. Non-shrink, non-staining mortar or grout shall be placed in the hole provided, then the anchoring device or dowel shall be set into the grout filled hole. Surface shall be flush with the surrounding concrete. No pressures or loads shall be applied to the anchoring device until the mortar or grout has attained its ultimate strength.

3.07 Grouting Plates and Structural Members

A. Thoroughly fill the area between the foundation and plate or member with nonshrink, nonmetallic grout. If required, immediately set shims and align plate or member as required. After the grout has set hard remove forms or shims and finish with a capping mortar.

3.08 Cold Weather Work

A. General:

1. No masonry units, mortar or grout Work shall be placed in contact with frozen surfaces. No mortar or grout Work shall be performed when the mean air temperature is below 40 degrees Fahrenheit (4 degrees Celsius) unless the materials are heated and/or CONTRACTOR provides adequate protection of the Work. Work shall be protected against freezing for no less than 48 hours after placement.

2. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.

B. Air Temperature 40 degrees to 32 degrees Fahrenheit (4 to 0 degrees Celsius):

1. Sand or mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Heating of either of the ingredients shall be to a minimum 70 degrees and maximum 160 degrees Fahrenheit (21 to 71 degrees Celsius). Ideal mortar temperature should be 70 degrees to 80 degrees Fahrenheit (21 to 27 degrees Celsius).

C. Air Temperature 32 degrees to 25 degrees Fahrenheit (0 to -4 degrees Celsius):

1. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Maintain temperatures of mortar on boards above freezing. Heat sand and water to a minimum 70 degrees and maximum 160 degrees Fahrenheit (21 to 71 degrees Celsius).

D. Air Temperature 25 degrees to 20 degrees Fahrenheit (-4 to -7 degrees Celsius):

1. Sand and mixing water shall be heated to produce mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Maintain mortar temperatures on boards above freezing. Salamanders or other sources of heat shall be used on both sides of interior bearing walls under construction and on the inside of all exterior walls. Windbreaks shall be employed when wind is in excess of 15 mph (24 kph).

E. Air Temperature 20 degrees Fahrenheit (-7 degrees Celsius) and Below:

1. Sand and mixing water shall be heated to provide mortar temperatures between 40 degrees and 120 degrees Fahrenheit (4 to 49 degrees Celsius). Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees Fahrenheit (0 degrees Celsius). Temperature of units when laid shall be not less than 20 degrees Fahrenheit (-7 degrees Celsius).

End of Section

Division 05
Metals

Section 05 1200
Structural Steel Framing

Part 1 General

1.01 Scope of Work

A. The extent of structural steel work is indicated on the Plans, including schedules, notes, and details to show size and location of members, typical connections, and type of steel required.

1.02 Related Work Specified Elsewhere

A. Section 03 3000: Cast-In-Place Concrete
B. Section 04 0511: Mortaring and Grouting

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. AISC - American Institute of Steel Construction
2. ASTM- American Society for Testing and Materials
3. AWS - American Welding Society

1.04 Codes and Standards

A. Comply with the provisions of the following, except as otherwise indicated.

1. AISC - "Code of Standard Practice for Steel Buildings and Bridges."

2. AISC - "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," including the "Commentary and Supplements" thereto as issued.

3. AISC - "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

4. AWS D1.l - "Structural Welding Code."

5. ASTM A6 - "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

1.05 Qualifications for Welding Work

A. Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous 12 months. If recertification of welders is required, retesting will be CONTRACTOR’s responsibility.

1.06 Design of Members and Connections

A. Details indicated on the Plans are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the site whenever possible without causing delay in the Work.

B. Connection details not shown on the plans shall be designed in accordance with the most current addition of the AISC "Manual of Steel Construction."

C. Promptly notify ENGINEER whenever design of members and connections for any portion of the structure is not clearly indicated.

1.07 Allowable Tolerances

A. Overall Length:

1. Members with both ends milled for contact bearing: + 1/32 inch (0.8 mm).

2. Members without ends milled for contact bearing which are framed to other members:

a. 30 feet (9 m**)** or less in length ± 1/16 inch (1.5 mm).
b. Over 30 feet (9 m) in length ± l/8 inch (3 mm).

B. Straightness:

1. Structural members may vary from straightness within the tolerances allowed for wide flange shapes by ASTM Specification A6, except that the tolerance on deviation from straightness of compression members is 1/1,000 of the axial length between points which are to be laterally supported.

2. Completed members should be free from twists, bends and open joints. Sharp kinks or bends are cause for rejection of material.

C. Individual pieces shall be erected so that the deviation from plumb, level and alignment shall not exceed 1:500.

1.08 Source Quality Control

A. Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

B. Promptly remove and replace materials or fabricated components which do not comply.

1.09 Submittals

A. For information only, submit two (2) copies of producer's or manufacturer's specifications and installation instructions for the following products including laboratory test reports and other data as may be required to show compliance with these specifications (including specified standards). Indicate by transmittal that copy of each applicable instruction has been distributed to Fabricators, Installers, and Erectors.

1. Structural Steel, including certified copies of mill reports covering the chemical and physical properties.

2. High-strength bolts including nuts and washers.

3. Unfinished bolts and nuts.

4. Structural steel primer paint.

5. Shrinkage-resistant grout.

6. Slide bearings.

B. Submit shop drawings, prepared by a professional engineer registered in the state where the Work is located, including complete details and schedules for fabrication and shop assembly of members, connections, and details. Also include schedules, procedures, and diagrams showing the sequence of erection.

C. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.

D. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages to be installed by others.

1.10 Delivery, Storage, and Handling

A. Deliver materials to the site at such intervals to insure uninterrupted progress of the work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures as directed by ENGINEER.

1.11 Sequencing with Related Work

A. Supply fabricated structural steel members and/or accessories to be installed by related Work. Bearing plates shall be furnished complete with anchor bolts, washers, nuts and setting diagrams or templates.

1.12 Environmental Requirements

A. Allowances shall be made during erection of structural steel for ambient air temperatures specified under Article 3.07 of this Section.

Part 2 Products

2.01 Structural Steel

A. Rolled Steel Wide Flange and Tee Shapes: ASTM A 992.

B. Other Rolled Steel Plates, Shapes, and Bars: ASTM A572, G50, unless otherwise indicated on the plans.

C. Hollow Structural Sections: ASTM A500, Gr B. Steel Pipe: ASTM A53, Type E or S, Grade B.

D. Anchor Bolts: ASTM A307, non-headed type unless otherwise indicated on the Plans.

2.02 Washers, Bolts, and Nuts

A. Washers: ASTM F436

B. Bolts and Nuts:

1. Standard: Grade A ASTM A307, with nuts conforming to Grade A ASTM A563.

2. High Strength: Type 1 ASTM A325, with heavy hex nuts conforming to Grade DH ASTM A563.

3. Alloy Steel: Type 1 ASTM A490, with heavy hex ASTM A194.

2.03 Miscellaneous Structural Items

A. Electrodes for Welding: Comply with AWS Code; Use E 70 XX Series.

B. Structural Steel Primer Paint: Inorganic Zinc-Rich Epoxy Primer Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with CRD-C588, Type A.

2.04 Shop Fabrication and Assembly

A. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the final shop drawings. Provide camber in structural members where indicated on the Plans.

B. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.

C. Where finishing is required, complete the assembly, including welding of units before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

2.05 Connections

A. Weld or bolt shop connections as indicated on the Plans.

B. Bolt field connections except where welded connections or other connections are specified.

C. Provide high-strength threaded fasteners for all principal bolted connections, except where unfinished bolts are indicated on the Plans.

D. Provide unfinished threaded fasteners for only the bolted connections of secondary framing members to primary members (including purlins, girts, and other framing members taking only nominal stresses) and for temporary bracing to facilitate erections.

E. Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts."

F. Comply with AWS Code for procedures, appearance, quality of welds, and methods used in correcting welding work.

G. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.06 Holes for Other Work

A. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members as indicated on the Plans and/or final shop drawings.

B. Provide threaded nuts welded to framing, and other specialty items as indicated on the Plans, and/or final shop drawings to receive other work.

C. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

2.07 Shop Painting

A. Shop paint structural steel work, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on portions which are exposed and initial two (2) inches (50 mm) of embedded areas only.

B. Do not paint surfaces which are to be welded or high-strength bolted with friction-type connections.

C. After inspection and before shipping, clean all steel work whether painted or not. Remove loose rust, loose mill scale, spatter, slag, or flux deposits. Clean steel in accordance with Steel Structures Painting Council (SSPC) SP-2 "Hand Tool Cleaning" and SP-3 "Power Tool Cleaning."

D. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions and at a rate to provide a uniform dry film thickness at 2.0 mils (50 pm). Use painting methods which will result in full coverage of joints, corners, edges, and all exposed surfaces.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR must examine the areas and conditions under which structural steel work is to be installed and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to CONTRACTOR.

B. The inspection and verification of construction in place shall be sufficiently in advance of steel erection to allow for possible correction of the construction in place or fabrication.

C. If the construction in place is not inspected by CONTRACTOR prior to erection, CONTRACTOR shall be responsible for removing and resetting construction in place or revisions in fabrication to correct discrepancies.

3.02 Erection - General

A. Comply with the AISC Specifications and Code of Standard Practice, and as herein specified.

3.03 Temporary Shoring and Bracing

A. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of the structures as erection proceeds.

3.04 Temporary Planking

A. Provide temporary planking and working platforms as necessary to effectively complete the Work.

3.05 Anchor Bolts

A. Furnish anchor bolts and other connectors required for securing structural steel to foundations.

B. Furnish templates and devices as necessary for presetting bolts and other anchors to accurate locations. Templates shall be 1/8" (3 mm) thick (min) steel plate.

3.06 Setting Bases and Bearing Plates

A. Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces.

B. Clean the bottom surface of base and bearing plates.

C. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

D. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.

E. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain.

F. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's installations, or as otherwise required.

3.07 Field Assembly

A. Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces which will be in permanent contact.

B. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

C. Level and plumb individual members of the structure as specified in Article 1.07 of this Section unless otherwise specified by AISC tolerances.

D. Establish required leveling and plumbing measurements on the mean operating temperature of the structure. Make allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.

E. Splice members only where indicated on the Plans and/or final shop drawings.

F. Erection bolts on exposed welded construction, shall be removed and holes filled with plug welds and ground smooth at exposed surfaces.

G. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

H. Do not enlarge undersized holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

I. Do not use cutting torches in the field for correcting fabrication errors in the structural framing. Cutting will be permitted only on secondary members which are not under stress, as acceptable to ENGINEER. Finish gas-cut sections equal to a sheared appearance when field cutting is permitted.

3.08 Touch-Up Painting

A. Immediately after erection clean field welds, bolted connections, and abraded areas of the shop paint. Apply paint to exposed areas with the same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils (50 μm).

3.09 Field Quality Control

A. General:

1. OWNER may engage an independent testing and inspection agency to inspect high-strength bolted connections and welded connections and to perform tests and prepare test reports. Inspections will meet requirements of the current building code at the place of the Work.

2. Testing agency shall conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state any deviations therefrom.

3. Provide access for the testing agency to places where structural steel work is being fabricated or produced so that required inspection and testing can be accomplished.

4. Testing agency may inspect structural steel at the plant before shipment; however, ENGINEER reserves the right to reject material not complying with specified requirements.

5. CONTRACTOR shall correct deficiencies in structural steel work which inspections and laboratory test reports have indicated to be not in compliance with requirements. Performance of additional tests necessary to reconfirm any noncompliance of the original work and to show compliance of corrected work will be at CONTRACTOR'S expense.

6. Work determined to be defective by ENGINEER and/or local agencies regardless of all previous inspections, shall be corrected to the satisfaction of ENGINEER at no extra cost to OWNER. CONTRACTOR shall be responsible for the cost and delay of replacing defective Work both in regard to his own Contract and as such cost or delay affects the Work of others.

B. Connections:

1. Inspect shop bolted connections in accordance with AISC Specifications. Inspect and test not less than five (5) percent of the shop and field welds during fabrication and erection of structural steel assemblies as follows:

   a. Certify welders and conduct inspections and tests as required.
   b. Record types and locations of all defects found in the work.
   c. Record work required and performed to correct deficiencies.
   d. Perform visual inspection of all welds complying with ASTM E164.

2. Inspection of field bolted connections will be in accordance with AISC Specifications.

End of Section

Section 05 5000
Metal Fabrications

Part 1 General

1.01 Section Includes

A. This Section includes shop fabricated steel and aluminum items as indicated on the Plans complete with materials, fabrication and installation.

1.02 Related Work Specified Elsewhere

A. Section 03 1500: Concrete Accessories
B. Section 03 3000: Cast-in-Place Concrete
C. Section 05 1200: Structural Steel Framing

1.03 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. AISC – American Institute of Steel Construction
2. ASTM – American Society of Testing and Materials
3. FS – Federal Specifications
4. OSHA – Occupational Safety and Health Act

1.04 Design Criteria

A. Grating, railings, stairs and hatches shall be capable of supporting loads as indicated unless otherwise shown on the Plans.

B. Top rail and supports of Guardrail System:

1. Concentrated load of 200 lbs. (90 kg) applied at any point in any direction.

2. Uniform load of 50 pounds per linear foot (75 kg/m) applied to the top rail horizontally with a simultaneous load of 100 lbs. per linear foot (150 kg/m) applied vertically downward.

C. Handrail not serving as top rails:

1. Horizontal concentrated load of 200 lbs. (90 kg) applied at any point.
2. Uniform load of 50 pounds per linear foot (75 kg/m) applied at any point.
3. Concentrated and uniform loads need not be assumed to act concurrently.

D. Intermediate rails (all those except handrails), balusters and panel fillers:

1. Horizontal applied normal load of 50 pounds (220 N) on an area not to exceed 1 square foot (925 cm2) including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of preceding paragraphs.

E. Gratings, hatches and stairs:

1. Uniformly distributed load of 200 lbs per square foot (975 kg/m2) of horizontal surface.

2. Maximum allowable deflection is 1/4 inch (5 mm) with 150 pounds per square foot (730 kg/m2) uniformly distributed load or 500 pounds (225 kg) concentrated load applied at mid-span.

F. Stairway and ladder design shall conform to the latest Michigan OSHA requirements for loading, rail sizes, and dimensions.

1.05 Requirements of Regulatory Agencies

A. The latest Federal OSHA Standards, as adopted by the State of Michigan, and as they relate to floor and wall openings, grating, stairways, ladders and skylights, shall apply to the Work of this specification where applicable.

B. Expansion anchor bolts shall meet OSHA requirements for pull out and shear.

1.06 Quality Assurance

A. Manufacturer's Qualifications:

1. Design connections and components not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Michigan.

B. Inspection:

1. Work done in accordance with this specification shall be subject to inspection. OWNER/ENGINEER shall have access to all places of manufacture where materials are being produced or fabricated, or where tests are being conducted and shall be accorded full facilities for inspection and observation.

1.07 Submittals

A. Submit shop drawings showing layout, fabrication dimensions, anchoring details and erection information for stair nosings, ladders, grating and floor hatches. Include pull-out and shear-strength information for recommended anchor bolts.

B. Fabrication and/or erection of items done prior to ENGINEER review of shop drawing shall be at the risk and expense of CONTRACTOR.

C. When requested by ENGINEER, submit mill or laboratory certified copies of testing reporting chemical analysis and physical property of metal used in fabrication of items of this Section.

D. Submit affidavits when requested by ENGINEER, certifying that the grating, handrail, and ladder capacities comply with the requirements as specified and indicated in this Section or on the Plans.

E. Certification that the equipment meets OSHA 1910.27 standard for Climber Protection shall be submitted.

1.08 Product Delivery, Storage, and Handling

A. Deliver miscellaneous metal items in an undamaged condition. Damaged items shall be repaired or replaced to the satisfaction of OWNER at the expense of CONTRACTOR.

B. Store items to permit easy access for inspection and identification. Keep items off the ground, using pallets, platforms, or other supports. Protect unpackaged and packaged items from erosion and deterioration of shop paint or finish surface.

C. Do not store on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replacement shall be to the satisfaction of OWNER at the expense of CONTRACTOR.

1.09 Protection

A. Installed anchor bolts, inserts and other miscellaneous metal items shall be protected while other Work is being performed. Installed items that are damaged shall be repaired or replaced at CONTRACTOR's expense.

1.10 Sequencing

A. Anchors, frames, or other miscellaneous metal items to be embedded in concrete shall be provided on site as required for uninterrupted construction sequence.

1.11 Guarantee

A. Floor hatches shall bear the manufacturer's 5-year guarantee for proper operation and against defects in materials and workmanship.

Part 2 Products

2.01 Zinc Coating

A. Unless otherwise indicated on the Plans or specified herein, miscellaneous metals shall receive zinc coatings as follows:

1. Steel Shapes, Plates or Bars: ASTM A123
2. Hardware of Steel or Iron: ASTM A153
3. Assembled Steel Products: ASTM A123

2.02 Plates, Sheets, Shapes and Bars

A. Steel: ASTM A36

B. Aluminum**:**

1. Plate and Sheet: Alloy 6061, Temper T6, ASTM B209
2. Extruded Shapes and Bars: Alloy 6061 T6, ASTM B221

C. Stainless steel: ASTM A316

2.03 Tubing

A. Steel:

1. Hot Formed Welded or Seamless Rolled: ASTM A501A1011, Grade 50
2. Cold Finished: Formed, ASTM A512A500, Grade C
3. Aluminum: Alloy 6061 T6, ASTM B221

2.04 Pipe

A. Steel: Black finish unless otherwise specified, Type E or S, Grade B, Schedule 40, ASTM A53

B. Aluminum: Alloy 6061 T6, ASTM B429

2.05 Expansion Anchor Bolts

A. Expansion anchor bolts shall be furnished and installed in accordance with Section 03 1500, Concrete Accessories.

2.06 Grating and Stair Treads

A. Steel**:**

1. Minimum 3/16 inch (4 mm) thick bearing bars manufactured from USS "Cor Ten" Steel with Blaw Knox Ponbake, Bordon Bo Ly, or approved equal finish. Stair treads shall have minimum 1 inch (25 mm) wide diamond plate nosings.

B. Aluminum:

1. Standard rectangular bar manufactured from Alloy 6061 T6, ASTM B221 with standard finish. Stair treads shall have abrasive nosings.

2.07 Concrete Stair Nosing

A. Ferrous metal tread nosing with abrasive tread surface. Nosing shall be minimum 1/8-inch thick, shall have a minimum of 4-inch legs on the horizontal surface of the tread and 2-inch leg on the vertical surface of the riser, and shall extend the full width of the tread. Nosing shall be integral with the concrete stairs by steel studs or anchors. Nosing shall be painted with an approved epoxy paint system.

2.08 Railings

A. Pipe railing system shall consist of top and intermediate rail with posts and kickplates. Handrail system for stairs shall consist of top and intermediate rail, and posts.

B. Aluminum rail and posts shall be nominal 1-1/2” (40 mm) diameter, Schedule 40. All fittings shall be extruded aluminum, machined to final shape. All fasteners shall be stainless steel. Fabricate railing systems and handrails for connection of members by means of manufacturer’s standard concealed mechanical fasteners and fittings unless otherwise approved.

C. Steel rails and posts shall be minimum 1-1/2” (40 mm) diameter, schedule 40, black steel pipe of flush welded construction.

2.09 Ladders

A. All items for ladders and associated safety devices shall be manufactured from aluminum alloy as stated above with stainless steel anchor bolt unless otherwise noted on the plans.

2.10 Fabrication

A. General:

1. Miscellaneous steel fabrications shall conform to AISC Code of Standard Practice. Welding where permitted and performed shall be in accordance with AWS Code for Welding in Building Construction.

2. Fabricate items to dimensions on plans or ENGINEER approved shop drawings. Use the type of materials of size and thickness as indicated on the Plans or specified herein. All structural members framing into beams or columns, unless otherwise detailed on the Plans, shall have standard framing connection angles of sufficient strength to develop the full strength of the member, even though the design stress may be less. Connections shall be bolted, welded or other ENGINEER approved means. Exposed connections shall be flush. Grind welds smooth to match and blend with adjoining surfaces.

3. Ferrous metal fabrications not to be galvanized or embedded in concrete shall be coated with a primer as specified in Division 9 of the Technical Specifications or as specified for individual items.

B. Grating and Stair Treads:

1. Grating shall be fabricated with span lengths and panel widths as indicated on the Plans. Bearing and cross bars shall be spaced evenly and provide the required loading capacity. Edges of grating panels shall be solid, flush for the full depth of the grating.

C. Ladders:

1. Ladders shall be fabricated in accordance with the details shown.

2. Ladder climbing safety devices such as cages shall be provided for all ladders 20 feet (6 m) or greater in length.

D. Floor Hatches:

1. Hatches shall be of sizes indicated on the Plans. Frame and door shall be aluminum with stainless steel hinges and pins unless otherwise called for on the plans. Provide spring counter balanced operators, automatic hold open arm with release handle and snap lock with removable handle. Hardware shall be stainless steel unless otherwise noted on the plans. Door shall have diamond checkered pattern.

2. Frames shall be neatly mitered and shall have welded corners and anchors.

3. Aluminum surfaces to come in contact with concrete, wood, and dissimilar metals shall be shop coated with alkali resistant bitumastic paint as specified in Division 9 of the Technical Specifications.

4. Acceptable manufacturers include The Bilco Company, New Haven, CT 06505 and ENGINEER-approved equal.

E. Lintels:

1. Steel lintels shall be provided for openings as shown and scheduled. Lintels shall have not less than four (4) inches (100 mm) of bearing on each end and shall have an additional 1 inch (25 mm) of bearing at each end for each 1 foot(300 mm) of clear span over four (4) feet (1200 mm), unless otherwise shown. Horizontal sections of lintels between the edge of the masonry opening and the end of the lintel shall be coped to allow for masonry joint not less than 1 inch (25 mm) deep measured from the interior and exterior faces of the masonry wall. See Lintel Schedule shown at the end of this Section.

2. Where steel plates are used in connection with structural shapes, they shall be welded to such structural shapes.

F. Guard Chains:

1. Where indicated on the Plans, chains shall be 3/16-inch (4 mm) cadmium plated steel link construction, provided with snap type fasteners at each end to permit attachment to posts and/or wall eyelets. Two (2) strands of chain, mounted at heights equal to guardrails, shall be installed wherever noted on the Plans.

G. Guard Posts:

1. Guard posts shall be 6 inches (150 mm) diameter, steel pipe conforming to ASTM A53, Schedule 80, filled with concrete. Guard Posts shall be galvanized steel unless otherwise shown on the plans. Guard posts to be painted shall have:

a. 2 – 3 mil polyamide epoxy primer

b. 2 – 3 mil aliphatic acrylic polyurethane, semi-gloss total dry film thickness 4 – 6 mils

2.11 Acceptable Manufacturers

A. Acceptable manufacturers of steel grating include: Blaw Knox "Cor Ten" steel with "Ponbake" finish; Gary Bo Ly; or equal.

B. Acceptable manufacturers of aluminum grating include: Reliance Steel Products Company; Gary Aluminum Grating, manufactured by IKG Industries; or equal.

C. Acceptable manufacturers of floor hatches include: Babcock Davis Associates, Inc.; Bilco Company; Halliday Products Inc., or equal.

Part 3 Execution

3.01 Installation – General

A. Miscellaneous metal items shall be installed plumb, level, square and true, set at proper elevations and positioning. Bearing surfaces and surfaces to be in permanent contact shall be cleaned of dirt, rust, and other substances before the members are assembled.

B. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and are intended for bolted or screwed field connections.

3.02 Installation of Anchor Bolts

A. Drill holes of diameter and depth recommended by anchor manufacturer. Clean hole of dust and debris before inserting anchor. Assemble anchor and complete installation according to manufacturer recommendations.

3.03 Installation of Grating, Floor Hatches, and Stair Nosings

A. Install items at locations indicated on the Plans in accordance with manufacturer's recommendations. Frames to be embedded in concrete shall be installed flush with the finished floor and shall be carefully leveled so that the plates of gratings do not rock.

B. Install stair nosings on concrete stairs.

C. Install eyelets in walls and/or posts for securing guard chains as indicated on the Plans. Mount chain strands at elevations equal to railings.

3.04 Installation of Guard Posts

A. Guard posts shall be set a minimum of 3' 6" (1 m) below finished grade in a concrete foundation as shown on the Plans. Guard posts shall extend 5' 0" (1.5 m) above finished grade.

3.05 Installation of Railings

A. Provide pipe railing system with maximum 8-foot (2400 mm) maximum post spacing and minimum 42-inch (1050 mm) railing height to top rail. Top rail of handrailing system shall be 34-inches (865 mm) high as measured from the leading edge of any tread. Provide minimum 3-inch (75 mm) clearance from the wall for single pipe handrail supported on brackets.

B. Provide removable pipe railings with close-fitting sleeves set in concrete where indicated on the Plans. Sleeves shall be 1-inch (25 mm) less in length than thickness of concrete.

End of Section

Division 07
Thermal and Moisture Protection

Section 07 1000
Dampproofing and Waterproofing

Part 1 General

1.01 Scope of Work

A. This Section includes furnishing and applying thermal and moisture protection for the surfaces of structures constructed under this Contract, as indicated on the plans, including perimeter insulation, vapor barriers and damp proofing.

1.02 Submittals

A. Submit manufacturer's literature of proposed products for review by ENGINEER in accordance with Section 01 3300.

1.03 Product Delivery, Storage, and Handling

A. Unload and store in accordance with manufacturer's recommendations.

1.04 Environmental Requirements

A. The temperature of the ambient air, surface and material during installation shall be in accordance with the manufacturer's recommendations.

Part 2 Products

2.01 Perimeter Insulation

A. Use multi-cellular board of extruded polystyrene or polyurethane foam of thickness shown on the Plans; minimum compressive strength of l&psi (125 kPa); maximum water vapor transmission of 1.1 per inch; conforming to Federal Specification HH-I-524B, Type 11, Class B.

2.02 Vapor Barrier

A. Use a 6-mi1 (150 pm), polyethylene film.

2.03 Damp Proofing

A. Use bituminous base for below grade surfaces and colorless, transparent nonstaining silicone compound for above grade surfaces.

2.04 Crystalline Waterproofing

A. A cementitious crystalline type waterproofing material consisting or portland cement, silica sand and chemicals which chemically controls and permanently fixes non-soluble crystalline growth throughout the capillary voids of the concrete.

2.05 Acceptable Manufacturers

A. Perimeter Insulation: Dow "Styrofoam"; United States Gypsum Company "Formula R; or ENGINEER approved equal.

B. Vapor Barrier: Polyamerica "Visqueen"; "Durethene"; or ENGINEER approved equal.

C. Crystalline Waterproofing: Xypex Concentrate or ENGINEER approved equal.

Part 3 Execution

3.01 Preparation

A. Subgrade surfaces shall be smooth, free from voids, and sharp projections, and shall be to the lines and grades indicated on the Plans before vapor barrier, perimeter insulation, damp proofing, or waterproofing is installed.

B. Prior to damp proofing or waterproofing, fill and finish flush with Portland cement mortar any cracks, holes, cavities or other surface defects.

C. Clean surfaces of all dirt, dust, scale, laitance, curing compounds, oil, grease or other foreign material. Surfaces shall be dry and structurally sound. Apply grout coat of mortar to portions of brick and block surfaces to be backfilled against.

3.02 Installation of Perimeter Insulation

A. Provide on foundation walls or under slabs as indicated on the Plans. Install and attach to walls as recommended by the manufacturer.

3.03 Installation of Vapor Barrier

A. Provide under all floor slabs on subgrade as indicated on the Plans.

B. Use widest practical, seamless width. Use 6-inch (150 mm) minimum laps with top lap placed in direction of concrete placement.

C. Use extreme care in placing concrete reinforcement so as to not disturb or damage vapor barrier.

D. Do not penetrate with stakes, concrete reinforcement or supports. Seal openings with tape in accordance with manufacturer's recommendations prior to concrete placement.

3.04 Installation of Damp Proofing

A. Provide on the wet, exposed or backfilled side of all walls or slabs with wet, exposed-to-weather or backfill on one side and dry on the other side as indicated on the Plans.

B. On backfilled surfaces use two (2) coats each applied at a rate of not less than 1-gallon per 100 square feet (4 L/10 m^2) in accordance with manufacturer's recommendations. Use care to not permit material to get on any exposed surfaces. Remove such spillage or misapplication immediately. Allow material to thoroughly dry between coats and after final application.

C. On exposed surfaces use two (2) coats each applied at a rate of not less than 1-gallon per 200 square feet (2 L/10 m^2) in accordance with manufacturer's recommendations. Do not stain or discolor surfaces or allow runs or waves in applied material.

3.05 Installation of Crystalline Waterproofing

A. Crystalline waterproofing shall be applied to green concrete or existing concrete which has been thoroughly saturated with clean water. Surfaces to be treated shall be moistened prior to application as required to insure proper migration of chemicals into the capillary voids in the concrete.

B. Waterproofing material shall be mixed by volume with clean water which is free from salt or other deleterious materials. Waterproofing material shall be mixed in accordance with manufacturer's instructions.

C. After repairs, patching and sealing has been done in accordance with manufacturers requirements, the concrete surfaces shall have a slurry of crystalline waterproofing applied in two coats at a rate of 1.5 lbs/syd per coat (8 kg/10 m^2).

D. Curing shall begin as soon as the waterproofing material has set up. Treated surfaces shall be fog sprayed three times a day for a three day period, or may be covered with damp burlap for three days.

E. Crystalline Waterproofing may also be applied by mixing an approved admixture into the fresh concrete, according to the manufacturer's directions, at the time of placing concrete.

End of Section

Section 07 1355
Bentonite Geotextile Sheet Waterproofing

Part 1 General

1.01 Scope of Work

A. The work of this section includes but is not limited to the furnishing and installing the following materials, per project specifications and drawings, or as directed by bentonite waterproofing manufacturer.

1.02 Related Work Specified Elsewhere

A. Other specification Sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 1100: Concrete Forming
2. Section 03 2000: Concrete Accessories
3. Section 03 3000: Cast-In-Place Concrete
4. Section 31 2333: Structural Excavation and Backfill

1.03 System Description

A. Provide bentonite waterproofing to prevent the passage of liquid water and install without defects, damage or failure. Waterproofing shall be two high strength geotextiles interlocked encapsulating minimum 1.10 lbs. per square foot (5.37 kg/sqm) granular Volclay sodium bentonite.

1.04 Submittals

A. Prepare and submit the following in accordance with "Conditions of the Contract" and Section 01 3300, Submittals Procedures:

1. Product Data: Submit manufacturer's product data, with complete general and specific installation instructions, recommendations, and limitations.

2. Product Samples: Submit representative samples of specified materials.

3. Material Certificates: Submit certificate(s) signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements. Submit certification that waterproofing system and components, and protection materials are supplied by a single-source manufacturer.

4. Contractor Certificate: At time of bid, submit written certification that installer has current Approved Applicator status with waterproofing material manufacturer.

5. NSF Standard 61 Certification: Submit Official NSF Listing for standard bentonite geotextile waterproofing membrane confirming that product conforms to the requirements of NSF Standard 61 - Drinking Water System Components - Health Effects.

1.05 Quality Assurance

A. Installer Qualifications:

1. Installing company should have at least three (3) years experience in work of the type required by this section, who can comply with manufacturer's warranty requirements, and who is an Approved Applicator as determined by waterproofing system manufacturer.

B. Manufacturer Qualifications:

1. Bentonite geotextile waterproofing and all accessory products shall be provided by a single manufacturer with a minimum of 30 years experience in the direct production and sales of bentonite waterproofing systems.

2. Manufacturer shall be capable of providing field service representation during construction, approving an acceptable installer, recommending appropriate installation methods, and conducting a final inspection of the bentonite waterproofing system applied.

C. Pre-Installation Conference:

1. A pre-installation conference shall be held prior to commencement of field installation to establish procedures to maintain required working conditions and to coordinate this work with related and adjacent work.

2. Verify that final waterproofing and waterstop details comply with waterproofing manufacturer's current installation requirements and recommendations.

3. Pre-con meeting attendees should include representatives for OWNER, ENGINEER, and CONTRACTOR.

D. Materials:

1. Obtain bentonite geotextile waterproofing materials from a single manufacturer to assure material compatibility.

E. Water Sample Test:

1. Project site water sample supplied to manufacturer by CONTRACTOR to determine type of bentonite system (standard sodium bentonite or contaminate resistant (CR) sodium bentonite) to be utilized on the project.

2. Manufacturer shall conduct test free of charge.

3. CONTRACTOR is responsible for collection and shipment of one liter of actual site water.

4. Water should be shipped in uncontaminated, sealed plastic container to: CETCO Technical Center, Attn: BMG Water sample Technician, 1500 West Shure Drive, Arlington Heights, IL 60004. Also provide project name, city and state along with return address to forward test results.

1.06 Product Delivery, Storage, And Handling

A. Delivery and Handling:

1. Deliver materials in factory sealed and labeled packaging. Sequence deliveries to avoid delays, while minimizing onsite storage.

2. Handle and store following manufacturer's instructions, recommendations and material safety data sheets.

3. Protect from construction operation related damage and prolonged weather exposure. Remove damaged material from site and dispose of in accordance with applicable regulations.

B. Storage:

1. Do not double-stack pallets during shipping or storage.

2. During storage protect waterproofing materials from moisture, excessive temperatures and sources of ignition.

3. Provide cover, top and all sides, for materials stored on-site, allowing for adequate ventilation.

1.07 Project Conditions

A. Substrate Condition:

1. Proceed with work only when substrate construction and preparation work is complete and in condition to receive waterproofing system.

B. Weather Conditions:

1. Perform work only when existing and forecasted weather conditions are within the guidelines established by the manufacturer of the waterproofing materials.

2. Do not apply waterproofing materials into standing water or over ice and snow.

3. Though exposure to precipitation and ground water seepage typically will not adversely affect the waterproofing materials, CONTRACTOR shall maintain site conditions to remove standing water from precipitation or ground water seepage in a timely manner.

4. Should waterproofing materials be subjected to prehydration as a result of prolonged immersion, inspection of the material and written acceptance from the manufacturer is required prior to concrete or backfill placement.

1.08 Warranty

A. Upon completion and acceptance of the work required by this section, the waterproofing materials manufacturer will provide a written five (5) year warranty, covering both materials and labor, to OWNER.

B. Issuance of Manufacturer's Warranty requires the following:

1. System waterproofing products and drainage composite products shall have been provided by a single manufacturer;

2. Installation of waterproofing products and prefabricated drainage composite by Manufacturer's Approved Applicator;

3. Installation inspected by certified Independent Inspection Firm per Article 1.06E;

4. Waterproofing materials must be installed in all applicable horizontal and vertical cold pour concrete construction joints and around applicable penetrations.

C. Manufacturer's warranty shall be independent from any other warranties made by CONTRACTOR under requirements of the Contract Documents and may run concurrent with the other warranties.

Part 2 Products

2.01 Acceptable Manufacturer

A. Provide Voltex bentonite interlocked-geotextile waterproofing with applicable accessories as manufactured by Colloid Environmental Technologies Company (CETCO), or ENGINEER-approved equal.

2.02 Materials

A. General:

1. Sodium Bentonite:

a. Specially selected Wyoming granular sodium bentonite with 90% passing through a 20-mesh sieve and less than 10% passing through a 200-mesh sieve.

b. Sodium bentonite shall have a 2 gram free swell minimum volume of 16 cc and a maximum fluid loss of 18ml in de-ionized water.

2. NSF Certified:

a. Standard bentonite geotextile waterproofing membrane shall be certified by NSF International to conform to the requirements of NSF Standard 61 - Drinking Water System Components - Health Effects.

B. Voltex Bentonite Geotextile Waterproofing:

1. Volclay Voltex®: 4’x15’ (1.2x4.5m) roll of interlocked geotextiles encapsulating a minimum of 1.10 lbs. per square foot (5.37 kg/sqm) of granular sodium bentonite. Composite shall consist of one woven and one non-woven polypropylene geotextile, interlocked using a needle-punching process that produces several interlocks per square inch (6.45 sq. cm) over the entire surface area of product.

2. Volclay Voltex® CR: 4'x15' (1.2x4.5m) roll of interlocked geotextiles encapsulating a minimum of 1.10 lbs. per square foot (5.37 kg/sqm) of contaminant resistant granular sodium bentonite. Composite shall consist of one woven and one non-woven polypropylene geotextile, interlocked using a needle-punching process that produces several interlocks per square inch (6.45 sq. cm) over the entire surface area of product.

C. Both Volclay Voltex and Voltex CR have the following performance properties:

Property	Test Method	Typical Value
Peel Adhesion to Concrete	ASTM D903 mod.	15 lbs. /in. (2.6 kN/m) min.
Hydrostatic Pressure Resistance	ASTM D5385 mod.	231 ft. (70 m)
Permeability	ASTM D5084	1×10^{-9} cm/sec.
Grab Tensile Strength	ASTM D4632	95 lbs. (422 N)
Puncture Resistance	ASTM D4833	100 lbs. (445 N) min.
Low Temperature Flexibility	ASTM D1970	Unaffected at -25°F (-32°C)
Geotextile Interlock Peel	ASTM D4632	15 lbs. (65 N)

D. Accessory Waterproofing Products:

1. Accessory waterproofing materials shall be provided by the bentonite waterproofing manufacturer or shall have manufacturer's written approval for substitution.

a. Volclay Bentoseal®: Trowel grade sodium bentonite compound used as detailing mastic around penetrations, corner transitions and grade terminations.

b. Volclay Hydrobar Tubes: 2-inch (50 mm) diameter x 2 feet (60 cm) long, water soluble tube container filled with granular sodium bentonite.

c. Volclay Waterstoppage®: 50 lbs. (22.7 kg) bag of granular Volclay sodium bentonite.

d. Volclay SeamTape®: 2-inch (50 mm) wide butyl rubber sealant tape.

e. Termination Bar: Min. 1-inch (25 mm) wide aluminum bar with pre-punched holes on 12 inches (300 mm) centering for fastening.

f. Cementitious Wall Board: 1/2-inch thick cementitious board for protection of waterproofing during the removal of metal soldier pile cap and top lagging boards.

g. Volclay TB-Boot®: preformed EPDM tie-back cover or field fabricated 26-gauge galvanized sheet metal tie-back covers.

Part 3 Execution

3.01 General

A. Comply with contract documents and manufacturer's product data, including product application and installation instructions.

3.02 Substrate Inspection and Conditions

A. General:

1. CONTRACTOR, with ENGINEER present, shall examine conditions of substrates and other conditions under which this section work is to be performed and notify CONTRACTOR, in writing, of circumstances detrimental to the proper completion of the work.

2. Do not proceed with work until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's warranty requirements.

3. General substrate conditions acceptable for the waterproofing installation are listed below. For conditions not covered in this Section, contact the waterproofing manufacturer for guidance.

B. Soil Substrates:

1. Site conditions allowing, Voltex applications do not require a mud-working slab.

2. Grade substrates should consist of well-leveled soils without voids and debris, and compacted to a minimum of 85% Modified Proctor density.

3. If substrate consists of large aggregate, place a high-strength geotextile layer over the aggregate and then provide several inches of compacted soil or sand for uniform support and containment of waterproofing sheets.

C. Wood Timber Shoring:

1. Wood lagging shoring should extend to the lowest level of the waterproofing installation with any voids or cavities exterior of the lagging timbers filled with compacted soil or cementitious grout.

2. Interior surface of lagging boards should be planar and tight together with gaps less than 1 inch (25 mm).

3. Gaps in excess of 1 inch should be filled with cementitious grout, wood, extruded polystyrene (40 psi min.) or compacted soil.

4. Do not use plywood or other surface treatment over large lagging gaps that leaves the cavity void.

D. Cut Rock Face or Auger Cast Caisson Shoring Walls:

1. Interior surface of cut rock and concrete auger pile retention walls should be planar without irregular surface conditions, voids, and sharp transitions that would leave a void space to the outside of the waterproofing installation.

2. Irregular rock, void pockets, cracks, sharp concave transitions should be completely filled or smoothed with cementitious grout, shotcrete, or other approved solid material.

E. Concrete:

1. Reinforced structural slabs should be a minimum of 6 inches (150 mm) thick when placed on a working mud slab.

2. Reinforced concrete slab(s) on compacted grade shall be a minimum of 4 inches (100 mm) thick.

3. When hydrostatic conditions exist, install Voltex under all footings, elevator pits and grade beams.

4. Cast-in-place concrete to receive waterproofing shall be of sound structural grade with a smooth finish, free of debris, oil, grease, laitance, dirt, dust, or other foreign matter which will impair the performance of the waterproofing and drainage system and which do not comply with manufacturer's warranty requirements.

5. Voltex can be installed on green structural concrete as soon as the forms are removed. There is no product limitation regarding a minimum concrete curing time requirement for Voltex to be installed over structural concrete. Manufacturer recommends gaining instructions from ENGINEER regarding any site-specific concrete curing time requirement.

a. Horizontal deck or roof concrete surfaces should be sloped for proper drainage.

b. Form fins, ridges, and other protrusions should be level and smooth with monolithic concrete surface. Honeycombing, aggregate pockets, tie-rod holes and other voids should be completely filled with non-shrink cementitious grout and level with monolithic concrete surface.

c. Expansion joints should receive applicable expansion joint sealant product manufactured by others prior to the installation of the Voltex Waterproofing System. Expansion joint material is the primary seal at the expansion joint and the expansion joint material manufacturer is responsible for water tightness of the joint.

3.03 Surface Preparation

A. Remove dirt, debris, oil, grease, cement laitance, or other foreign matter which will impair or negatively affect the performance of the waterproofing and drainage system.

B. Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing products during installation operations.

3.04 General Installation Guidelines

A. Install Voltex Waterproofing System with the dark gray woven geotextile side facing the concrete to be waterproofed in both horizontal and vertical applications. Overlap Voltex membrane edges a minimum 4 inches (100 mm) or greater as defined herein.

B. Expansion Joints:

1. Voltex waterproofing is not an expansion joint filler or sealant but may be used as an expansion joint cover over a properly installed expansion joint material placed during substrate preparation.

2. To use Voltex as an expansion joint cover, trowel 1/8-inch (3 mm) thick, 6-inch (150 mm) wide layer of Bentoseal centered over expansion joint.

3. Install a 24-inch (60 cm) wide strip of Voltex centered over the expansion joint. Then install the main course of Voltex.

3.05 Slab / Footing Edge Voltex Transition Course

A. Provide a minimum of 6 inches (150 mm) overlap between underslab and vertical wall waterproofing. Secure overlap with washer-head fasteners a minimum of 24 inches (600 mm) on center and apply Bentoseal to the overlap edge.

B. At the slab/footing form edge, secure Voltex sheet horizontally oriented (dark gray woven geotextile facing installer) to the top inside edge of the exterior slab/footing form with the sheet conforming to the interior form sides and then extending out onto the horizontal slab substrate a minimum 12 inches (300 mm). Overlap edges of adjacent Voltex sheets a minimum 4 inches (100 mm) and secure to prevent sheet movement during construction or concrete placement.

3.06 Under Slab Voltex Installation

A. Reinforced structural foundation slabs should be a minimum of 6 inches (150 mm) thick when placed on a working mud slab. Reinforced concrete slab(s) on compacted grade shall be a minimum of 4 inches (100 mm) thick. Install Voltex under all footings, elevator pits and grade beams when hydrostatic conditions exist or are anticipated per the historical high ground water elevation reported in the project's geotechnical documents.

B. Install underslab Voltex membrane (dark gray woven geotextile side up) extending to interior edge of slab/footing form edge, fully overlapping the 12 inches (300 mm) horizontal tail of the Voltex slab edge sheet installed in Step B, Section 3.04. Overlap edges of adjacent Voltex sheets a minimum 4 inches (100 mm) and secure to prevent sheet movement during construction or concrete placement.

C. Place Voltex directly on properly prepared substrate (dark gray woven geotextile side up facing installer) with adjoining edges overlapped a minimum of 4 inches (100 mm). Stagger sheet end seams a minimum of 24 inches (60 cm). Mechanically fasten or staple Voltex as required to prevent movement from construction operations or concrete placement. When the slab is poured in sections, extend Voltex a minimum 12 inches (300 mm) beyond the slab edge to enable proper overlapping.

D. Detail all slab penetrations, grade beams, and pile caps, install 1/4-inch (6 mm) thick layer of Waterstoppage extending 6 inches (150 mm) radius. Cut Voltex to fit snugly around penetrations and pile caps. Around base of penetrations trowel 3/4-inch (18 mm) thick fillet of Bentoseal and extend the Bentoseal up the penetration 1-1/2 inches (38 mm) and onto the Voltex. Around base of pile caps and grade beams trowel 3/4-inches (18 mm) thick fillet of Bentoseal and extend the Bentoseal up the cap and onto Voltex a minimum 2 inches (50 mm).

E. Inspect finished Voltex installation and repair any damaged material prior to concrete slab placement. Assure that Voltex is not displaced during concrete placement.

F. Volclay Waterstop-RX shall be installed in all slab joints, around applicable slab penetrations and structural members. Refer to Waterstop-RX Product Manual for further installation procedures and guidelines.

3.07 Backfilled Cast-In-Place Concrete Walls

A. Place Hydrobar Tubes along the wall/footing intersection with ends "butted" tightly together to form a continuous installation.

B. Trowel 3/4-inch (18 mm) thick, continuous Bentoseal fillet at all inside wall corner transitions. Trowel Bentoseal form-tie pockets/patches and any slightly irregular honeycomb areas.

C. Starting at the base of the wall, install Voltex sheet horizontally (dark gray woven geotextile against the wall) covering the Hydrobar Tubes and extending onto the footing a minimum of 6 inches (150 mm). For hydrostatic conditions, cover the entire footing and overlap waterproofing membrane from underslab work a minimum of 6 inches (150 mm). Attach Voltex using washer-headed mechanical fasteners centered 24 inches (60 cm) around the sheet edge. Overlap all adjacent sheet edges a minimum 4 inches (100 mm). Stagger all vertical overlap seams a minimum of 12 inches (300 mm).

D. After the bottom horizontal course, Voltex sheets can be installed either vertically or horizontally oriented. Continue Voltex installation up wall to finished grade elevation, staggering all sheet roll ends of adjacent courses a minimum 12 inches (300 mm). Do not allow horizontal Voltex overlap joints to run at same elevation as the concrete pour lift joints. Overlap all adjacent Voltex sheet edges a minimum 4 inches (100 mm).

E. Cut Voltex to fit snugly around penetrations. Detail around all penetrations with 3/4-inch (18 mm) cant of Bentoseal. Completely fill any space between the penetration and Voltex edge. Extend Bentoseal 1/4-inch (6 mm) thick over substrate a minimum radius of 1-1/2 inches (38 mm) and onto penetration.

F. Terminate at grade with metal termination bar fastened 12 inches (300 mm) on center. Cover top edge of Voltex with 1/2-inch (12 mm) thick, 2 inches (50 mm) wide layer of Bentoseal.

G. Inspect finished Voltex installation and repair any damaged material prior to backfill placement. Assure that Voltex is not displaced during backfill placement or soil compaction.

3.08 Backfill Excavated Cast-In-Place Concrete Walls

A. Closely coordinate Voltex installation with Backfill conducted under Division 2 work. Care should be used during backfill operation to avoid damage to the waterproofing system.

B. Follow generally accepted practices for backfilling and compaction. Backfill should be added in 6 inches to 12 inches (150 - 300 mm) lifts and compacted to a minimum 85% Modified Proctor density. If gravel backfill, angular aggregate shall be less than 3/4-inches (18mm) with fines.

3.09 Clean Up

A. Clean areas where adjacent finished surfaces are soiled by work of this Section. Remove all tools, equipment and remaining product on-site. Dispose of section work debris and damaged product following all applicable regulations.

End of Section

Section 07 9200
Joint Sealants

Part 1 General

1.01 Scope of Work

A. Section covers sealant and caulking materials and their application, wherever required for complete installation of building materials or systems.

B. Section includes sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:

a. Control and expansion joints in unit masonry or concrete.

b. Perimeter joints between materials listed above and frames of doors and windows.

c. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:

a. Control and expansion joints on exposed interior surfaces of exterior walls.

b. Perimeter joints of exterior openings where indicated.

c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.

d. Joints on underside of precast beams and planks.

e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.

f. Joints between plumbing fixtures and adjoining walls, floors, and counters.

g. Other joints as indicated.

1.02 Reference Standards

A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by basic designation only.

1. American Society for Testing and Materials (ASTM):

a. ASTM C509 - Elastomeric Cellular Preformed Gasket and Sealing Material.

b. ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.

c. ASTM C717 - Standard Terminology of Building Seals and Sealants.

d. ASTM C834 - Latex Sealants.

e. ASTM C919 - Use of Sealants in Acoustical Applications.

f. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

g. ASTM C1193 - Standard Guide for Use of Joint Sealants.

h. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).

1.03 Submittals

A. Submit the following in accordance with Section 01 3300, Submittal Procedures:

1. Product Data: For each joint-sealant product indicated.

2. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

3. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

1.04 Quality Assurance

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.05 Delivery, Storage, and Handling

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.06 Project Conditions

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.

2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 degrees Fahrenheit (4.4 degrees Celsius).

3. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.07 Warranty

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

Part 2 Products

2.01 Performance Requirements

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

C. Joint sealant used in concrete water storage tanks or otherwise in contact with potable water shall be NSF 61 approved.

2.02 Materials, General

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

C. Approvals: Joint sealant and other materials used in concrete water storage tanks or otherwise in contact with potable water shall be NSF 61 approved.

2.03 Elastomeric Joint Sealants

A. Elastomeric Sealant Standard: Comply with ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C920 classifications for type, grade, class, and uses.

B. Stain-Test Response Characteristics: Where elastomeric sealants are specified in Elastomeric Joint Sealant Schedule to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

2.04 Latex Joint Sealants

A. Latex Sealant Standard: Comply with ASTM C834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.05 Joint-Sealant Backing

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 degrees Fahrenheit (minus 32 degrees Celsius). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.06 Miscellaneous Materials

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

Part 3 Execution

3.01 Examination

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Preparation

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

    a. Metal.
    b. Glass.
    c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 Installation of Joint Sealants

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses provided for each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

4. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.

5. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.

G. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.04 Field Quality Control

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.

B. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

1. Test Method: Test joint sealants by hand-pull method described below:

a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches (50 mm) long at sides of joint and meeting cross cut at one end. Place a mark 1 inch (25 mm) from cross-cut end of 2-inch (50-mm) piece.

C. Use fingers to grasp 2-inch (50-mm) piece of sealant between cross-cut end and 1-inch (25-mm) mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

D. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

1. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.

2. Inspect tested joints and report on the following:

a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.

b. Whether sealants filled joint cavities and are free from voids.

c. Whether sealant dimensions and configurations comply with specified requirements.

3. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

4. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

E. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 Cleaning

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 Protection

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion.

B. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.07 Elastomeric Joint-Sealant Schedule

A. Multicomponent Nonsag Polysulfide Sealant; Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Available products include the following:

a. CM-60; W.R Meadows, Inc.
b. T-2235-M; Morton International, Inc.
c. T-2282; Morton International, Inc.
d. Thiokol 2P; Morton International, Inc.
e. GC-5 Synthacalk; Pecora Corporation.
f. Two-Part Sealant; Sonneborn Building Products Div., ChemRex Inc.

2. Type and Grade: M (multicomponent) and NS (nonsag).

3. Class: 25.

4. Use Related to Exposure: NT (nontraffic).

5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

    a. Use O Joint Substrates: Coated glass, galvanized steel, brick, ceramic tile, and wood.

3.08 Latex Joint-Sealant Schedule

A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

B. Products: Available products include the following:

1. Chem-Calk 600; Bostik Inc.
2. NuFlex 330; NUCO Industries, Inc.
3. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
4. AC-20; Pecora Corporation.
5. PSI-701; Polymeric Systems, Inc.
6. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
7. Tremflex 834; Tremco.

End of Section

Division 09
Finishes

Section 09 9600
Industrial Paints and Coatings

Part 1 General

1.01 Scope of Work

A. Interior paint and coatings systems including: latexes, alkyds, epoxies, water-based epoxies, water-based urethanes and urethanes.

B. Use products specified in this section to finish all surfaces exposed to view, unless otherwise indicated, including but not limited to the following:

1. Interior wall and ceiling surfaces.
2. Interior wood doors and woodwork.
3. Interior concrete floors.
4. Opening frames and trim.
5. Exterior plaster and stucco.
6. Exterior wood.
7. Exterior concrete and concrete masonry.
8. Exterior metal items.
9. Roof flashings, trim, roof accessories, rain drainage accessories.
10. Roof-mounted equipment, piping, ductwork, brackets, and hangers.
11. Access and equipment cabinets.
12. Mechanical piping, hangers, and supports.
13. HVAC ductwork, hangers, supports, louvers, and grilles.
14. Electrical conduit, junction boxes, and other equipment.
15. Shop-primed items.

C. Do not paint the following:

1. Items specified or provided with factory finish.
2. Items indicated to receive other finish.
3. Items indicated to remain natural.
4. Brick, precast concrete, integrally colored plaster.
5. Concrete masonry in utility, mechanical, and electrical spaces.
6. Stainless steel, anodized aluminum, bronze, terne, or lead.
7. Equipment nameplates, fire rating labels, and operating parts of equipment.
8. Acoustical materials.
9. Concealed piping, ductwork, and conduit.

1.02 Related Work Specified Elsewhere

A. Section 09 1000: Piping Identification System.

1.03 Standard References

A. ANSI - American National Standards Institute, ANSI Z535.1.
B. ASTM - American Society for Testing and Materials, ASTM D16 and D3359.
C. SSPC - Society for Protective Coatings, SP7.

1.04 Submittals

A. Submit under provisions of Section 01 33 00, Submittal Procedures.

1. Coating Materials List: CONTRACTOR shall provide six (6) copies of a coating materials list which indicates the manufacturer and the coating number, keyed to the coating schedule herein, for approval of ENGINEER. Submittals shall be made sufficiently in advance of the coating operations to allow ample time for checking, correcting, resubmitting and rechecking.

2. Paint Manufacturer's Information: For each paint system to be used, CONTRACTOR shall submit the following listed data prior to beginning painting operations.

   a. Paint manufacturer's data sheet for each product used.

   b. Paint manufacturer's instructions and recommendations on surface preparation and application.

   c. Colors available for each product (where applicable).

   d. Compatibility of shop and field applied coatings (where applicable).

   e. Material safety data sheet for each product used.

B. Selection Samples: Submit a complete set of color chips that represent the full range of manufactures color samples available.

C. Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen. Minimum sample size shall be 6 inches (150 mm) square.

1.05 Mock-Up

A. Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish surfaces for verification of products, colors, & sheens.

2. Finish area designated by ENGINEER.

3. Provide samples that designate prime & finish coats.

4. Do not proceed with remaining work until ENGINEER approves the mock-up samples.

1.06 Delivery, Storage, and Handling

A. Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufactures name, label, and the following list of information:

1. Product name, type (description)
2. Application & use instructions
3. Surface preparation
4. VOC content: for two component products, provide mixed VOC in g/L
5. Environmental issues
6. Batch date
7. Color number

B. Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction. Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

C. Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

1.07 Quality Assurance

A. General:

1. CONTRACTOR shall give ENGINEER a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

2. All such work shall be performed only in the presence of ENGINEER, unless ENGINEER has granted prior approval to perform such work in its absence.

3. Inspection by ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve CONTRACTOR of his responsibility to perform the work in accordance with these Specifications.

4. Where protective coatings are to be performed by a subcontractor, said subcontractor must provide 5 references which show that the painting subcontractor has previous successful experience with the specified or comparable coating systems.

5. Include the name, address, and the telephone number for the owner of each installation for which the painting subcontractor provided the protective coating.

B. Scaffolding shall be erected and moved to locations where requested by ENGINEER to facilitate inspection. Additional illumination shall be provided to cover all areas to be inspected.

C. Inspection Devices:

1. CONTRACTOR shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings.

2. Dry-film thickness gages shall be made available for ENGINEER's use at all times while coating is being done, until final acceptance of such coatings.

D. Holiday Testing:

1. CONTRACTOR shall holiday test all coated ferrous surfaces inside a steel reservoir, or other surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures and surfaces coated with any of the submerged and severe service coating systems. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

a. Coatings With Thickness Exceeding 20 Mils:

(1) For surfaces having a total dry film coating thickness exceeding 20 mils a pulse-type holiday detector shall be used.

(2) The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.

b. Coatings With Thickness of 20 Mils or Less:

(1) For surfaces having a total dry film coating thickness of 20 mils or less a non-destructive type holiday detector shall be used.

(2) The unit shall operate at less than 75 volts.

(3) For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent shall be added to the water prior to wetting the detector sponge.

2. CONTRACTOR shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of ENGINEER.

E. Film Thickness Testing:

1. On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage.

2. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating.

3. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gage.

F. Surface Preparation:

1. Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.

1.08 Manufacturer Representative

A. CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the project site for technical support as specified in the paragraph entitled "Manufacturer's Certification", herein, and as may be necessary to resolve field problems attributable or associated with the manufacturer's products furnished under this Contract or the application thereof.

1.09 Maintenance

A. Warranty Inspection:

1. A warranty inspection may be conducted during the eleventh month following completion of coating and painting work. CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection.

2. Defective work shall be repaired in accordance with these specifications and to the satisfaction of OWNER.

3. OWNER may, by written notice to CONTRACTOR, reschedule the warranty inspection, or may cancel the warranty inspection altogether. If a warranty inspection is not held CONTRACTOR is not relieved of its responsibilities under the Contract Documents.

1.10 Project Conditions

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not apply coatings under environmental conditions outside manufacturer's absolute limits.

1.11 Coordination

A. Coordinate Work with other operations and installation of finish materials to avoid damage to installed materials.

B. Do not apply coating materials until moisture-producing construction activities, dust-producing construction activities, and other construction activities which could impair performance or appearance of the coatings, have been completed.

1.12 Extra Materials

A. Supply for each finish coating material, color, and finish specified two gallons (7.75L) of coating material, in sealed 1-gallon (3.875 L) containers, marked with color and finish identification.

B. Custom Colors: Provide details of color formula and product availability for each finish specified.

Part 2 Products

2.01 Acceptable Manufacturers

A. Each of the following manufacturers is capable of supplying many of the industrial coating materials specified herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required.

1. Ameron
2. Carboline Coatings Company
3. Engard Coatings Corporation
4. Glidden Coatings and Resins
5. ICI Paint Company
6. Pittsburgh Paints
7. Sherwin-Williams
8. Tnemec Company

B. Substitutions:

1. Requests for substitutions will be considered in accordance with provisions of Section 01 6000, Product Requirements. When submitting request for substitution, provide complete product data specified above under Submittals, for each substitute product. Proposed substitute materials must be shown to satisfy the material descriptions and to equal or exceed the properties of the listed materials:

2.02 Materials

A. General:

1. Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not dilute or thin coatings, except as instructed.

2. Do not add additives, except as instructed or recommended by coating manufacturer.

3. For opaque finishes, tint each coat, including primer coat and intermediate coats, one-half shade darker than succeeding coat, with final finish coat as base color.

4. Supply each coating material in quantity required for this Section from a single production run.

B. Accessories:

1. Provide as required or as identified in the coating manufacturer's application instructions. Accessories include but are not limited to thinners, sealers, primers, cleaning agents, etching agents, cleaning cloths, sanding materials, and clean-up materials.

Part 3 Execution

3.01 Examination

A. Do not begin installation until substrates have been properly prepared.

B. Ensure that surfaces to receive coatings are dry immediately prior to application.

C. Ensure that moisture-retaining substrates to receive coatings have moisture content within tolerances allowed by coating manufacturer, using moisture measurement techniques recommended by coating manufacturer.

D. Examine surfaces to receive coatings for surface imperfections and contaminants that could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.

E. Correct conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.02 Preparation

A. General:

1. Surfaces to receive protective coatings shall be cleaned as specified herein prior to application of said coatings. CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application..

   a. Remove stains and marks completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.

   b. Remove mildew, algae, and fungus using materials and methods recommended by coating manufacturer.

   c. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.

2. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.

B. Protection of Surfaces Not to be Coated:

1. Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

2. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked or otherwise protected. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

3. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces.

4. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.

C. Protection of Painted Surfaces:

1. Cleaning and coating shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly coated surfaces.

3.03 Surface Preparation

A. General:

1. Prepare surfaces in accordance with manufacturer's instructions for specified coatings and indicated materials, using only methods and materials recommended by coating manufacturer, and as follows:

B. Existing Coatings:

1. Remove surface irregularities by scraping or sanding to produce uniform substrate for coating application; apply one coat primer of type recommended by coating manufacturer for maximum coating adhesion.

2. If presence of lead in existing coatings is suspected, cease surface preparation of existing coating and notify Architect immediately.

C. Incompatible Coatings:

1. If coatings to be applied are not compatible with existing coatings CONTRACTOR shall apply intermediate coatings per the paint manufacturer's recommendation for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings:

1. Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Concrete and Concrete Masonry: Clean surfaces free of loose particles, sand, efflorescence, laitance, form oil, curing compounds, and other substances which could impair coating performance or appearance.

F. Concrete Floors: Remove contaminants which could impair coating performance or appearance, acid-etch, flush with clean water; verify alkaline-acid balance recommended by coating manufacturer; mechanically abrade surface, if required, to achieve medium-sandpaper texture.

G. Restored Masonry Surfaces: Clean surfaces free of loose particles, sand, efflorescence, laitance, cleaning compounds, and other substances that could impair coating performance or appearance.

H. Ferrous Metals, Unprimed: Remove rust or scale, if present, by wire brush cleaning, power tool cleaning, or sandblast cleaning; remove grease, oil, and other contaminants which could impair coating performance or appearance by solvent cleaning, with phosphoric-acid solution cleaning of welds, bolts and nuts; spot-prime repaired welds with specified primer.

I. Ferrous Metals, Shop-Primed: Remove loose primer and rust, if present, by scraping and sanding, feathering edges of cleaned areas to produce uniform flat surface; solvent-clean surfaces and spot-prime bare metal with specified primer, feathering edges to produce uniform flat surface.

J. Galvanized Steel (not passivated): Clean with a water-based industrial strength cleaner, followed by a clean water rinse; or wipe down surfaces using clean, lint-free cloths saturated with xylene or lacquer thinner; followed by wiping the surface dry using clean, lint-free cloths.

K. Passivated Galvanized Steel: Clean with a water-based industrial strength cleaner, and/or "Brush Blast" in accordance with SSPC-SP7. After the surface has been prepared, apply recommended primer to a small area. Allow primer to cure for 7 days, and test adhesion using the "cross-hatch adhesion tape test" method in accordance with ASTM D 3359. If the adhesion of the primer is positive, proceed with a recommended coating system for galvanized metal.

L. Mill-Finish Aluminum: Etch surfaces with a phosphoric acid-water solution, flush with clean water and allow to dry, before applying primer coat. An alternative to etching the surface is to clean using a water-based industrial cleaner.

M. Copper: Clean surfaces by pressurized steam, pressurized water, or solvent washing.

N. Stainless Steel: Clean surfaces by pressurized steam, pressurized water, or clean with a water-based industrial cleaner.

O. Wood:

1. Seal knots, pitch streaks, and sap areas with sealer:

a. For interior use Duron Terminator 3 White Pigmented Shellac (DU1710222), or equal.

b. For exterior use Duron Dura Clad 180 HR Ready-Mixed Aluminum, or equal.

2. Fill nail recesses with putty or a glazing compound.

3. Fill interior ceiling and wall cracks with spackling compound.

4. Let fillers dry, then sand surfaces smooth.

5. Fill cracks or joints in or between wood, metal, masonry, glass, ceramic, plaster and plastics with a quality acrylic or siliconized acrylic latex caulk.

6. Apply primer coat to back of wood trim and paneling.

P. Doors: Prior to finishing, apply additional primer or sealer coat to door tops and bottoms.

Q. Field-Glazed Frames and Sash: Prior to glazing, apply primer or sealer coat to glazing channels.

R. Gypsum Plaster: Cut out cracks, holes, indentations, and other surface defects to extent required for bonding adhesion; apply patching plaster or joint compound to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry; allow to cure 30 days before coating application.

S. Portland Cement Plaster: Cut out cracks, holes, indentations, and other surface defects to extent required for bonding adhesion; apply patching plaster to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry; allow to cure 30 days before coating application.

T. Gypsum Board: Repair cracks, holes, indentations, and other surface defects using joint compound to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry.

U. Insulated Coverings, Canvas or Cotton: Clean using high-pressure air and solvent of type recommended by coating manufacturer.

V. Polyvinyl Chloride (PVC) Pipe: Wipe clean and remove ink markings by wiping down with clean, lint-free cloths saturated with denatured alcohol.

3.04 Application

A. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.

B. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.

C. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).

D. Do not apply succeeding coat until ENGINEER has approved previous coat; only Architect-approved coats will be considered in determining number of coats applied.

E. Remove dust and other foreign materials from substrate immediately prior to applying each coat.

F. Where coating application abuts other materials or other coating color, terminate coating with a clean sharp termination line without coating overlap.

G. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.

H. Re-prepare and re-coat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

3.05 Mechanical and Electrical Equipment

A. HVAC Louvers and Grilles: Finish in accordance with requirements for shop-primed ferrous metal items, including dampers visible behind units, color matching adjacent surfaces unless otherwise indicated.

B. HVAC Ductwork: Finish interior surfaces visible through grilles and louvers with one coat acrylic flat wall paint, color black.

C. Convector and Baseboard Heating Cabinets: Finish in accordance with requirements for shop-primed ferrous metal items, including dampers visible behind units, color matching adjacent surfaces unless otherwise indicated; finish interior surfaces visible through grilles and louvers with one coat alkyd flat paint, color black.

D. Piping, Ductwork, and Conduit Exposed to View in Finished Spaces: Finish in accordance with requirements for unprimed ferrous metal items, color matching adjacent surfaces unless otherwise indicated.

E. Piping, Ductwork, and Conduit Exposed to View in Finished Utility, Mechanical, and Electrical Spaces:

1. Finish in accordance with requirements for unprimed ferrous metal items.
2. Provide identification markings.
3. Use color matching adjacent surfaces, unless otherwise indicated.
4. Do not allow coatings on identification tags or markings.
5. Replace identification markings when painted accidentally.

F. Access Panels, Electrical Panels, and Cover Plates: Finish in accordance with requirements for shop-primed ferrous metal items, including doors, door backs and sight-exposed cabinet surfaces, color matching adjacent surfaces unless otherwise indicated; do not allow coatings on identification plates, tags, or markings.

3.06 Curing of Coatings

A. CONTRACTOR shall provide curing conditions in accordance with the conditions is the highest requirement, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

C. Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures:

1. Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures.

2. During curing periods continuously exhaust air from a maintenance hole in the lowest shell ring, or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting.

3. After all interior coating operations have been completed provide a final curing period for a minimum of 10 days, during which the forced ventilation system shall operate continuously.

3.07 Cleaning

A. Clean excess coating materials, and coating materials deposited on surfaces not indicated to receive coatings, as construction activities of this section progress; do not allow to dry.

B. Re-install hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items that have been removed to protect from contact with coatings.

C. Reconnect equipment adjacent to surfaces indicated to receive coatings.

D. Relocate to original position equipment and fixtures that have been moved to allow application of coatings.

E. Remove protective materials.

3.08 Protection

A. Protect completed coating applications from damage by subsequent construction activities.

B. Repair to Architect's acceptance coatings damaged by subsequent construction activities. Where repairs cannot be made to Architect's acceptance, re-apply finish coating to nearest adjacent change of surface plane, in both horizontal and vertical directions.

3.09 Schedule

A. Metal Submerged, Nonpotable Water:

1. Coal Tar Epoxy Coating with total dry film thickness of 18.5 mils.

a. Surface Preparation: Near-White Blasting SSPC-SP10.

b. Field Prime Coat: Polyamide Epoxy

(1) Tnemec: Series 66-1211 HI-Epoxoline Primer
(2) Carboline: Bitumastic 300M

c. First and Second Coats: Polyamide Epoxy – Coal Tar

(1) Tnemec: Series 46-413 Hi-Build Tneme-Tar
(2) Carboline: Bitumastic 300M
(3) Sherwin-Williams: Targuard Coal Tar Epoxy B69B60/ B69V60.

B. Metal Submerged, Potable Water:

1. NSF approved high solids epoxy system, total dry film thickness of 16.0 mils

a. Surface Preparation: Near-White Blasting SSPC-SP-10

b. Field Prime Coat: Polyamide Epoxy

(1) Tnemec: Series 20-1255 Pota-Pox
(2) Carboline: Carboguard 891

c. Sherwin-Williams: Epoxide HS B62 Series

d. First and Second Coat: Polyamidoamine Epoxy

(1) Tnemec: Series 140 Pota-Pox Plus

C. Concrete Surfaces Submerged, Nonpotable Water:

1. Coal Tar Epoxy Coating, total dry film thickness of 18.5 mils

a. Surface Preparation: Near-White Blasting SSPC-SP10

b. Field Prime Coat: Polyamide Coal Tar Epoxy

(1) Tnemec: Series 46-413 Tneme-Tar
(2) Carboline: Bitumastic 300M
(3) Sherwin-Williams: Targuard Coal Tar Epoxy B69B60/ B69V60

c. First and Second Coats: Polyamide Coal Tar Epoxy

(1) Tnemec: Series 46-413 Tneme-Tar
(2) Carboline: Bitumastic 300M
(3) Sherwin-Williams: Targuard Coal Tar Epoxy B69B60/ B69V60

D. Concrete Surfaces Submerged, Potable Water:

1. NSF approved High Solids epoxy system, total dry film thickness 16.0 mils

a. Surface Preparation: Brush Off Blast SSPC-SP-13

b. Field Prime Coat: Polyamide Epoxy

(1) Tnemec: Series 20-1255 Pota-Pox
(2) Carboline: Carboguard 891
(3) Sherwin-Williams: Epoxide HS B62 Series

c. First and Second Coat: Polyamidoamine Epoxy

(1) Tnemec: Series 140 Pota-Pox Plus

E. Concrete Surfaces, Interior:

1. Surface Preparation: Clean and dry

2. First and Second Coats: Interior acrylic latex, flat finish, two coats with total dry film thickness of 6.0 mils.

F. Piping Systems, Steel, Ductile, or Cast Iron:

1. Epoxy-Polyamide Coating with total dry film thickness of 6.0 mils

a. Surface Preparation (if not shop primed): Near-White Blasting SSPC-SP10

b. First and Second Coats: Polyamide Epoxy

(1) Tnemec: Series 66 Hi-Build Epoxoline
(2) Carboline: Carboguard 890

2. Sherwin-Williams: Epolon II Multi-Mil Epoxy

G. Concrete Masonry Units (Interior):

1. Interior Polyamide Epoxy in Semi-Gloss Finish: Three coats with total dry film thickness not less than 4.0 mils.

a. Filler:

(1) Solvent-thinned block filler (FS-TT-F-1098). Apply filler coat at a rate to ensure complete coverage with pores filled.

(a) Tnemec: 54-660 Masonry Filler
(b) Sherwin-Williams: Epo-Plex Cementitious Water Based Epoxy Block Filler

b. First Coat:

(1) Shellac pigmented primer (TT-P-652) or undercoater as recommended by coating manufacturer.

c. Second and Third Coats: Polyamide Epoxy.

(1) Tnemec: Series 66 Hi-Build Epoxoline
(2) Carboline: Carboguard 888
(3) Devoe: Tru-Glaze 4508
(4) Sherwin-Williams: Tile-Clad High Solids B62Z Series/ B60VZ75

H. Concrete Masonry Units (Exterior):

1. Lusterless (Flat) Acrylic Finish: Two coats over filler coat with total dry film thickness not less than 2.5 excluding filler coat.

a. Filler Coat:

(1) High-performance latex block filler; heavy-duty latex block filler.

(a) Tnemec: Series 130

b. First and Second Finish Coats:

(1) Acrylic Emulsion (FS TT-P-19):

(a) Tnemec: Series 6
(b) Sherwin-Williams A-100 Exterior Flat Latex A6 Series

I. Ferrous Metal (Interior) (Mild Service):

1. Semi-gloss enamel finish: Two coats over primer, with total dry film thickness not less than 7.0 mils.

a. Surface Preparation: Commercial Blast Cleaning SSPC –SP6

b. Prime Coat:

(1) Rust Inhibitive primer. Prime coat is not required on items delivered shop primed.

(a) Tnemec: Series 10 Tnemec Primer
(b) Carboline: Carbocoat 150
(c) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

c. First Coat and Second Coat:

(1) Interior enamel undercoat (FS TT-E-543)

(a) Tnemec: Series 23 Enduratone
(b) Carboline: Carbocoat 139 and Carbocoat 30
(c) Sherwin-Williams: Industrial Enamel B54 Series

J.

Ferrous Metal (Interior) (Severe Service):

a. Epoxy-Polyamide Coating with total dry film thickness of 12.0 mils minimum.

b. Surface Preparation: Near-White Blasting SSPC-SP10

c. Prime Coat:

(1) Rust Inhibitive primer. Prime coat is not required on items delivered shop primed.

(a) Tnemec: Series 37H Tnemec Primer
(b) Carboline: Carbocoat 150
(c) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

d. First and Second Coats: Polyamide Epoxy

(1) Tnemec: Series 66 Hi-Build Epoxoline
(2) Carboline: Carboguard 890
(3) Sherwin-Williams: Epolon II Multi-Mil Epoxy

K. Ferrous Metal (Exterior):

1. Semi-gloss enamel finish: Two coats over primer, with total dry film thickness not less than 8.5 mils.

a. Surface Preparation: Commercial Blast Cleaning SSPC-SP6

b. Prime Coat:

(1) Rust inhibitive primer/Prime coat is not required on items delivered shop primed.

(a) Tnemec Series: Tneme Primer, Series 10
(b) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

c. First Coat and Second Coat:

(1) Interior enamel undercoat (FS TT-E-543)
(2) Tnemec: Series 23 Enduratone
(3) Sherwin-Williams: Industrial Enamel B54 Series

L. Zinc Coated Metal (Interior):

1. Semi-Gloss Finish: Two coats over primer with total dry film thickness not less than 2.5 mils.

a. Surface Preparation: Commercial Blast Cleaning SSPC-SP6

b. Prime Coat:

(1) Zinc dust - zinc oxide primer coating (FS TT-P-641)

(2) Sherwin-Williams Galvite HS Primer B50WZ30

c. Second Coat:

(1) Interior Enamel Undercoat

(2) Sherwin-Williams ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

d. Third Coat:

(1) Odorless interior alkyd semi-gloss enamel
(2) Sherwin-Williams ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

M. Zinc Coated Metal (Exterior):

1. High Gloss Alkyd Enamel: Two finish coats over primer.

a. Prime Coat:

(1) Zinc Dust-Zinc Oxide Primer
(2) Sherwin-Williams Galvite HS Primer B50WZ30

b. First and Second Finish Coats:

(1) High Gloss Alkyd Enamel
(2) Sherwin-Williams: Industrial Enamel B54 Series.

N. Painted Wood and Hardboard (Interior) (Living space exposure):

1. One or two finish coats over primer, total dry film thickness 4.5 mils minimum

a. First Coat:

(1) Interior Enamel Undercoat
(2) Tnemec: Series 36 Undercoater
(3) Sherwin-Williams: PrepRite Wall & Wood Primer B49 Series.

b. Second and Third Coats:

(1) Odorless interior semi-gloss enamel (FS TT-E-509)
(2) Tnemec: Series 23 Enduratone
(3) Sherwin-Williams: ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

O. Painted Wood and Hardboard (Interior) (Chemical and Moisture Exposure):

1. One or two finish coats over primer, total dry film thickness 8.0 mils minimum

a. First Coat:

(1) First Coat (Alkyd primer/undercoater):
(2) Tnemec: Series 36 Undercoater
(3) Sherwin-Williams: Kem Kromik Universal Primer B54 Series

b. Second and Third Coats (Waterborne Acrylic Epoxy – Semi gloss/satin):

(1) Tnemec: Series 113 or 114 H.B. Tneme-Tufcoat
(2) Sherwin-Williams: Epo-Plex Multi-Mil

P. Wood Trim (Exterior):

1. High Gloss Alkyd Enamel: Two finish coats over primer. Not less than 7.5 mil dry film thickness.

a. First Coat (Alkyd primer/undercoater):

(1) Tnemec: Series 36 Undercoater
(2) Sherwin-Williams PrepRite Wall & Wood Primer B49 Series

b. Second and Third Coats (Alkyd Enamel):

(1) Tnemec: Series 2H Tneme-Gloss
(2) Sherwin-Williams Industrial Enamel B54 Series

Q. Stained Wood:

1. First Coat:

a. Semi-Transparent oil stain
b. Sherwin-Williams Wood Classics Interior Oil Stain

2. Second and Third Coats:

a. Polyurethane, lightly sanded between coats with steel wool.
b. Sherwin-Williams Wood Classics Polyurethane Varnish A67 Series.

R. Gypsum Wallboard:

1. Two coats over primer/sealer, not less than 7.5 mils dry film thickness

a. First Coat:

(1) Waterborne Vinyl Acrylic primer sealer
(2) Tnemec: Series 51-792 PVA Sealer

b. Second and Third Coats:

(1) Oderless interior semi-gloss enamel, Alkyd enamel (TT-E-509)
(2) Tnemec: Series 23 Enduratone
(3) Sherwin-Williams ProMar 200 Alkyd Semi-Gloss Enamel B34 Series

End of Section

Division 22
Plumbing

Section 22 1000
Plumbing Piping Materials and Methods

Part 1 General

1.01 Scope of Work

A. Section includes piping materials and installation methods including, but not limited to pipe, fitting and joining materials, piping specialties, and basic piping installation instructions.

1.02 Submittals

A. Shop Drawings and Product Data:

1. Shop Drawings: Submit in accordance with Sections 01 3300, Submittal Procedures, and 22 0500, Basic Plumbing/HVAC General Requirements, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

2. Submit product data on the following items:

a. Escutcheons.
b. Dielectric unions and fittings.
c. Mechanical sleeve seals.

B. Quality Control Submittals: Submit welders' certificates specified in Quality Assurance Article below.

1.03 Quality Assurance

A. Welder's Qualifications: Welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI Standard B31.1.0, Standard Code for Pressure Piping, Power Piping, and The American Welding Society, Welding Handbook. Soldering and Brazing procedures shall conform to ANSI B9.1, Standard Safety Code for Mechanical Refrigeration.

1.04 Delivery, Storage, and Handling

A. Provide factory applied plastic end-caps on each length of pipe and tube except for concrete, corrugated metal, hub and spigot, and clay pipe.

B. Maintain end-caps through shipping, storage, and handling to prevent pipe end damage and prevent entrance of dirt, debris, and moisture.

C. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

D. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

E. Store pipe in a manner to prevent sagging and bending.

Part 2 Products

2.01 Manufacturers

A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

1. Pipe Escutcheons:

   a. Chicago Specialty Mfg. Co.
   b. Grinnell.
   c. Sanitary-Dash Mfg. Co.

2. Dielectric Waterway Fittings:

   a. Epco Sales, Inc.
   b. Victaulic Company of America.

3. Dielectric Unions:

   a. Eclipse, Inc.
   b. Perfection Corp.
   c. Watts Regulator Co.

4. Mechanical Sleeve Seals:

   a. Thunderline Corp.

5. High-Impact Thermoplastic Wall Sleeve:

   a. Thunderline.

6. Silicone Rubber Adhesive:

   a. General Electric.

7. High-Density Polyethylene Pipe (64.2):

   a. Driscopipe 8000.
   b. Nipak.
   c. Dupont.

8. High-Density Polyethylene Pipe (64.7):

   a. Driscopipe 8600.
   b. Nipak.
   c. Dupont.

2.02 Pipe Materials

A. Refer to the individual piping system specifications in Sections 22 1113 for specifications on piping materials required from those listed below.

1. Steel Pipe (61.1):

a. Normal Service Pressure: Up to 150 psig
b. Temperature: Up to 366 degrees Fahrenheit

Type	Size	Specifications
Pipe	1/4-inch through 4-inch	Carbon steel pipe, Schedule 40, ASTM A 120 seamless or electric welded. Note: Standard weight and Schedule 40 are the same in all sizes through 10 inches; in larger sizes, the wall thickness differs.
Type of Joints	1/4-inch through 2-inch	Screwed.
	2-1/2-inch and larger	Welded.
Fittings	1/4-inch through 2-inch	Black malleable iron, 150-pound class, screwed. ANSI standard B16.3.
Nipples	1/4-inch through 2-inch	Carbon steel, extra strong, ASTM A 120 or A 53.
Unions	1/4-inch through 2-inch	Malleable iron, 250-pound class (500 WOG), rail-road type with brass seats.
Thread Sealant		Pipe dope. John Crane Insoluble Plastic Lead Seal No. 2 or approved equal. Exception: For temperatures in excess of 250 degrees F, use Teflon ribbon, 1/2-inch wide.

2. Cast Iron (62.2):

a. Normal Service Pressure: Approximately 5 psig
b. Temperature: Up to 180 degrees Fahrenheit

Type	Size	Specifications
Pipe	2-inch through 15-inch	Cast iron soil pipe, plain end, service weight (SV), bituminous coating inside and outside. Cast Iron Soil Pipe Institute Std. 301.
Type of Joints	2-inch through 15-inch	No-hub coupling.
Fittings	2-inch through 15-inch	Cast iron soil pipe, no-hub type, service weight (SV), bituminous coating inside and outside. Cast Iron Soil Pipe Institute Std. 301.

3. Copper Tubing (63.1):

a. Normal Service Pressure: Up to 150 psig
b. Temperature: Up to 250 degrees Fahrenheit
c. Use solder fittings at all joints between terminal points.
d. Bends may be used for 1/4-inch and 3/8-inch tubing.

(1) Bends shall be made with a bending tool to the following minimum radii:
(a) 1/4-inch: 9/16-inch minimum radius
(b) 3/8-inch: 15/16-inch minimum radius

Type	Size	Specifications
Pipe	All sizes	Copper tubing, type L, hard-drawn above ground. Type K (soft) for below grade.
Type Of Joints	1/4-, 3/8-, 1/2-inch	Soldered or compression type as required. (See 2.02.3.c).
	5/8-inch and larger	Soldered (Exposed.) Flared (Buried.)
Soldered Fittings	All sizes	Wrought copper or cast bronze, solder-joint fittings. ANSI Standard B16.22.
Compression	1/4-, 3/8-, 1/2-inch	Brass compression type fittings.
Fittings (Exposed)		Gyrolok, Swagelok, Parker CPI.
Unions	1/4-inch through 2-inch	Wrought copper or cast bronze; solder joint union.
Flanges	All sizes	Copper, solder-joint flange. 150-pound ASME drilling. Raised or flat face to match equipment.
Gaskets		1/16-inch Teflon; ring type for raised-face, or full-face for flat face flange.
Solder		Tin/Antimony (or lead-free to meet Code requirements).
Thread Sealant (Where Necessary)		Teflon tape.

4. High Density Polyethylene Pipe (64.2) for Gas Distribution:

   a. Normal Service Pressure: 80 psig
   b. Temperature: Up to 140 degrees Fahrenheit

Type	Size	Specifications
Pipe	3/4-inch and larger	High-density polyethylene, SDR-11, ASTM D 2513, PE 3408.
Type Of Joints	3/4-inch and larger	Fusion welded, ASTM D 2513 or socket.
Fittings	3/4-inch and larger	High-density polyethylene, SDR-11, socket fusion type, with diameters compatible with pipe for fusion joining.
Gaskets	3/4-inch and larger	1/16-inch solid neoprene, full-face type.
Flanges (When Required)	3/4-inch and larger	PVC, 150-pound, flat-face, Schedule 80, socket type.

5. PVC DWV Pipe (64.6):

   a. Normal Service Pressure: 5 psig (maximum)
   b. Temperature: Up to 150 degrees Fahrenheit

Type	Size	Specifications
Pipe	1-inch through 8-inch	PVC, Schedule 40, ASTM D 2665.
Type Of Joints	1-inch through 8-inch	Solvent welded.
Fittings	1-inch through 8-inch	PVC, Schedule 40, socket type, ASTM D 2949.

6. High-Density Polyethylene Pipe (64.7) for Sump Discharge:

   a. Normal Service Pressure: 80 psig (maximum)
   b. Temperature: Up to 140 degrees Fahrenheit

Type	Size	Specifications
Pipe	3/4-inch and larger	High-density polyethylene, SDR-11, ASTM D 3350, PE 3408.
Type Of Joints	3/4-inch and larger	Fusion welded, ASTM D 3261 or socket. ASTM D 2683.
Fittings	3/4-inch and larger	High-density polyethylene, SDR-11, socket fusion type, with diameters compatible with pipe for fusion joining.
Gaskets	3/4-inch and larger	1/16-inch solid hypalon, full-face type.
Flanges (When Required)	3/4-inch and larger	PVC, 150-pound, flat-face, Schedule 80, socket type.

2.03 Joining Materials

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed, and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 Piping Specialties

A. Escutcheons: Chrome plated, stamped steel, hinged, split-ring escutcheon with setscrew. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions: Malleable iron, Class 150 for low-pressure service and Class 250 for high-pressure service; hexagonal stock with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion. Insulated and gasketed, galvanized, malleable iron unions as manufactured by Crane No. 1259, ITT-Grinnell, Figure 470, or equal.

D. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

E. Sleeves: Unless otherwise shown on Drawings, at all points where pipes must pass through walls, floors or roofs of structures, CONTRACTOR shall furnish and install suitable sleeves or wall castings.

1. In general, the wall sleeve or casting shall be of the same material as the pipe, or standard weight steel pipe thimbles of at least 1 size larger than the pipe itself shall be installed. Iron pipe wall castings, wall pipe, transition sleeves and solid sleeves shall meet the requirements or AWWA Specifications C100 and shall be of the lightest class conforming to the pressure rating of the pipelines which they connect, but in no case shall be lighter than Class B. Sleeves shall be shop coated with universal primer 2 mils minimum thickness.

2. A high-impact thermoplastic wall sleeve as manufactured by Thunderline may be used for low and standard temperature service.

F. Sleeve Seals:

1. Unless otherwise shown or permitted, the space between the pipe and the sleeve shall be caulked at the inside and outside wall faces on walls exposed to earth or water/sewage, at one face of the other walls, and at the top surface of floors and slabs. The space shall be caulked with lead and oakum as specified under Bell and Spigot Lead with an RTV-silicone rubber adhesive as manufactured by General Electric or sealed with a rubber link seal. Rubber link seal shall be identical rubber links interconnected with bolts and elongated nuts and washers.

2. Sealing element shall be made of synthetic rubber material especially compounded to resist aging, ozone, sunlight, and chemical action.

3. Bolts and metal parts shall be made of galvanized or cadmium-plated steel to resist corrosion. Rubber link seal joints shall be submitted to ENGINEER for approval.

Part 3 Execution

3.01 Preparation

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 Installation

A. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for submittals.

B. Piping shall be exposed unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on Drawings.

E. Install piping far enough from slabs, beams, joists, columns, walls, and other permanent elements of the building to permit access for painting. Provide space to permit insulation applications, with 3-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals.

3.03 Fittings and Specialties

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

C. Install unions adjacent to each valve, and at the final connection to each piece of equipment and plumbing fixture having 2-inch and smaller connections, and elsewhere as indicated.

D. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).

E. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.04 Joints

A. Steel Pipe Joints:

1. Pipe 2-inch and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1.

    a. Cut threads full and clean using sharp dies.

b. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.

2. Pipe Larger than 2-inch:

a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.

b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.

c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Nonferrous Pipe Joints:

1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0, Standard Code for Pressure Piping, Power Piping, and ANSI B9.1, Standard Safety Code for Mechanical Refrigeration.

2. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4-inch and smaller.

C. Joints for other piping materials are specified within the respective piping system sections.

3.05 Field Quality Control

A. Testing: Refer to individual piping system Specification Sections.

End of Section

Section 22 1429
Sump Pumps

Part 1 General

1.01 Scope of Work

A. This section includes submersible sump pump and related appurtenances.

1.02 Submittals

A. Shop Drawings and Product Data:

1. Shop Drawings: Submit in accordance with requirements of Section 01 3300, Submittal Procedures, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

a. Shop Drawings showing layout and connections for pumps. Include setting Drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.

b. Product data including certified performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.

c. CONTRACTOR shall submit to ENGINEER for approval performance curves on each pump. These curves shall include capacity, head, required NPSH efficiency and horsepower required for operation as shown on Pump Schedule and on Drawings.

d. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.

B. Operation and Maintenance Manuals: Submit in accordance with requirements of Section 01 7700, Closeout Procedures, operation and maintenance manuals for items included under this Section.

1.03 Reference Standards

A. Hydraulic Institute Compliance: Design, manufacture, and install pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70, "National Electrical Code."

C. UL Compliance: Pumps shall be listed and labeled by UL and comply with UL Standard 778, "Motor Operated Water Pumps."

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. SSPMA Compliance: Test and rate sump and sewage pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.

1.04 Delivery, Storage, and Handling

A. Apply factory finish paint to assembled, tested units prior to shipping.

B. Preparation for Shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anti-corrosion compound. Protect flanges, pipe openings, and nozzles.

1. Store pumps in a dry location.

2. Retain shipping flange protective covers and protective coatings during storage.

3. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

4. For extended storage times (greater than 30 days), dry internal parts with hot air or a vacuum-producing device. After drying, coat internal parts with light oil, kerosene, or antifreeze. Dismantle bearings and couplings, dry and coat with an acid- free, heavy oil, and tag and store in dry location.

C. Comply with manufacturer's rigging instructions for handling, if required.

Part 2 Products

2.01 Manufacturers

A. Pump shall be a submersible model as manufacturered by:

1. ABS Model EJ 04W-2
2. ENGINEER-approved equal.

2.02 Submersible Sump Pump

A. Pump shall be a heavy-duty submersible model.

B. Casing: Cast iron.

C. Impeller: PTB Vortex impeller capable of passing 2-inch solids.

D. Seal: Ceramic-faced mechanical seal.

E. Shaft: Shaft shall be stainless steel.

F. Motor: Motors shall be hermetically sealed.

G. Controls: Fully automatic, equipped with a piggyback float switch.

H. Pump Discharge Piping: 2-inch discharge. CONTRACTOR shall provide discharge check and gate valve meeting the appropriate specifications.

I. Basin: Provide a 30-inch diameter by 36-inch deep fiberglass basin with a 30-inch aluminum cover bolted to the basin top, unless specified otherwise in the Contract Drawings. Cover shall include manhole, vent, discharge connections, and openings for power connection.

Part 3 Execution

3.01 Examination

A. The following requirements apply only to pumps furnished under this Section. Pumps furnished under other Sections may have different requirements.

1. Examine areas, equipment foundations, and conditions for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

2. Examine rough-in for piping systems to verify actual locations of piping connections prior to installation.

3.02 Installation

A. Comply with manufacturer's written installation and alignment instructions.

B. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

D. Electrical wiring and connections are specified in Division 26.

End of Section

Division 26
Electrical

Section 26 0500
Electrical General Requirements

Part 1 General

1.01 Scope of Work

A. The specifications of Division 26 and the accompanying drawings contemplate the furnishing and installation of materials, equipment, supplies, testing, adjustments, labor, and supervision required for the complete performance of operations relating to the electrical and instrumentation.

B. CONTRACTOR shall be held responsible for the complete and satisfactory accomplishment of Work inclusive of whatever miscellaneous material and/or appurtenances are required to perfect the installation and demonstrate that electrical systems will operate satisfactorily under normal operating conditions.

C. CONTRACTOR shall be responsible for all electrical connections to equipment. Electrical connections in addition to making wire connections shall include, but not be limited to, furnishing, installing, and testing circuit protection devices, motor overload devices, conduits, and fittings needed to ensure a complete and operable electrical installation.

1.02 Related Work Specified Elsewhere

A. Section 03 3000: Cast-in-Place Concrete
B. Section 26 0510: Basic Materials and Methods

1.03 Responsibility

A. It shall be the responsibility of CONTRACTOR to furnish a complete and fully operating system. CONTRACTOR shall be responsible for all details which may be necessary to properly install, adjust, and place in operation the complete installation. CONTRACTOR shall assume full responsibility for additional costs which may result from unauthorized deviations from the Plans and Specifications.

1.04 Apportionment of the Work

A. CONTRACTOR shall classify and apportion materials and performance of labor to the several trades involved in accordance with all local customs, rules, regulations, jurisdiction awards, decisions, etc., insofar as they may apply and as required to efficiently execute the Work involved in this Contract.

1.05 Cooperation of the Contractor

A. CONTRACTOR shall coordinate the work of Subcontractors of each trade to avoid interference in the Work and to avoid delays in the construction. He shall coordinate the Work of all Subcontractors to obtain a first-class workmanlike system.

B. Where interference occurs as a result of poor cooperation between Subcontractors and the coordination on the part of CONTRACTOR, OWNER reserves the right to change the Work in hand to resolve the interferences and such changes will not be considered as extras.

1.06 Damage to Other Work

A. CONTRACTOR will be held responsible for damage done by his workmen. Patching and repairing of damaged Work shall be done by CONTRACTOR.

1.07 Maintenance Prior to Final Acceptance

A. CONTRACTOR shall be responsible for the maintenance of equipment and systems installed until final acceptance by OWNER and shall take such measures as necessary to ensure adequate protection of equipment and materials during delivery, storage, installation, start up, temporary operation, and shut down.

1.08 Accessibility

A. Equipment shall be installed so as to be readily accessible for operation, maintenance, and repair, subject to the approval of ENGINEER.

1.09 Cutting and Patching

A. CONTRACTOR shall perform all cutting and patching that may be necessary for the installation of the Work.

B. Major wall penetrations shall not be made without the written consent of ENGINEER unless they are called for on the construction drawings.

C. Structural steel shall not be cut, welded, or altered in any way without the written consent of ENGINEER.

1.10 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - The American National Standards Institute
2. ASA - Acoustical Society of America
3. ASTM - The American Society for Testing Materials
4. ETL - Electrical Testing Laboratories
5. IEEE - The Institute of Electrical and Electronic Engineers
6. ICEA - The Insulated Cable Engineers Association
7. ISA - The Instrument Society of America
8. ITL - Independent Testing Laboratories
9. JIC - Joint Industrial Conference
10. NACE - National Association of Corrosion Engineers
11. NEC - The National Electric Code
12. NEMA - The National Electrical Manufacturers Association
13. NESC - The National Electrical Safety Code
14. NFPI - The National Fire Protection Institute
15. OSHA - Federal Occupational Safety and Health Act
16. UL - Underwriters Laboratories, Inc.
17. FM - Factory Mutual Insurance Underwriters

1.11 Quality Assurance

A. Erector Qualifications:

1. Work shall be performed in accordance with latest accepted standards and practices for the trades involved. Workmanship shall be subject to the approval of ENGINEER at all times.

2. Only experienced craftsmen will be allowed to perform the items of Work as required within this Project.

B. Requirements of Regulatory Agencies:

1. Materials and equipment required for the Work and their installation shall conform to national, state, county, and local codes, rules, regulations, and ordinances. Each contractor shall secure all permits, inspections, and tests required in connection with his Work.

2. Changes in the drawings and/or Specifications required to conform to the above codes, laws, rules, and/or regulations shall be taken up with ENGINEER by CONTRACTOR before submitting his Proposal. After entering into the Contract, CONTRACTOR shall be held responsible to make all changes required to conform to the above ordinances, laws, rules, and/or regulations without extra expense to OWNER, except in the instance of ordinances, laws, rules, and/or regulations which are revised or enacted subsequent to the time of signing the Contract.

1.12 Submittals

A. Schedule:

1. CONTRACTOR shall submit a schedule in accordance with Section 01 3300, Submittal Procedures, for review to ENGINEER outlining the steps to be taken to maintain electrical service and showing the coordination effort which will be taken to coordinate the work between the various trades.

B. Samples:

1. When directed by ENGINEER or required by the Specifications, CONTRACTOR shall submit samples of materials and accessory equipment such as lighting fixtures, switches, receptacles, etc.

2. CONTRACTOR shall not use these materials in the Work until ENGINEER has had ample time to determine the products suitability and compliance with the Specifications. In general, two weeks shall be considered ample time to approve or reject the submitted sample.

C. Shop Drawings and Product Data:

1. Submit shop drawings and product data as required in Section 01 3300, Submittal Procedures.

2. CONTRACTOR shall submit the following types of information for approval by ENGINEER before any equipment is installed:

a. Catalog Cuts and/or Product Data Sheets:

(1) Catalog cuts shall be provided for standard manufactured items such as conduit and conduit fittings, electric heaters, lighting fixtures, lighting panels, instruments, motors, switches, transformers, wire, etc.

(2) Each sheet shall identify the exact equipment for which it is intended.

(3) All pertinent information such as physical dimensions, current rating, horsepower, kilowatt rating, phase, power factor, voltage, NEMA classifications, and material type shall be indicated.

(4) Also shown shall be approved listings such as UL label or other testing agencies.

b. Vendors Standard Drawings:

(1) 24" x 36" drawings are preferred, however, where a manufacturer's standard equipment is being used, his "full size" standard drawings may be submitted for approval provided the following information is included on the drawings:

(a) Identity of equipment for which drawing is intended.

(b) Optional features to be used for this Project identified.

(c) Field connections clearly identified complete with necessary terminal and wire numbers.

(d) Sequence of operation shall be written on the drawing unless the control diagram is easily understood without a sequence of operation.

c. Process Control Drawings:

(1) CONTRACTOR shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

(2) Drawings shall be on 24" x 36", reproducible media, with border, title block, symbols, etc., as used on the Contract drawings and approved by ENGINEER.

(3) Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc.

(4) Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.

D. Test Reports:

1. When directed, CONTRACTOR shall submit the manufacturer's test reports on any equipment proposed for this Project.

2. CONTRACTOR will maintain a complete set of test records covering all tests required by this Specification. The records will include the date, equipment or system tested, testing conditions, test results, and CONTRACTOR verification. Records will be available for review during construction and will be submitted to the ENGINEER upon completion of the Project.

E. Certificates:

1. CONTRACTOR, upon completion of his portion of the Project, shall secure and present to ENGINEER a certificate of inspection and approval from the department having jurisdiction over his work, if such be issued. CONTRACTOR shall pay all fees in connection with the above requirements.

F. Operation and Maintenance Data:

1. Provide maintenance manuals as required in 01 3300, Submittal Procedures, for the main switchgear, motor control centers and reduced voltage starters, and the main control/instrumentation panels.

G. Record Drawings:

1. It shall be the responsibility of CONTRACTOR to provide all drawings pertaining to his Work. Drawings including both manufacturer's drawings and engineer design drawings shall be reproducible media electronic record drawings will be acceptable when approved by ENGINEER.

2. The drawing set shall include:

a. A site plan and floor plans of each elevation showing the location of all equipment, lighting fixtures, embedded conduit, grounding, conduit size, conduit routing, wire size, etc.

b. Schematic ladder diagrams for each piece of equipment and system using JIC format.

c. Wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

3. CONTRACTOR shall accurately maintain the set of drawings and submit prints at various stages of the Work, upon request of ENGINEER. Final revised record drawings shall be turned over to ENGINEER upon completion or termination of CONTRACTOR's responsibility to this Contract.

1.13 Delivery, Storage, and Handling

A. Storage:

1. Electrical equipment and materials shall be stored in a location and manner to protect against damage.

B. Delivery and Handling:

1. Materials and equipment shall be delivered, unloaded, and handled in a manner to protect against damage. CONTRACTOR shall repair or replace all damaged or defective material at ENGINEER's option and at no cost to OWNER or ENGINEER.

1.14 Job Conditions

A. Existing Conditions:

1. CONTRACTOR shall be responsible for determining the existing conditions at the time the electrical work begins and arrange for surveys, trenching, concrete work, conduit sleeves, and any other work necessary to perform the electrical installation.

B. Environmental Requirements:

1. CONTRACTOR shall exercise caution during installation and afterward to assure all equipment is protected from adverse environmental conditions such as temperature, wind velocity, humidity, rain, ice, etc.

C. Protection of Work and Property:

1. Materials and equipment both before and after erection shall be properly protected and kept in a clean condition.

2. Conduit ends and parts of equipment left unconnected shall be capped, plugged or properly covered to prevent the intrusion of foreign matter.

3. The use of tarpaulins or plastic sheets for temporary enclosures, protection of materials, etc., will not be permitted in areas where burning and/or welding operations are going on or in any location where there may be the slightest hazard of their use contributing to a fire.

4. Equipment which has been installed and later becomes damaged shall be replaced or repaired at ENGINEER's option at CONTRACTOR's expense.

D. Sequencing:

1. CONTRACTOR shall so schedule his Work to assure that he does not delay the work of any other trades. He shall also supply sleeves, supports, anchors, hangers, and other items that are to be included in the work of other trades and provide information for positioning.

Part 2 Products

2.01 Materials

A. Material and equipment furnished and installed by CONTRACTOR for the permanent Work shall be new, unused, of the best quality of make specified, shall be free from defects of any character, and shall be listed as approved by the UL and/or FM.

B. Equipment with aluminum buses, aluminum conduits, fittings, supports and conductors are not acceptable.

C. Outdoor electrical equipment shall be weatherproof, NEMA 4X (stainless steel), unless otherwise indicated.

D. Unless otherwise specified in other Division 26 sections, the sheet metal surfaces of equipment enclosures shall be coated with a rust resisting primer.

E. Over the primer, a corrosion resistant baked enamel finish shall be applied. The color shall be ASA No. 49, medium light gray.

Part 3 Execution

3.01 General

A. CONTRACTOR shall install electrical work in accordance with the codes and standards specified, except where more stringent requirements are indicated or specified, verify that materials and equipment properly fit the installation space with clearances conforming to the codes and standards specified except where greater clearance is indicated.

B. CONTRACTOR shall perform work as required to correct improper installations, at no additional cost to OWNER.

3.02 Electrical Supervision

A. In addition to supervision required under the General Conditions, CONTRACTOR shall assign a competent representative to supervise the electrical construction work from beginning to completion and final acceptance.

3.03 Inspection

A. CONTRACTOR shall inspect each item of material and equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of electrical work.

3.04 Preparation

A. Prior to installing electrical work, CONTRACTOR shall ensure that installation areas are clean, shall maintain the areas in a broom-clean condition during installation operations, shall clean, condition, and service equipment in accordance with the manufacturer's instructions, approved submittals, and other requirements indicated or specified.

3.05 Workmanship

A. CONTRACTOR shall employ skilled craftsmen experienced in installation of the types of electrical materials and equipment specified. CONTRACTOR shall use specialized installation tools and equipment as applicable and produce installations free of defects.

3.06 Field Quality Control

A. Equipment Start-Up:

1. After completion of the installation, all systems and equipment shall be tested by CONTRACTOR in the presence of ENGINEER under actual operating conditions. Tests shall be performed according to manufacturer's recommendations.

2. CONTRACTOR shall include with his bid the services of all required Equipment Manufacturer's field service technicians for a period necessary to complete the work to the satisfaction of ENGINEER and OWNER.

3. This service shall be for the purposes of check-out, initial start-up, certification, and instruction of plant personnel.

4. A written report covering the technician's findings and installation approval shall be submitted to ENGINEER covering all inspections and outlining in detail any deficiencies noted.

5. Specific requirements, if any, for a particular system or piece of equipment are contained in the particular specification sections. CONTRACTOR's responsibility relative to coordinating these services is contained in Section 01 7700, Closeout Procedures.

B. Manufacturer's Supervision and Field Installation Check:

1. Where specified, electrical equipment manufacturer shall furnish the services of an authorized representative especially trained and experienced in the installation of his equipment to:

a. Supervise the equipment installation in accordance with the approved submittals and manufacturer's instructions;

b. Be present when the equipment is first put into operation;

c. Inspect, check, adjust as necessary, and approve the installation;

d. Repeat the inspection, checking, and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable; and,

e. Prepare and submit the specified manufacturers' certified report. Include all costs for representative’s services in the contract price.

C. Final Operation Tests:

1. CONTRACTOR shall test electrical systems for not less than 168 hours, with no interruptions except for normal maintenance or corrective work. Conform to the approved test plan. Coordinate with final operation test required under Section 40 0500, Process Equipment General Requirements.

a. Testing Materials:

(1) CONTRACTOR shall furnish labor, instruments, recorders, gages, materials, and power for tests as required.

Testing Methods:

(2) CONTRACTOR shall operate systems continuously 24 hours a day under constant inspection of trained operators.

(3) Cause variable speed equipment to cycle through the applicable speed range at a steady rate or change. Induce simulated alarm and distressed operating conditions, and test controls and protective devices for correct operation.

End of Section

Section 26 0510
Basic Electrical Materials and Methods

Part 1 General

1.01 Scope of Work

A. Requirements specified in Section 26 0500, Electrical General Requirements, are part of this Section. This section forms a part of all other sections of Division 26, unless otherwise indicated.

1.02 Related Work Specified Elsewhere

A. Section 03 3000: Cast-in-Place Concrete
B. Section 26 0500: Electrical General Requirements

1.03 Submittals

A. CONTRACTOR shall submit for ENGINEER's, approval material lists, shop drawings, and factory test reports, to the extent required in this section and Section 26 0500, Electrical General Requirements.

Part 2 Products

2.01 Basic Equipment and Materials

A. Disconnect Switches:

1. Provide heavy-duty rated disconnect switches of the types and ratings, as indicated on the Plans. Disconnect switches for use on 120 VAC systems shall be rated for 240 VAC. All disconnect switches shall be NEMA 4X stainless steel and provided with a pad-lockable operating handle.

2. Disconnect switches shall be manufactured by Square D Co., Allen Bradley, or Eaton.

B. Lighting Panels:

1. Lighting panels shall be of code gauge steel, of the dead front safety type with single or multi pole circuit breaker branches of the number and size as indicated on the drawings. Lighting panels shall be NEMA 4X stainless steel. Main bus shall be copper. Each panel shall have a main circuit breaker as indicated on the drawing and have a 10,000 RMS symmetrical interrupting capacity for 240/120 volt panels. Lighting panels shall be square D "NQOB", G.E. NLAB, or Eaton.

C. Wire Size and Insulation (Low Voltage):

1. Wire for branch circuits, including power and lighting shall consist of No. 12 minimum size copper conductors, type THHN, THW, XHHW or THWN, insulated with Underwriters' approved 600-volt insulation, and in accordance with the following:

2. Rubber and rubber-like insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-19-81 (latest edition), NEMA Publication No. WC3.

3. Thermoplastic insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-61-402 (latest edition), NEMA Publication WC5.

4. Cross-linked polyethylene insulated wire and cable shall be manufactured and tested in accordance with ICEA Publication No. S-66-524 (latest edition), NEMA Publication No. WC7.

5. Indoor lighting branch circuits and 120 volt receptacle circuits shall be single conductor solid copper, 600 volt insulation, Type "THW", "THWN", or "XHHW" moisture and heat resistant thermoplastic approved by N.E.C. for operating temperature of 75°C and for installation in wet or dry locations.

6. Type "XHHW" heat resistant wire shall be used for wiring of recessed fixtures, and between fixtures and their adjacent outlets.

7. For 480 volt standard service, single conductor stranded copper cable shall have corona, ozone, heat and moisture resistant cross-linked polyethylene 600 volt insulation, or approved equal, rated to withstand a copper temperature of 90°C. without deterioration. It shall meet applicable ICEA Standards, and be UL labeled XHHW.

8. Wire and cable, including feeders, main and branch circuits, shall be color coded as follows:

208 / 120 Volt		480 / 277 Volt	
Color	**Phase**	**Color**	**Phase**
Black	A	Brown	A
Red	B	Orange	B
Blue	C	Yellow	C
White	Neutral	Gray	Neutral
Green	Ground	Green	Ground

9. Conductors No. 8 and smaller shall have color coded insulation, Conductors No. 6 and larger shall have terminations and conductors in pull boxes taped with colored tape, not less than two inches wide.

10. Wire and cable shall be continuous in the same color code and type to its extreme termination point. The use of different type of insulated wire to the same device or equipment will not be accepted. Manufacturers shall be Anaconda, General Cable, General Electric, Okonite, Triangle, or equal.

D. Control Wiring:

1. Control circuit, single conductor field wire shall be No. 14 AWG, stranded copper with 30-mil thick wall of cross-linked polyethylene or polyvinyl chloride insulation rated to withstand a copper temperature of 90° C. at 600 volts without deterioration. It shall meet applicable ICEA Standards.

2. Multi-conductor control cable shall consist of individual conductors, No. 14 AWG, stranded copper with 30-mil thick wall of insulation rated to withstand a copper temperature of 75° without deterioration. The insulation shall be a 20-mil wall of polyethylene with a 10-mil thick polyvinyl chloride jacket. The individual conductors shall be identified per Paragraph 5.6.3. of ICEA Publication No. S-61402 and shall be cabled together with suitable fillers and binder tape to give the completed cable a substantially circular cross section.

3. An overall sheath of black polyvinyl chloride shall be applied to the cable and shall not be less than the following thickness:

No. of Conductors	Jacket Thickness
2 – 5	0.045”
6 – 14	0.060”
15 and above	0.080”

4. The entire cable shall meet applicable ICEA Standards and tests for thermoplastic insulated cables.

5. Control wires to be identified with vinyl wire markers.

E. Panel Wiring:

1. Panel wiring shall be a minimum 14 AWG-MTW, 60° rated for AC connections.

2. Thermoplastic wire cover shall be rated at 600 volts and be colored red for AC wires; light blue shall be used for DC wires; canary yellow shall be used for wires interconnecting with other control panels or systems which may be energized from alternate power source; green shall be used on all ground wire connections; black wire shall be used for power source and white shall be used for power neutral.

3. Instrument shields shall be connected to a common ground termination in the control panel. Shields shall not be grounded in the field.

4. No splices of either control or instrument wiring shall be permitted outside of termination points.

5. Wires comprising the various control systems for this installation shall be identified at each termination with wire identification tags.

6. Numbered tags shall be of the type manufactured of laminated mylar and be capable of withstanding temperatures to 300°F. without deterioration and discoloration.

7. Each wire number shall be "solid" preprinted and not pieced from single and/or double-digit tags.

F. Shielded Single Pair Cable:

1. For general shielded service, single-pair cables shall consist of two conductors, twisted together, served with a continuous aluminum mylar shield with grounding bleed wire and protected with an insulating jacket.

2. Individual conductors shall consist of a tinned, soft annealed copper conductor, stranded, insulated with a 24-mil thick wall of polyethylene. The twisted pair shall be color coded and sized as follows:

   a. Runs under 400 feet - No. 16 AWG
   b. Over 400 feet - No. 14 AWG

G. Multiple Conductor Shielded Cable:

1. This cable construction shall be an assembly of twisted pairs cabled together and served with an overall aluminum mylar shield with grounding bleed wire, with an extruded jacket of polyvinyl chloride having a thickness as follows:

Cable Size	Jacket
3 and 7 pair	60 mils

2. Portable cords shall consist of flexible, bunch stranded, plain annealed copper conductors with a 600-volt heat and moisture resistant rubber insulation suitable for operation with a 60 degrees Celsius copper temperature. Individual conductors shall be color coded for identification and cabled with suitable high strength fillers to give the completed cable a circular cross section.

H. Conduits and Fittings:

1. Conduits shall be manufactured in conformance with the latest published standards of ANSI, ASTM, and UL and shall be as follows:

2. Rigid and intermediate steel conduit, conduit bends, elbows, couplings, and nipples shall be hot-dipped galvanized. Buried rigid steel conduit shall be plastic coated galvanized steel conduit. Couplings and connectors shall be threaded type.

3. Conduit terminations shall consist of double locknuts and insulated bushing, raintight connectors, or threaded hubs as applicable to maintain the rating of the enclosure to which it is being terminated.

4. Joints in conduits shall be made with standard couplings unless neither conduit can be turned; then, union shall be made with O.Z. Type "SP" split coupling or Erickson couplings. Running threads are not permitted.

5. Conduit expansion fittings shall be O.Z. Type "DX" with bonding jumper, as required.

6. PVC conduit material shall have tensile strength of 7,000 psi at 73.4 degrees Fahrenheit, flexural strength of 11,000 psi, and compressive strength of 8,600 psi.

7. PVC conduit fittings and covers shall be of the same manufacturer as the PVC conduit.

8. Flexible liquid tight conduit shall be provided for connections to vibrating or rotating equipment. Conduit shall be Anaconda Type "UA" for 3/4-inch to 1-1/4 inch and Type "EF" for 1-1/2-inch and larger, flexible conduit, with Appleton STN series fittings, as required.

9. Flexible steel conduit similar to "Greenfield" shall not be permitted.

10. Conduits installed in "hazardous areas" shall be approved for the Hazardous Class Division and Group as required by NEC and identified on the drawings.

I. Pull Boxes:

1. Pull boxes, junction boxes, and cable support boxes of proper size and design shall be provided in accordance with the N.E.C. and as required to facilitate installation of wires. Boxes shall be sized in accordance with the N.E.C. Covers shall be gasketed and held in place with corrosion resistant machine screws. Cable supports for vertical runs shall be provided at code required locations, within pull or junction boxes. Boxes shall be NEMA 12 for inside and NEMA 4 for outside use where exposed to the weather or where otherwise called for on the drawings.

2. Pull boxes located in "hazardous areas" shall be in strict accordance with National Electric Code requirements for the type of area classification and as identified on the drawings.

J. Outlet Boxes:

1. Cast steel outlet boxes shall be used for every outlet and switch where called for on the drawings and as herein specified. All cast boxes shall meet the requirements for galvanized finish specified for steel conduits.

2. All outlet boxes for exposed work shall be of cast steel construction with threaded openings Type "FS" or “FD” unless noted otherwise.

3. Provide temporary caps on boxes similar to Gedney, "Red Caps" during construction.

4. Outlet boxes installed in hazardous areas shall be approved for the Hazardous Class, Division and Group as required by NEC and identified on the drawings.

K. Receptacles:

1. In general, the receptacles shall be duplex convenience grounding type with weathertight gasket and covers and shall be installed in exposed cast metal conduit boxes type FD with mounting ears. This also includes receptacles used for disconnects.

2. Convenience receptacles shall be rated 20 amps with back and side wiring and with exposed metal parts finished to resist corrosion.

3. Special purpose receptacles shall be rated 20 amps, 230 volt, unless otherwise called for on the drawings.

4. Weatherproof duplex receptacles shall have a separate spring type cover for each receptacle mounted on a FS or FD box.

5. Receptacles in wet well, kitchens, bathrooms, and as indicated on the drawings shall be provided with ground fault circuit interrupting breakers.

6. Explosion proof receptacles shall be 20 ampere, 2 wire, 3 pole, 120 volts, Killark KRS-215-220 Appleton Crouse-Hinds or equal. Supply one matching plug each.

L. Light Switches:

1. Switches shall be "T" rated. Switches, and receptacles shall be specification grade and as called for on the drawings.

2. Covers shall be stainless steel unless otherwise called for on the drawings.

M. Switch and Receptacle Plates:

1. Plates for switch, receptacles, telephone, and miscellaneous signal outlets shall be 0.040 inches stainless steel with No. 4 finish in all areas unless otherwise noted.

2. Cadmium plated steel plates shall be installed in equipment space and process areas.

3. Grouped devices shall be mounted in a single continuous gang plate.

N. Lighting Fixtures:

1. CONTRACTOR shall furnish all materials and equipment required to install and place in operation all LED fixtures.

2. Lighting fixtures shall be complete, including all lamps and/or tubes, ballasts, fuses, support brackets and other parts and devices necessary for complete operation.

3. The lighting fixtures shall be Lithonia model FEM L48 3000LM IMACD MD MVOLT GZ10 40K 80CRI WLFEND2. Other manufactures may be acceptable if approved by ENGINEER in accordance with the requirements for “substitutes” in the General Conditions.

4. Lighting fixture supports and conduit connections and fittings shall have corrosion resistant qualities.

5. Underwriters' labels - all fixtures, signs, etc., shall carry the approval of the Underwriters Laboratories, Inc., and be so labeled.

O. Lamps:

1. CONTRACTOR shall furnish and install all lamps for all types of lighting fixtures as shown on the schedules and drawings. All fixtures shall be cleaned, and all lamps shall be relamped at the end of the job. See Article 3.05 for adjustment and cleaning.

2. Led lamp color temperature shall be, 4000^{o}K. The initial light output shall be 3,000 lumens.

P. Ballast:

1. Ballast shall be an integral part of the fixtures as specified on the drawings.

2. Ballasts shall be high power factor, non-PCB, E.T.L. certified and shall carry Certified Ballast Manufacturer's and Underwriters Laboratories' labels.

Q. Motor Starters:

1. 3-Phase Starters:
   a. Starter for each 3-phase single speed motor shall be on the nonreversing across the line combination magnetic type, minimum size 1 with magnetic circuit breaker and control transformer.

   b. Circuit breaker shall be externally operated, interlocked to prevent opening the cover when the switch is closed.

   c. Starter shall have, in addition to a holding circuit contact, two auxiliary contacts.

   d. Control transformer shall be rated 480 volts to 120 volt with fused secondary, minimum 50 VA but of sufficient capacity to service the starter coil plus such auxiliaries as may be indicated. Each starter shall be provided with wiring and schematic control diagrams which applies to the unit it serves.

2. Single Phase Starters:

   a. Starters for single phase motors shall be manual type, with overload protection and on-off switch.

R. Nameplates:

1. Safety switches, lighting panels, starter enclosures, panelboards, etc., name-plates shall be of laminated white plastic with black lettering and shall be attached with sheet metal screws. Nameplates size shall be 2-1/2-inch wide x 3/4-inch high. First line character size 1/4-inch high, second line 3/16-inch high. For panel designations, refer to electrical panel schedule on drawings. Panelboards shall contain a typed circuit schedule inside of cover.

2. Field located instruments and devices shall be equipped and identified with 1" x 3" engraved nameplates (similar to the panelboard nameplates) and affixed to their respective devices in a positive but flexible method (wire strap or other similar means).

2.02 Mixes

A. Patches, conduit sealing compound, fire stop compounds, etc., shall be mixed in accordance with the manufacturer's recommendations.

2.03 Fabrication and Manufacture

A. CONTRACTOR shall, to the degree possible, preassemble switchgear, panel boards, motor control centers, control panels, relay panels, etc.

1. Preassembly should be done off site in a clean shop environment by CONTRACTOR or manufacturer.

B. Control panels, motor control centers, and switchgear shall be fabricated in sections not exceeding 10 feet in length and provided with jumpers for field connections of bus and interconnecting wiring.

1. Panels shall be provided with adequate lifting eyes.

2.04 Equipment

A. Electrical devices furnished under this Contract will be of the most recent manufacture and received at the job site in the manufacturer's shipping container which clearly identifies the item.

B. Only new electrical equipment will be acceptable. Used, rebuilt, or discontinued models will not be accepted for installation under this Contract.

2.05 Acceptable Manufacturers

A. Only manufacturers recognized as producing new, top quality products meeting applicable standards will be considered acceptable.

B. ENGINEER may require CONTRACTOR to furnish acceptable material from other sources of supply, if he finds the Work will be delayed or adversely affected in any way because the stated source of supply cannot furnish a satisfactory product in sufficient quantities or if it is known to be unsuitable for the purpose for which it is proposed to be used. CONTRACTOR shall have no claim for additional compensation because of such requirement.

Part 3 Execution

3.01 Contractor's Verification

A. General:

1. Dimensions which tie mechanical and/or electrical installations to the building structure shall be thoroughly field checked for accuracy and possibility of interference due to field conditions. Ignorance of such field conditions because of CONTRACTOR's failure to field check the dimensions in question will be no excuse for additional compensation.

B. Surveys:

1. CONTRACTOR shall lay out and establish the lines and grades of all underground conduits on the site in accordance with the drawings and he shall employ a competent surveyor for this portion of the work.

2. In the event of unforeseen obstructions, CONTRACTOR shall confer with ENGINEER and obtain his written approval before proceeding with any work deviating from the governing drawings. CONTRACTOR shall assume full responsibility for locations and grades throughout this portion of the Work.

C. Locations:

1. Wall outlets, telephone outlets, clock outlets, specialized outlets, fixtures, and equipment rough-ins shall be field located except as otherwise shown on the drawings.

D. Points of Termination:

1. The points of connection and termination of related work under this Division of this Project are indicated on the Plans or stated in the Specifications, but in case of doubt as to such points of connection or termination, the decision of ENGINEER shall be final.

3.02 Preparation

A. Conduit, fittings, and accessories shall be free of foreign matter. Conduit ends shall be reamed and deburred to prevent damage to the wire and cable.

3.03 Installation

A. General Requirements:

1. Electrical system layouts indicated on the Plans are generally diagrammatic and locations of outlets and equipment are approximate. Exact routing of conduits and wiring, locations of outlets and equipment shall be governed by structural conditions and obstructions. Equipment requiring maintenance shall be located and installed so that it shall be readily accessible.

2. CONTRACTOR shall not burn, cut or drill structural steel for the installation of conduit in any manner except where written permission is granted by ENGINEER

3. Wiring shall be installed in raceway, including low voltage work, except where otherwise shown or specified.

4. Minimum conduit size shall be 3/4-inch unless noted otherwise.

5. Conduit shall be installed to be concealed wherever possible, unless otherwise indicated. In unfinished mechanical equipment rooms where the exact location of ventilation ducts, etc., is not shown, install the conduit exposed and avoid interferences.

6. Conduits shall be separated by at least 12 inches from parallel runs of steam or hot water piping.

7. Rigid steel conduit shall be used for exposed service drops in mechanical equipment and process area rooms, in exposed outdoor areas, except where another type of raceway is specified. Locknuts shall be steel or malleable iron (as size requires).

8. Conduit runs in floor slabs and direct buried underground between structures shall be rigid steel. Stub ups shall be rigid steel.

9. Where PVC conduit is permitted as noted on drawings, underground PVC conduit runs shall be installed on approved plastic spacers and encased in a 3-inch Granular Material envelope with red-oxide pigmented concrete over top. Envelopes shall have a yellow-colored, plastic, detectable caution tape buried a minimum of 12-inches above the conduit. Caution tape shall be labeled "Caution – Buried Electrical Lines".

10. Connections to vibrating or rotating equipment shall be made with flexible liquid tight conduit.

11. Provide expansion fittings at all expansion joints and/or where required to compensate for expansion and contraction in long conduit runs. Connectors shall be compatible with flexible conduit used.

12. Conduits shall be installed in floors and walls, wherever possible, unless otherwise indicated on the Plans or specified herein.

13. Empty feeder and riser conduits shall contain one No. 10 AWG galvanized steel pull wire. Splicing of the pull wire will not be permitted.

14. Conduit joints shall be set up tight. Runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical.

15. Multiple conduit runs exposed shall be mounted with rustproofed steel supports arranged so that each conduit is individually clamped or bolted. Steel conduit supports shall be hot-dipped galvanized after fabrication.

16. Concealed conduits or outlets installed flush in masonry or concrete construction shall be rigidly braced against movement during the construction period to ensure accurate termination points.

17. Conduits hidden by suspended ceilings may be run exposed between ceiling construction and structural slab. Conduits, where exposed in service rooms, mechanical equipment rooms, etc., and other work areas, shall be racked in neat symmetrical lines with proper supports. Conduits shall be run at right angles and parallel to floors, ceilings, and walls.

18. Underground conduit shall be tested to determine that all fittings are completely sealed. The tests shall be performed during and after installation of conduit, but before cable is pulled and before any conduit is encased in concrete.

19. Ninety (90) degree bends 1-1/4 inches and larger shall be made with factory elbows. Elbows of 3-inch conduit size and larger shall be long radius. Field bends shall be made so that the conduit will not be injured and the internal diameter shall not be effectively reduced. Factory elbows, nipples, and couplings shall be the same type as the conduit with which they are used.

B. Hazardous Locations:

1. Equipment, fittings, and wiring installed in hazardous areas, shall be approved by the N.E.C. for respective class and division which is applicable to area(s) where installed.

2. Sealing fittings shall be properly installed at all required locations in accordance with code regulations. Automatic drain conduit seals shall be used wherever necessary to ensure the prevention of moisture accumulation. Approved breathers shall be installed in appropriate locations.

C. Conduit Supports:

1. Conduit supports shall be suitably spaced and secured so as to provide adequate mechanical support and shall meet the code requirements. Supports shall be of steel bar, unistrut, angle or channel and of a size to provide a firm, rigid support. Fabricated supports and mounting brackets shall be hot dip galvanized after fabrication and drilling is complete. Rod hangers may be used when laterally braced. Structural steel flanges of I beams or channels shall not be drilled. Prefabricated sections may be used with approval of ENGINEER.

2. Electrical equipment including raceways, outlet boxes, panels, fixtures, etc., shall be substantially secured to the building structure. Inserts or insert bolts for support of the electrical equipment shall be installed during the building construction wherever practical.

3. Exposed multiple horizontal and vertical parallel runs of conduit shall consist of galvanized steel framing channels, conduit clamps, and rod hangers, where required, installed in accordance with the manufacturer's recommendation for the carried loads.

4. Where exposed isolated conduit needs clamping to flat surfaces, clamps shall consist of galvanized malleable iron, one-hole pipe straps for conduit up to and including 1-1/2 inches. Straps for conduits above 1-1/2 inches shall be two-hole, extra heavy steel. Steel bolts of appropriate size to fill the holes of the straps shall be used.

5. Conduit shall be supported in accordance with N.E.C.

D. Conduit Fittings:

1. Conduit fittings shall be made of a compatible material as the conduit. All conduit fittings with blank covers shall have rubber gaskets except in clean, dry areas and shall be accessible after the Work is completed.

E. Sleeves and Inserts:

1. CONTRACTOR shall provide all openings and sleeves on walls and floors as required for his work. Inserts shall be the tapered nut type with lead alloy expansive retainer sleeve. The use of wooden plugs will not be permitted.

F. Lighting:

1. Lighting fixtures shall be mounted level at the height as indicated on the Plans.

G. Taps and Splices:

1. Splices and taps shall be made by means of screw type pressure connectors. Spring pressure type connectors may be used for No. 10 AWG conductors and smaller. Instrument pigtail splices shall be made with solderless crimp type connectors.

2. Connections for No. 8 wire and larger to switches, panels, and controllers shall be made with solderless lugs of proper style and size to handle full wire capacity.

3. Stranded cable terminations shall be equipped with solderless lugs.

4. No splices outside of enclosures will be allowed. No splices except for lighting fixture and instrument pigtail connections shall be permitted unless specifically indicated on the Plans or written approval is given by ENGINEER.

5. Joints not supported and enclosed on terminal strips or equipment lugs shall be insulated with high-quality tape or material in an approved manner.

H. Wiring:

1. Wiring for power, lighting, telephone, sound, and low voltage control shall be run in one of the types of conduit described in these Specifications, unless indicated otherwise on the Plans.

2. Multi-wire branch circuits shall be color coded as stipulated in the National Electrical Code, and as herein specified.

3. Circuits feeding duplicate processing equipment shall be installed in separate conduits.

4. Instrumentation cable shall be run in conduits so as to isolate the cable from power or electrical wiring.

5. Cable insulation shall not be cut back beyond what is reasonably required to make connection, splice, or termination.

6. Wires and cables shall be tagged at both ends and in pull boxes or panel box gutters they pass through.

7. No conductors shall be pulled into any conduit run before all joints are made up tightly and the entire run rigidly secured in place.

8. Approved pulling-in compounds shall be permitted for ease of pulling cables. Pulling of cables shall in no way cause injury to conductors by elongation or to insulation by abrasion, binding, etc. Damaged cable shall be replaced.

I. Foundations:

1. The electrical subcontractor shall arrange with CONTRACTOR to provide concrete pad foundations for all floor-mounted equipment installed under this Division. Pad shall be four inches high, unless noted otherwise.

J. Access Panels:

1. Access panels or hatches shall be provided wherever electrical equipment concealed by the building construction requires access for inspection, operation, or maintenance. CONTRACTOR shall furnish all such panels required for access to his work. CONTRACTOR shall install all panels.

2. A subcontractor requiring access panels shall confer with CONTRACTOR in regard to access panel locations and shall, wherever practicable, group equipment requiring access such that a single panel with serve all and eliminate additional panels.

K. Grounding:

1. CONTRACTOR is responsible for providing all grounding, whether or not shown on the Plans, and all grounding shall be provided in accordance with NEC and local codes and ordinances. Grounding as shown on the plans is the minimum acceptable. Electrical grounding shall be grouped into two (2) classifications as follows: system grounding and equipment grounding.

a. System:

(1) Use of the metallic conduit or fittings or piping as a grounding path shall not be acceptable.

b. Equipment:

(1) Metal or conducting type enclosure frames, raceways, cable trays, conduit, panelboards, substation, motor frames, switches, switch boxes, outlet boxes, junction boxes, lighting fixture frames, building steel, metal siding, rebar, piping, etc., shall be grounded by a green colored or bare equipment grounding conductor of size called for in tables of the most recent applicable N.E.C. edition.

(2) When a separate equipment grounding conductor is used, it must be contained within the same raceway or cable with the circuit conductors.

(3) Grounding rods, hereinafter referred to as ground rods, shall be solid cylindrical rods, 3/4-inch in diameter and 10 feet in length, or longer, as required to reach specified resistance. Rods shall be of copper-clad steel tinned at top end for connection.

(4) Resistance from the building ground loop to earth before connection to the building steel and the water system shall not exceed 2 ohms.

(5) Bare copper bar, cables, or fittings used for grounding shall not be installed in cinder fill or covered with soil containing cinders or other corrosive materials. Cables shall be installed with enough slack to prevent stresses.

(6) Where ground conductors pass through floor slabs, building walls, etc., and are not encased in rigid metal conduit as specified elsewhere, shall be provided with sleeves of transit, plastic, fiber or other approved nonmetallic material, and of the required size, shape, and length unless otherwise specified or indicated on the Plans.

(7) Bonding jumpers shall be copper and of a cross-sectional area at least equal to their corresponding grounding conductors. Where attached to equipment, conduits, cabinets, etc., suitable approved solderless lugs, compression connectors or clamps

shall be used. No soldered connections shall be used on grounding circuits at any point, except where ground conductors are attached to lead cable sheaths.

(8) Grounding mediums shall be bonded together. This shall include electric, telephone, antenna systems, ground and underground piping systems which enter the structure.

(9) Compression connectors, lugs, etc., used in grounding circuits in any location shall have bolts, nuts, etc., of silicone bronze alloy metal. Ground connections, clamps, etc., shall be as manufactured by Burndy Engineering Company, Thomas & Betts Company, Penn-Union Electric Company, or equal.

(10) The minimum number, spacing, and location of ground rods to be driven shall be per the site soil conditions during dry weather. Connections to ground rods shall be below finished grade level and shall be connected by a "cadweld", or other thermal process.

(11) Use of the water system as the grounding electrode shall not be acceptable. However, the water system shall be grounded to the grounding system.

(12) Taps and splices in grounding cables shall be made by the "cadweld", or equal process.

(13) Conduits which run to boxes or cabinets having concentric or eccentric knockouts which partially perforate the metal around the conduit and impair the electrical connection to ground shall be provided with approved bonding jumpers. Jumpers shall consist of a stranded, braided copper wire at least No. 6 AWG with solderless lug on each end. Jumper shall be connected inside the box to a stud or silicone bronze alloy bolt in the cabinet frame.

(14) Conduit expansion joints and telescoping sections of metal raceways not thoroughly bonded otherwise shall be provided with approved bonding jumpers of not less than No. 6 AWG stranded bare copper.

L. Electrical Equipment Identification:

1. Electrical devices shall be labeled in a clear and permanent manner to identify its electrical circuit.

2. Motor circuits shall have the functional description on motor starter panel and distribution panelboard doors, remote safety switches and manual switches.

3. Receptacles and wall switches shall be identified using the distribution panel "letter designation" and circuit breaker numerical assignment.

4. Motor starters, switch boards, and panelboards shall have laminated plastic identification nameplates attached to the unit with screws as specified herein. Other electrical devices shall be identified using 1/4-inch plastic adhesive-backed embossed tape securely fastened to the face of the device.

M. Painting and Finishing:

1. Concealed iron work, panel boxes, junction and pull boxes, and support boxes not galvanized shall be given one coat of rust resisting paint inside and out. In addition, junction boxes shall be given one coat of white enamel inside only.

2. Equipment which was finish painted by the manufacturer or fabricator shall remain as is unless paint has become marred or damaged during installation, in which case the equipment shall be repainted to its original condition by CONTRACTOR.

3.04 Field Quality Control

A. Requirements of Regulatory Agencies:

1. Materials and equipment required for the work and the installation shall conform to all national, state, and local codes, rules, regulations, and ordinances. CONTRACTOR shall secure all permits, inspections, and tests required in connection with his portion of the Project.

B. Tests:

1. After the installation of apparatus and wiring has been completed, all electrical conductors shall be tested by CONTRACTOR to ensure continuity, phasing, proper splicing, freedom from unwanted grounds, and insulation values.

2. A 1,000-volt hand-driven megger shall be used on all 600 volt insulated service conductors and a 500-volt hand-driven megger may be used on all lower voltage insulated service conductors. Conductors shall be isolated from other equipment during test and each cable shall be tested until reaching a constant value for 15 seconds.

3. Megger and high potential tests of multiple conductor cables shall be applied between one conductor and ground with all other conductors connected to the same ground. Each conductor shall be tested in like manner.

4. Wiring not measuring up to minimum ICEA field testing standards shall be replaced.

5. Minimum acceptable reading is 100 megohms for 600 volt insulated service conductors and 1.0 megohms for lower voltage insulated services such as instrumentation cables.

6. Tests shall be made with lightning arrestors removed and disconnections made at points of final termination.

7. Motor rotation shall be checked with the motor disconnected mechanically from equipment to be driven, to prevent damage to the equipment. Motor rotation shall be as directed by the equipment manufacturer and shall be checked for accuracy in cooperation with the manufacturer.

8. Do not test the equipment unless it is sufficiently lubricated.

    a. Tests on Grounding:

        (1) Inspect ground conductors and connections for conformance with design specifications and for satisfactory workmanship.

        (2) Test resistance to earth of each ground rod and each ground grid.

        (3) Test ground paths for equipment and structural steel grounding.

    b. Maintain each ground rod isolated from the associated ground grid for tests on individual rods for resistance to earth.

    c. Include associated ground rods and interconnecting wiring in tests on each grid system for resistance to earth.

    d. Include ground bus on equipment, grid connection, and associated intermediate copper ground conductors in tests on ground paths for electrical equipment.

    e. Include structural steel connection, grid connection and intermediate conductor in tests on ground paths for structural steel.

    f. Test each ground rod for resistance to earth by a standard method. Use a Biddle ground tester or the method of using two auxiliary ground rods as described in IEEE Standard No. 550, paragraph 3.42. The IEEE method requires the use of AC test current. Place auxiliary test rods sufficiently far away from the rod under test so that the regions in which their resistance is localized do not overlap. Calculate ground resistance from the readings taken. Maximum acceptable resistance to earth at each ground rod: 25 ohms.

g. If the resistance is found to be higher than 25 ohms, drive additional rods with a minimum separation of 10 feet and connect in parallel with the rod under test until 25 ohms or less is obtained, or increase the length of the rod under test until 25 ohms maximum is obtained.

h. Test each isolated ground grid as specified for individual ground rods, except the maximum acceptable resistance to earth is five ohms. In tests on total ground systems, the maximum acceptable resistance to earth is two ohms.

i. Test ground paths for electrical equipment and structural steel for continuity by applying a low voltage DC source of current, capable of furnishing up to 100 amperes. The ground path for electrical equipment using structural steel must conduct 100 amperes. Resistance as calculated from the current and voltage must not exceed 0.010 ohms.

j. Grounding materials and connections must pass all inspections and must meet all specified maximum and minimum values.

k. Make complete records of all tests. Include resistance values obtained, calculations of same, and methods of test and calculation.

9. Notice of tests to be performed shall be sent to ENGINEER and OWNER before tests are made.

10. Duplicate certified records of all insulation tests shall be furnished to ENGINEER.

3.05 Adjustment and Cleaning

A. Adjustments:

1. CONTRACTOR shall be responsible for making any equipment and instrument adjustments necessary to provide a complete and safe working system under normal operating conditions.

a. Equipment to be adjusted shall include, but not limited to, ground fault circuit interrupters, circuit breaker trip settings, motor starter overload settings, thermostats, pressure switches, level switches, limit switches, control instruments, etc.

b. CONTRACTOR shall provide a coordination study of the electrical system.

B. Manufacturer's Services:

1. Services of a factory trained, qualified service representative of the equipment manufacturer shall be provided by CONTRACTOR to inspect the complete equipment installation to ensure that it is installed in accordance with the manufacturer's recommendations, make all adjustments necessary to place the system in trouble-free operation, and instruct the operating personnel in the

proper care and operation of the equipment furnished. This will be required for the main switch gear/motor control center, main control panel including all instrumentation and any other major equipment.

C. Cleaning and Finishing:

1. Before turning the systems over to OWNER, clean all fixtures, equipment, exposed metal surfaces, and leave all in clean condition at the end of the Work as specified elsewhere in the Contract Documents.

D. Final Inspection:

1. Upon completion of the Work, CONTRACTOR shall conduct a complete inspection of all items of Work and make whatever corrections and adjustments are deemed necessary to a well functioning system that will meet with the satisfaction of ENGINEER and OWNER.

End of Section

Section 26 0800
Commissioning of Electrical Systems

Part 1 General

1.01 Scope of Work

A. These Specifications and the accompanying drawings contemplate the furnishing and installation of materials, equipment, supplies, testing, adjustments, labor, and supervision required for the complete performance of operations relating to the electrical and instrumentation.

B. CONTRACTOR shall be held responsible for the complete and satisfactory accomplishment of Work inclusive of whatever miscellaneous material and/or appurtenances are required to perfect the installation and demonstrate that electrical systems will operate satisfactorily under normal operating conditions.

C. CONTRACTOR shall be responsible for electrical connections to equipment. Electrical connections in addition to making wire connections shall include, but not be limited to, furnishing, installing, and testing circuit protection devices, motor overload devices, conduits, and fittings needed to ensure a complete and operable electrical installation.

1.02 Related Work Specified Elsewhere

A. Section 03 3000: Cast-in-Place Concrete
B. Section 26 0500: Common Work Results for Electrical

1.03 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute
2. ASA - Acoustical Society of America
3. ASTM - American Society for Testing Materials
4. ETL - Electrical Testing Laboratories
5. IEEE - Institute of Electrical and Electronic Engineers
6. ICEA - Insulated Cable Engineers Association
7. ISA - Instrument Society of America
8. ITL - Independent Testing Laboratories
9. JIC - Joint Industrial Conference
10. NACE - National Association of Corrosion Engineers
11. NEC - National Electric Code
12. NEMA - National Electrical Manufacturers Association
13. NESC - National Electrical Safety Code
14. NFPI - National Fire Protection Institute
15. OSHA - Federal Occupational Safety and Health Act
16. UL - Underwriters Laboratories, Inc.
17. FM - Factory Mutual Insurance Underwriters

1.04 Submittals

A. Schedule:

1. CONTRACTOR shall submit a schedule in accordance with Section 01 3300, Submittal Procedures, for review to ENGINEER outlining the steps to be taken to maintain electrical service and showing the coordination effort which will be taken to coordinate the work between the various trades.

B. Samples:

1. When directed by ENGINEER or required by the Specifications, the CONTRACTOR shall submit samples of materials and accessory equipment such as lighting fixtures, switches, receptacles, etc.

2. CONTRACTOR shall not use these materials in the Work until ENGINEER has had ample time to determine the products suitability and compliance with the Specifications. In general, two weeks shall be considered ample time to approve or reject the submitted sample.

C. Shop Drawings and Product Data:

1. Submit shop drawings and product data as required in Section 01 3300, Submittal Procedures. CONTRACTOR shall submit the following types of information for approval by ENGINEER before any equipment is installed:

a. Catalog Cuts and/or Product Data Sheets: Catalog cuts shall be provided for standard manufactured items such as conduit and conduit fittings, electric heaters, lighting fixtures, lighting panels, instruments, motors, switches, transformers, wire, etc. Each sheet shall identify the exact equipment for which it is intended. Pertinent information such as physical dimensions, current rating, horsepower, kilowatt rating, phase, power factor, voltage, NEMA classifications, and material type shall be indicated. Also shown shall be approved listings such as UL label or other testing agencies.

b. Vendors Standard Drawings: 24" x 36" drawings are preferred, however, where a manufacturer's standard equipment is being used, his "full size" standard drawings may be submitted for approval provided the following information is included on the drawings:

(1) Identity of equipment for which drawing is intended.

(2) Optional features to be used for this Project identified.

(3) Field connections clearly identified complete with necessary terminal and wire numbers.

(4) Sequence of operation shall be written on the drawing unless the control diagram is easily understood without a sequence of operation.

D. Process Control Drawings:

1. CONTRACTOR shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

2. Drawings shall be on 24" x 36" mylar or linen with border, title block, symbols, etc., as used on the Contract drawings and approved by ENGINEER.

   a. Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc.

   b. Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.

3. Where applicable, and if CONTRACTOR desires, he may purchase mylars of the process control drawings from ENGINEER, modify these drawings as required, and utilize them as shop drawings.

E. Test Reports:

1. When directed, CONTRACTOR shall submit the manufacturer's test reports on any equipment proposed for this Project.

2. CONTRACTOR will maintain a complete set of test records covering all tests required by this Specification. Records will include the date, equipment or system tested, testing conditions, test results, and CONTRACTOR verification. Records will be available for review during construction and will be submitted to ENGINEER upon completion of the Project.

F. Certificates:

1. CONTRACTOR, upon completion of his portion of the Project, shall secure and present to ENGINEER a certificate of inspection and approval from the department having jurisdiction over his work, if such be issued. CONTRACTOR shall pay all fees in connection with the above requirements.

G. Operation and Maintenance Data:

1. Provide maintenance manuals as required in Section 01 7800, Closeout Submittals, for the main switchgear, motor control centers and reduced voltage starters, and the main control/instrumentation panels.

H. Record Drawings:

1. It shall be the responsibility of CONTRACTOR to provide all drawings pertaining to his Work. Drawings including both manufacturer's drawings and engineer design drawings shall be on mylar or linen.

2. Drawing set shall include, but not be limited to the following:

   a. Site plan and floor plans of each elevation showing the location of all equipment, lighting fixtures, embedded conduit, grounding, conduit size, conduit routing, wire size, etc.

   b. Schematic ladder diagrams for each piece of equipment and system using JIC format.

   c. Wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

3. CONTRACTOR shall accurately maintain the set of drawings and submit prints at various stages of the Work, upon request of ENGINEER.

4. Final revised record drawings shall be turned over to ENGINEER upon completion or termination of CONTRACTOR's responsibility to this Contract.

1.05 Quality Assurance

A. Materials and equipment required for the Work and their installation shall conform to all national, state, county, and local codes, rules, regulations, and ordinances. Each contractor shall secure all permits, inspections, and tests required in connection with his Work.

B. Changes in the drawings and/or Specifications required to conform with the above codes, laws, rules, and/or regulations shall be taken up with ENGINEER by CONTRACTOR before submitting his Proposal. After entering into the Contract, CONTRACTOR shall be held responsible to make all changes required to conform to the above ordinances, laws, rules, and/or regulations without extra expense to OWNER, except in the instance of ordinances, laws, rules, and/or regulations which are revised or enacted subsequent to the time of signing the Contract.

C. Erector Qualifications:

1. Work shall be performed in accordance with latest accepted standards and practices for the trades involved. Workmanship shall be subject to the approval of ENGINEER at all times.

2. Only experienced craftsmen will be allowed to perform the items of Work as required within this Project.

1.06 Delivery, Storage, and Handling

A. Storage: Electrical equipment and materials shall be stored in a location and manner to protect against damage.

B. Delivery and Handling: Materials and equipment shall be delivered, unloaded, and handled in a manner to protect against damage. CONTRACTOR shall repair or replace all damaged or defective material at ENGINEER's option and at no cost to OWNER or ENGINEER.

1.07 Job Conditions

A. Existing Conditions:

1. CONTRACTOR shall be responsible for determining the existing conditions at the time the electrical work begins and arrange for surveys, trenching, concrete work, conduit sleeves, and any other work necessary to perform the electrical installation.

B. Environmental Requirements:

1. CONTRACTOR shall exercise caution during installation and afterward to ensure equipment is protected from adverse environmental conditions such as temperature, wind velocity, humidity, rain, ice, etc.

C. Protection of Work and Property:

1. Materials and equipment both before and after erection shall be properly protected and kept in a clean condition.

2. Conduit ends and parts of equipment left unconnected shall be capped, plugged or properly covered to prevent the intrusion of foreign matter.

3. The use of tarpaulins or plastic sheets for temporary enclosures, protection of materials, etc., will not be permitted in areas where burning and/or welding operations are going on or in any location where there may be the slightest hazard of their use contributing to a fire.

4. Equipment which has been installed and later becomes damaged shall be replaced or repaired at ENGINEER's option at CONTRACTOR's expense.

D. Sequencing:

1. CONTRACTOR shall so schedule his Work to assure that he does not delay the work of any other trades. He shall also supply sleeves, supports, anchors, hangers, and other items that are to be included in the work of other trades and provide information for positioning.

E. Responsibility:

1. It shall be the responsibility of the CONTRACTOR to furnish a complete and fully operating system. CONTRACTOR shall be responsible for all details which may be necessary to properly install, adjust, and place in operation the complete installation. CONTRACTOR shall assume full responsibility for additional costs which may result from unauthorized deviations from the Plans and Specifications.

F. Apportionment of the Work:

1. CONTRACTOR shall classify and apportion all materials and performance of labor to the several trades involved in accordance with all local customs, rules, regulations, jurisdiction awards, decisions, etc., insofar as they may apply and as required to efficiently execute the Work involved in this Contract.

G. Cooperation of the Contractor:

1. CONTRACTOR shall coordinate the work of Subcontractors of each trade to avoid interference in the Work and to avoid delays in the construction. He shall coordinate the Work of subcontractors to obtain a first-class workman like system.

2. Where interference occurs as a result of poor cooperation between Subcontractors and the coordination on the part of CONTRACTOR, OWNER reserves the right to change the Work in hand to resolve the interferences and such changes will not be considered as extras.

H. Damage to Other Work:

1. CONTRACTOR will be held responsible for all damage done by his workmen. Patching and repairing of damaged Work shall be done by CONTRACTOR.

I. Maintenance Prior to Final Acceptance:

1. CONTRACTOR shall be responsible for the maintenance of equipment and systems installed until final acceptance by OWNER and shall take such measures as necessary to ensure adequate protection of all equipment and materials during delivery, storage, installation, start up, temporary operation, and shut down.

J. Accessibility:

1. Equipment shall be installed so as to be readily accessible for operation, maintenance, and repair, subject to the approval of ENGINEER.

K. Local Utilities:

1. CONTRACTOR shall be responsible for coordinating, obtaining service, including costs and advising ENGINEER, and utility company(s) as to electrical and telephone installation schedules.

L. Cutting and Patching:

1. CONTRACTOR shall perform all cutting and patching that may be necessary for the installation of the Work.

2. Major wall penetrations shall not be made without the written consent of ENGINEER unless they are called for on the construction drawings.

3. Structural steel shall not be cut, welded, or altered in any way without the written consent of ENGINEER.

Part 2 Products

2.01 Materials

A. Material and equipment furnished and installed by CONTRACTOR shall be new, unused, of the best quality of make specified, free from defects of any character, and shall be listed as approved by the UL and/or FM.

B. Equipment with aluminum buses, aluminum conduits, fittings, supports and conductors are not acceptable.

C. Outdoor electrical equipment shall be weatherproof, NEMA 4, unless otherwise indicated.

D. Unless otherwise specified in other Division 26 sections, the sheet metal surfaces of equipment enclosures shall be coated with a rust resisting primer. Over the primer, a corrosion resistant baked enamel finish shall be applied. The color shall be ASA No. 49, medium light gray.

Part 3 Execution

3.01 General

A. CONTRACTOR shall install electrical work in accordance with the codes and standards specified, except where more stringent requirements are indicated or specified, verify that materials and equipment properly fit the installation space with clearances

conforming to the codes and standards specified except where greater clearance is indicated. Perform work as required to correct improper installations, at no additional cost to OWNER.

3.02 Electrical Supervision

A. In addition to supervision required under the General Conditions, CONTRACTOR shall assign a competent representative to supervise the electrical construction work from beginning to completion and final acceptance.

3.03 Inspection

A. CONTRACTOR shall inspect each item of material and equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of electrical work.

3.04 Preparation

A. Prior to installing electrical work, CONTRACTOR shall ensure that installation areas are clean, shall maintain the areas in a broom-clean condition during installation operations, shall clean, condition, and service equipment in accordance with the manufacturer's instructions, approved submittals, and other requirements indicated or specified.

3.05 Workmanship

A. CONTRACTOR shall employ skilled craftsmen experienced in installation of the types of electrical materials and equipment specified. CONTRACTOR shall use specialized installation tools and equipment as applicable and produce installations free of defects.

3.06 Field Quality Control

A. Equipment Startup:

1. After completion of the installation, all systems and equipment shall be tested by CONTRACTOR in the presence of ENGINEER under actual operating conditions. Tests shall be performed according to manufacturer's recommendations.

2. CONTRACTOR shall include with his bid the services of all required Equipment Manufacturer's field service technicians for a period necessary to complete the work to the satisfaction of ENGINEER and OWNER.

    a. This service shall be for the purposes of checkout, initial startup, certification, and instruction of plant personnel.

3. A written report covering the technician's findings and installation approval shall be submitted to ENGINEER covering all inspections and outlining in detail any deficiencies noted.

4. Specific requirements, if any, for a particular system or piece of equipment are contained in the particular specification sections. CONTRACTOR's responsibilities relative to coordinating these services are contained in Section 40 0900, Instrumentation.

B. Manufacturer's Supervision and Field Installation Check:

1. Where specified, electrical equipment manufacturer shall furnish the services of an authorized representative especially trained and experienced in the installation of his equipment to:

a. Supervise the equipment installation in accordance with the approved submittals and manufacturer's instructions;

b. Be present when the equipment is first put into operation;

c. Inspect, check, adjust as necessary, and approve the installation;

d. Repeat the inspection, checking, and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable; and,

e. Prepare and submit the specified Manufacturers' Certified report. Include all costs for representative's services in the contract price.

C. Final Operation Tests:

1. CONTRACTOR shall test all electrical systems for not less than 168 hours, with no interruptions except for normal maintenance or corrective work. Conform to the approved test plan.

2. Testing Materials: CONTRACTOR shall furnish labor, instruments, recorders, gages, materials, and power for tests as required.

3. Testing Methods: CONTRACTOR shall operate systems continuously 24 hours a day under constant inspection of trained operators. Cause variable speed equipment to cycle through the applicable speed range at a steady rate or change. Induce simulated alarm and distressed operating conditions, and test controls and protective devices for correct operation.

3.07 Coordination Study

A. General:

1. CONTRACTOR shall provide a complete short circuit study and a protective device coordination study for the electrical distribution system. The study shall include all portions of the electrical distribution system throughout the low voltage distribution system.

2. The study shall be submitted to ENGINEER prior to granting final approval of the distribution equipment shop drawings.

B. Protective Device Coordination Study:

1. CONTRACTOR shall perform a protective device coordination study to check the selection of circuit breakers and power fuses ratings, protective relays settings, low voltage breaker trip characteristics and settings.

2. Coordination study shall include all voltage classes of equipment from the utility's incoming line protective device down each motor control center and panelboard.

3. Time-circuit characteristics of the protective devices shall be plotted on the appropriate log paper.

4. These plots shall indicate the types of protective devices selected, time delay and instantaneous trip settings.

C. Study Report:

1. The results of the short circuit and protective device coordination study shall be summarized in a final report. The report shall be submitted to ENGINEER.

End of Section

Division 31
Earthwork

Section 31 1100
Clearing and Grubbing

Part 1 General

1.01 Scope of Work

A. This section includes all clearing and grubbing work indicated on the Plans and as required, complete with cutting and removal of trees, shrubs, vegetation, stumps, logs, brush, roots and undergrowth, and disposal of materials.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 5713: Temporary Erosion and Sediment Control
C. Section 01 8900: Site Construction Performance Requirements
D. Section 31 2200: Grading
E. Section 31 2313: Subgrade Preparation

1.03 Soil Erosion and Sedimentation Control

A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Clearing

A. Trees, stumps, brush, hedges, and other vegetation occurring within the contract limits as defined on the Plans or as directed by ENGINEER shall be cut off flush with the ground and shall be completely removed.

3.02 Clearing and Grubbing

A. Trees, stumps, brush, shrubs, hedges, roots, corduroy, logs, matted roots, other vegetation and debris occurring within the contract limits as defined on the Plans or as directed by ENGINEER, shall be completely removed. Depth of removal shall be in accordance with Article 3.04 or 3.05.

B. Selective clearing shall consist of removing and disposing of dead, diseased, poorly formed, or otherwise undesirable trees, undergrowth, stumps, uprooted trees and debris. Trees to be removed will be marked and the area where the undergrowth is to be removed will be indicated on the Plans or designated by ENGINEER.

1. Selective Clearing, Type I:

a. Trees and stumps shall be cut off at an elevation not more than four (4) inches (100 mm) above the existing ground level.

2. Selective Clearing, Type II:

a. Trees and stumps shall be chipped or ground down to an elevation approximately four (4) inches (100 mm) below proposed ground level.

3.03 Depth of Removal in Excavation Area

A. For excavation areas within roadways, parking lots, and other paved areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the subgrade elevation.

B. In all other excavation areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the finish surface elevation, or as indicated on the Plans or as designated by ENGINEER.

3.04 Depth of Removal in Embankment Areas

A. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is five (5) feet (1.5 m) or less in height above the existing ground, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the existing ground.

B. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is more than five (5) feet (1.5 m) in height above existing ground, the trees and stumps shall be cut off flush with the existing ground surface.

C. For embankment areas other than roadways, parking lots, and other paved areas, the trees and stumps shall be cut off flush with the existing ground surface, or as indicated on the Plans or as designated by ENGINEER.

3.05 Removal of Trees, Stumps, and Other Vegetation

A. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections.

B. Removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of ENGINEER.

3.06 Removing Corduroy

A. Logs, stumps, poles, brush, and other unsatisfactory material occurring in the contract limits at or below the surface of the ground and within the depth of four (4) feet (1.2 m) below the proposed plan grade shall be removed and shall be disposed of by the CONTRACTOR.

B. When material is disposed of outside of the contract limits, disposal shall be as specified in Section 01 8900, Site Construction Performance Requirements.

C. Burial of trees, stumps and other vegetation, will not be permitted, except at disposal areas indicated on the Plans or as determined by ENGINEER. Trees and stumps buried in these areas shall have a minimum cover of two (2) feet (0.6 m).

3.07 Holes and Trenches

A. Holes and trenches remaining after the clearing or grubbing operations in embankment areas, shall have the sides broken down or leveled, and shall be refilled with acceptable material.

1. Material shall be moistened and properly compacted in layers by tampers or rollers to the density required under roadways, parking areas, and other special areas, as determined by ENGINEER.

2. The same construction procedure shall be applied to all holes and trenches remaining in excavation areas where the depth of holes exceeds the depth of proposed excavation.

3.08 Salvaging Timber

A. Trees required to be removed and having a diameter of four (4) inches (100 mm), or more, are classed as merchantable timber. On right-of-way, fee simple, merchantable timber shall become the property of CONTRACTOR, unless otherwise specified in the Contract Documents. When such material is placed outside of the right-of-way, CONTRACTOR shall obtain and provide ENGINEER with written permission from owner of the property on which the timber is to be placed.

B. Merchantable timber to be removed from areas outside of right-of-ways, fee simple, shall be cut and piled for the use of property owner, except where CONTRACTOR provides ENGINEER with a written agreement from the property owner that he does not desire the salvaged timber. Where the property owner has signed such an agreement, the salvaged timber will become the property of CONTRACTOR.

C. When such material is placed outside the contract limits, CONTRACTOR shall obtain and provide ENGINEER with written permission from the owner of the property on which the timber is to be placed. Timber from 4 to 12 inches (100 to 300 mm) in diameter may be left in full tree lengths or cut to commercial lengths, at the option of CONTRACTOR. Timber 12 inches (300 mm), or more, in diameter shall be cut into commercial lengths and piled separately from other timber.

End of Section

Section 31 2200
Grading

Part 1 General

1.01 Scope of Work

A. This Section includes site grading as indicated on the Plans, complete with removing and salvaging topsoil, rough grading, finish grading, adjusting structures, and reconstructing structures.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 5713: Temporary Erosion and Sediment Control
C. Section 01 8900: Site Construction Performance Requirements
D. Section 31 1100: Clearing and Grubbing
E. Section 31 2313: Subgrade Preparation
F. Section 31 2316: Structural Excavation and Backfill
G. Section 32 9219: Seeding
H. Section 32 9223: Sodding

1.03 Soil Erosion and Sedimentation Control

A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

C. Measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products (Not Used)

Part 3 Execution

3.01 Site Grading

A. Sites shall be graded as specified on the Plans or as determined by ENGINEER. CONTRACTOR shall carry out the grading operation to prevent standing water and soil saturation detrimental to structures and improvements.

B. Provisions shall be made to preserve and protect trees and other vegetation specified on the Plans or determined by ENGINEER as not to be removed.

3.02 Removing and Salvaging Topsoil

A. Topsoil encountered along the route of the construction shall be pushed back and preserved for use in restoration following completion of the construction.

B. Topsoil must remain on each given parcel and lot throughout the Project including the existing road right-of-way adjoining the parcel or lot where it existed.

C. Removal of topsoil from the Project or movement of topsoil from one portion of the Project for use in another portion of the Project will not be allowed.

D. If there is insufficient working area, the topsoil may be removed, stockpiled and later replaced on the original lot or parcel. CONTRACTOR shall furnish ENGINEER with written permission obtained from the property owner of the property on which the topsoil is to be stockpiled, prior to commencing the stockpiling operation.

E. Topsoil shall be salvaged in an amount equivalent to the quantity required by the Plans. Topsoil salvaged in excess of that required by the Plans or as required by ENGINEER will be disposed of by CONTRACTOR at his expense.

F. Before removing topsoil, all vegetation shall be reduced to a height of approximately four inches (100 mm) and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign material shall be removed and disposed of before the ground is broken for topsoil removal.

G. Equipment and methods of operations shall be such as to avoid the lifting of the subsoil. If soil or weather conditions are unsuitable, CONTRACTOR shall cease stripping until stripping can resumed in a suitable manner.

H. Topsoil shall be removed within the grading limits for cuts and shall be removed to a width and depth specified on the Plans or as determined by ENGINEER.

I. Topsoil shall be stockpiled within the limits of construction in areas designated on the Plans, or in areas out of the way of construction as determined by CONTRACTOR. Stockpiles shall be located and shaped so as to avoid diversion of storm water runoff, either in or out of the limits of construction, towards buildings, creation of standing water or interference of controlled irrigation. CONTRACTOR shall not place topsoil around trunks and root areas of trees to be preserved.

J. Topsoil shall be kept separate from other excavated materials that are to be used for embankment and shall be completely removed from any designated area prior to the beginning of regular excavation or placing embankment in the area.

K. Topsoil stockpiles shall be located as near the original location as possible and no payment will be made for overhaul.

L. After the completion of construction, the topsoil shall be screened through a 5/8-inch maximum size mesh screen, spread, graded, raked and prepared for seeding or sodding.

3.03 Existing Sand Onsite

A. In those instances where the construction takes place within private easements, the sand shall not be removed from each parcel or lot. Sand encountered in existing road right-of-way may be used for construction purposes throughout the Project providing it meets the requirements for the material it is intended to be used for.

B. Removal of sand from the Project will not be allowed, except for the volume displaced by the new construction.

C. If there is insufficient working area, the sand may be removed, stockpiled and replaced on the original lot or parcel. CONTRACTOR shall furnish ENGINEER with written permission obtained from the property owner of the property on which the sand is to be stockpiled, prior to commencing the stockpiling operations.

3.04 Rough Grading

A. Site shall be graded as necessary to comply with the Plans or as determined by ENGINEER. The subgrade shall be roughly established by cut or fill, approximately parallel to proposed finished grades and to elevations which allow for thickness of topsoil and installation of site or roadway improvements.

B. In fill areas all debris shall be removed from the area to be filled. Material detrimental to site improvement shall be removed from the site and acceptably disposed of as specified in Section 01 8900 Site Construction Performance Requirements.

C. Original ground shall be scarified and benched or otherwise treated to provide adequate bond and to prevent slippage of fill.

D. Fill material shall be free of debris or other detrimental material and shall have a moisture content within 2 percent of optimum moisture when placed. All fill shall be compacted to a density not less than 95% of the maximum unit weight and placed in layers no less than nine inches (230 mm) and no greater than 15 inches (380 mm). The maximum unit weight shall be determined by ASTM D698, Method B.

E. If possible, fills or embankments shall be constructed when the ground is frost-free and there is favorable weather. However, if winter grading is necessary, all ice and snow shall be removed from the surface of the ground before the fill or embankment is placed. No frozen material will be allowed in the fill area or in the embankment being constructed. Any frozen material on a partially completed fill shall be removed before placing any more fill. Frozen material shall be stockpiled outside the grading limits until thawed. Thawed material from the stockpiled frozen material may be used in the fill and embankment areas.

3.05 Finish Grading

A. General:

1. Subgrade shall be smoothed parallel to proposed finished grades and elevations specified on the Plans. The subgrade shall be scarified to assure bond with the topsoil prior to spreading of the topsoil.

2. Topsoil shall be spread uniformly to provide a smooth, even surface at a finish grade specified on the Plans or acceptable to ENGINEER. After spreading, the topsoil shall be compacted lightly as necessary to minimize settlement. Final grades shall not vary more than one-tenth of a foot (30 mm) from the elevations indicated on the Plans.

3. Finished grading shall be done when the ground is frost-free and weather is favorable.

B. Adjust Structures:

1. Structures to be adjusted shall be as called for on the Plans or as indicated by ENGINEER.

2. Adjustment of structures shall apply where the elevation of the casting is either raised 12 inches (300 mm) or less or lowered six (6) inches (150 mm) or less.

C. For Rehabilitation/Resurfacing Projects:

1. For structures in existing pavement, the pavement shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

2. For structures in concrete pavement, the structure shall be adjusted, backfilled and compacted as noted below.

3. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed concrete pavement.

4. In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

5. For resurfacing projects, expansion or epoxy anchored hook bolts shall be placed 18-inches on center around the edges of the existing concrete pavement, unless otherwise shown on the plans.

6. Concrete pavement, minimum 8-inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.

7. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed.

8. Structure shall be adjusted, backfilled and compacted as noted below.

9. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

10. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base or leveling courses.

11. The bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

D. For Bituminous Reconstruction or New Construction Projects:

1. Frame and cover on all new and existing structures shall be removed and the structure plated prior to placing the bituminous base or leveling courses.

2. Bituminous base and leveling courses shall be placed over the plated structures.

3. Prior to placing the bituminous wearing course, the bituminous base and leveling courses shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

4. Structure shall be adjusted, backfilled and compacted as noted below.

5. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

6. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base course.

7. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

8. Sawcutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the adjusting the structure unless otherwise noted in the Contract Documents.

9. Existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure, unless a new frame and cover are called for on the Plans.

10. Brick courses or concrete adjustment rings shall be removed or installed as necessary to adjust the structure's frame and cover to the proper elevation.

11. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by ENGINEER.

12. Outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 inch (10 mm) thick.

13. Structure shall be properly backfilled with Class II granular material, compacted in place, and meeting the approval of ENGINEER.

14. Flow in the entire system shall be maintained, at CONTRACTOR's expense, while performing any part of the Work. Also, the structure shall be cleaned and all unsuitable material shall be disposed of at CONTRACTOR's expense.

3.06 Reconstruct Structures

A. General:

1. Structures to be reconstructed shall be as called for on the Plans or as determined by ENGINEER.

2. Reconstruction of structures shall apply where the elevation of the casting must be raised in excess of 12 inches (300 mm), lowered in excess of six (6) inches (150 mm), or to rebuild portions of the existing structure which are deteriorated.

B. For Rehabilitation/Resurfacing Projects:

1. For structures in existing pavement, the pavement shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

2. For structures in concrete pavement, the structure shall be reconstructed, backfilled and compacted as noted below.

3. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed concrete pavement.

4. In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

5. For resurfacing projects, expansion or epoxy anchored hook bolts shall be placed 18-inches on center around the edges of the existing concrete pavement, unless otherwise shown on the plans.

6. Concrete pavement, minimum 8-inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.

7. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed.

8. Structure shall be reconstructed, backfilled and compacted as noted below.

9. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

10. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base or leveling courses.

11. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

C. For Bituminous Reconstruction or New Construction Projects:

1. Frame and cover on new and existing structures shall be removed and the structure plated prior to placing the bituminous base or leveling courses.

2. Bituminous base and leveling courses shall be placed over the plated structures.

3. Prior to placing the bituminous wearing course, the bituminous base and leveling courses shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

4. Structure shall be reconstructed, backfilled and compacted as noted below. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.

5. A minimum of 8-inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base course.

6. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.

7. Sawcutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the reconstructing the structure unless otherwise noted in the Contract Documents.

8. Existing frame and cover shall be carefully removed and stored and shall be reinstalled on the same structure unless a new frame and cover are called for on the Plans.

9. Existing corbel entrance sections or precast concrete chimney type entrance shall be removed along with any additional brick courses or precast concrete sections necessary to achieve the amount of reconstruction called for on the Plans or as determined by ENGINEER.

10. The necessary brick work and precast concrete sections shall be installed to meet the design grade.

11. Manhole steps shall be furnished and shall be installed, as necessary, so that maximum spacing is 24-inches (600 mm).

12. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by ENGINEER.

13. Outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 (10 mm) inch thick.

14. Structure shall be properly backfilled with Class II granular material, compacted in place, and meeting the approval of ENGINEER.

15. Flow in the entire system shall be maintained, at CONTRACTOR's expense, while performing any part of the Work.

16. Structure shall be cleaned, and all unsuitable material shall be disposed of at CONTRACTOR's expense.

End of Section

Section 31 2313
Subgrade Preparation

Part 1 General

1.01 Scope of Work

A. This Section includes preparing subgrade for pavement construction complete with excavation, embankments, proof rolling, subgrade undercut and backfill, subgrade stabilization fabric, subbase, right-of-way ditching, right-of-way restoration, field quality control, and appurtenances.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 5713: Temporary Erosion and Sediment Control
C. Section 01 8900: Site Construction Performance Requirements
D. Section 31 1100: Clearing and Grubbing
E. Section 31 3500: Slope Protection
F. Section 31 2319: Dewatering
G. Section 32 3100: Fences and Gates
H. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

A. Finish subgrade surface shall be shaped to conform to plan grade and cross section within a tolerance of one-inch (25 mm) in ten (10) feet (3.0 m).

1.05 Submittals

A. Test Reports:

1. Testing lab shall provide ENGINEER with two (2) certified copies of the sieve analysis of the backfill material.

2. Testing of the material and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

3. Testing lab shall provide ENGINEER with two (2) certified copies of the compaction and moisture tests of the backfill and subgrade materials.

4. Testing of the materials and the certification of the test results shall be performed by a testing laboratory approved by the ENGINEER.

B. Samples:

1. Submit sample of the proposed subgrade stabilization fabric measuring not less than 1 yd^2 (1 m^2) in area, and the manufacturer's certification that the proposed fabric meets or exceeds all requirements listed in Article 2.03 of this Section.

2. Submissions shall be made not later than 10 working days prior to any installation.

1.06 Product Delivery Storage and Handling

A. Geotextile fabric shall be furnished and stored in a wrap that will protect the geotextile from ultraviolet radiation and abrasion.

B. Geotextile shall be covered with the aggregate base as per plan within two (2) weeks of its placement.

1.07 Soil Erosion and Sedimentation Control

A. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.

C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Granular Materials

A. Granular material gradation shall conform to the grading requirements for granular material Class II as specified in MDOT, Section 902.08.

2.02 Aggregate Materials

A. Aggregate materials, used for undercut backfill shall be crushed limestone, natural aggregate, blast furnace slag, or crushed concrete, meeting the requirements of 21AA, 21A or 22A as specified in MDOT Section 902.06.

B. Crushed concrete shall be free of all steel and other deleterious materials.

2.03 Subgrade Stabilization Fabric

A. Subgrade stabilization fabric shall be composed of synthetic fibers formed into a woven fabric. The fibers shall be composed of 85% propylene or ester polymers. The geotextile shall conform to the following requirements listed below:

Property	Test Procedure	Test Result
Grab Tensile	ASTM D4632	270 lbs. (min)
Elongation	ASTM D4632	15% (min)
Trapezoidal Tear	ASTM D4533	100 lbs. (min)
CBR Puncture Strength	ASTM D6241	900 lbs. (min)
Apparent Opening Size	ASTM D4751	40 – 70 U.S. Sieve
Permittivity	ASTM D4491	0.05 per sec (min)

Part 3 Execution

3.01 Removing Structures

A. Structures and sewers to be removed shall be called for on the Plans or as determined by ENGINEER. Removal or abandonment of structures shall be in accordance with Section 01 8900, Site Construction Performance Requirements.

3.02 Holes

A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material approved by ENGINEER.

B. Material shall be compacted to 95% of its maximum unit weight.

C. Furnishing, placing and compacting of the backfill material shall be at CONTRACTOR's expense.

3.03 Salvaging and Stockpiling Topsoil

A. Topsoil, within the grading limits for cuts, and where the fill is less than five (5) feet (1.5 m) in height to the top of proposed road, shall be removed to a depth and width specified on the Plans.

B. Topsoil from peat and muck areas shall not be removed.

C. Topsoil salvaged in excess of that required by the Plans will be disposed of by the CONTRACTOR at his expense.

D. Removing and salvaging topsoil shall be in accordance with Section 31 2200, Grading.

3.04 Preparing Roadway Subgrade

A. Muck, peat and other unsuitable material within the roadway shall be removed, displaced or otherwise treated, as shown on the Plans or as directed by ENGINEER.

B. Deposits of frost heave material within lines two (2) feet (0.6 m) outside the proposed roadbed shall be removed to a depth of three (3) feet (0.9 m) below the surface of the earth grade, unless otherwise shown on the Plans or as determined by ENGINEER.

C. Ice and snow shall be removed from the surface of the ground before the embankment is placed.

D. Muck, peat, frost heave material and other unsuitable material shall be disposed of outside the highway limits or shall be spread uniformly in low places beyond the roadway limits when so approved by ENGINEER.

E. Old road surfacing or gravel, crushed stone, or other nonrigid type surfacing, occurring within the area of the roadbed and underlying proposed embankment less than 1-foot in depth, and which is not to be salvaged and incorporated in the new Work, shall be plowed or scarified full depth, spread and compacted to form a uniform foundation, before any new embankment is placed.

F. Old pavement and other rigid structures, occurring within the area of the roadbed and underlying the proposed embankment less than 1-foot in depth and which are not to be incorporated into the new Work, shall be broken up and removed.

3.05 Subgrade

A. Area to be paved shall be excavated and smoothed to the line, grade and cross section as indicated on the Plans.

B. Subgrade between the lines two (2) feet (0.6 m) on either side of the proposed edge of pavement or curb shall be compacted to 95% of the maximum unit weight for a depth of seven (7) inches (175 mm), by rolling with a roller weighing not less than ten (10) tons (9000 kg).

C. Subgrade shall be completed ahead of placing forms or paving a distance equal to the distance of one day's average paving operation. Prior to the paving operation, the subgrade shall be shaped and compacted to the Plan cross section by approved mechanical means.

3.06 Pavement Excavation

A. Pavement excavation shall consist of all Work required to construct the earth grade and its appurtenances true to the lines, grades, and cross sections called for on the Plans and in accordance with these Specifications.

B. Excavation shall consist of the following items, any of which or all of which may be included or incidental to it; removing trees, stumps, hedges, roots, culverts, sewers, miscellaneous structures, roadway excavation, removing of all asphalt or concrete pavements, curbs, curb and gutters, sidewalks, end headers, removing aggregate surfaces, salvaging and stockpiling topsoil, subgrade undercut, excavation for structures, trimming and finishing earth grade, fine grading, right-of-way ditching and restoration, and the disposal of all unsuitable material.

C. Large stones, trees, stumps, brush, shrubs, logs, matted roots, other vegetation and debris occurring between lines three (3) feet (0.9 m) outside the grading limits or as otherwise shown on the Plans shall be completely removed and properly disposed of as specified in Section 31 1100, Clearing and Grubbing.

D. Earth and other existing materials shall be excavated for the full depth and width of the cross section as shown on the Plans. Material shall be excavated sufficiently for setting of forms or slip-form equipment. Excavation shall be limited to 3,000 linear feet (900 m) of right-of-way unless additional lengths are requested in writing and approved by ENGINEER.

E. Excess excavated material shall be removed from the project by CONTRACTOR along approved routes to disposal sites approved by OWNER. Disposal of excess excavation and maintenance of the dump sites shall be considered incidental to the price paid for excavation and shall be as specified in Section 01 8900, Site Construction Performance Requirements.

3.07 Borrow Excavation

A. Materials which are secured from locations outside of the project limits for the purpose of completing embankments and other items, will be considered as borrow excavation.

B. Borrow pits and the materials to be removed therefrom shall be subject to the inspection of ENGINEER and shall be secured by CONTRACTOR, unless otherwise provided.

C. Borrow excavation will be measured by volume in cubic yards compacted in place, based on the neat lines called for on the Plans or as authorized by ENGINEER. To facilitate the accurate measurement of borrow quantities, unless otherwise specified in the Contract Documents, CONTRACTOR shall perform all the regular excavation and grading with existing materials for any designated area and ENGINEER will cross section these areas prior to CONTRACTOR furnishing and placing the required borrow material. ENGINEER will then resection the completed area and compute the volume of borrow material in its compacted-in-place state. Any borrow material placed beyond the neat lines called for on the Plans or which is not authorized by ENGINEER in writing will not be measured and computed as borrow excavations. Measurement of borrow material by truck count will not be acceptable.

D. Public and private roads used by CONTRACTOR between the source of borrow and the Project shall be maintained by ONTRACTOR, at his expense, including repairs of any damage caused by his operations. Also included is the application of a dust palliative when necessary, as determined by ENGINEER.

3.08 Embankments

A. Embankments shall be constructed with sound earth. Materials shall be deposited and compacted by either the Twelve Inch Layer Method, or the Controlled Density Method. The Controlled Density Method will be required unless the 12-inch layer method or some other method is specifically called for on the Plans.

B. Topsoil shall be stripped from the entire fill area. Depth of the topsoil to be removed shall be as shown on the Plans or as determined by ENGINEER. After the topsoil is removed, the entire area upon which the embankment is to be constructed shall be compacted to not less than 90% of the maximum unit weight, to a depth of nine (9) inches (225 mm).

C. Where stones are prevalent, the material shall be carefully placed so that all large stones will be well distributed, and the crevices completely filled with smaller stones, earth, sand or gravel so as to form a solid embankment. Rock or fragmental material of such size as would prohibit it from being placed in layers of the specified depth shall not be placed in the embankment. In no case shall stones over three (3) inches (75 mm) in diameter be placed within 12 inches (300 mm) of the surface of the earth grade within the areas between lines two (2) feet (0.6 m) outside of the edges of proposed roadbed.

D. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

E. Construction requirements for the two (2) methods of placing and compacting embankments are as follows:

1. Twelve-Inch Layer Method:

a. Material shall be deposited and spread in layers not more than 12 inches (300 mm) in depth, loose measure, parallel to the finished grade and extending to the full width of the embankment. Material shall be deposited by operating the conveying equipment over the layer being placed, insofar as feasible.

b. Each layer shall be compacted to not less than 95% of the maximum unit weight as determined at the existing moisture content. Operation of compacting shall be continued until each layer is compacted to the required density for its full width.

2. Controlled Density Method:

a. Material for the embankment shall be deposited and spread in layers not more than nine (9) inches (225 mm) in depth, loose measure, and extending to the full width of the embankment, except that granular material may be spread and compacted in layers not more than 15 inches (375 mm) in thickness if the specified density is obtained.

b. Material for embankments of five (5) feet (1.5 m) or less and the bottom four (4) feet (1.2 m) of embankments of more than four (4) feet (1.2 m) above the surface of the ground upon which the embankment is to be constructed shall have not more than the optimum moisture content at the time of compaction.

c. Material for that part of the embankment more than five (5) feet (1.5 m) above the surface of the ground upon which the embankment is to be constructed shall have a moisture content of not greater than three (3) percent above optimum at the time of compaction, except that the moisture content of the top three feet (0.9 m) of the embankment shall not exceed optimum. If granular material is used to construct the embankment, it shall be at a moisture content below saturation.

F. If the material contains an excess of moisture, it shall be dried to the required moisture content before being compacted.

G. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of its maximum unit weight, unless otherwise specified, before the succeeding layer is started.

H. When the original ground upon which the embankment is being placed, or any section of compacted embankment, or the soil in cut sections becomes rutted or distorted by CONTRACTOR's equipment, the method of operation shall be changed to eliminate this condition. CONTRACTOR shall reshape and recompact any areas so rutted or distorted at his own expense. This shall be done before any succeeding layers are placed.

3.09 Rough Grading

A. CONTRACTOR shall rough grade as close as possible to finished subgrade leaving a minimum to be removed in fine grading.

B. Excavated material removed during grading and stored along the line of Work between curb and sidewalk on improved lawns shall not be left longer than 48 hours. Lawns or otherwise improved areas shall be left in a neat and clean state within the specified 48 hours.

C. During the excavation operation, including the placing of the subbase, the Work area shall be kept free of water. A dewatering system shall be provided and maintained by CONTRACTOR at his expense. The dewatering system shall remain in operation until the paving is completed.

3.10 Proof Rolling

A. After removal of topsoil or other overburden and after construction of embankments, proof roll the existing subgrade with six passes of a minimum 15 ton pneumatic-tired roller. Operate the roller in a systematic manner to assure the number of passes over all areas, and at speeds between 2.5 and 3.5 miles per hour. When proof rolling under structures, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes.

B. Proof rolling shall be done in the presence of ENGINEER. Rutting or pumping shall indicate unsatisfactory material and that material shall be undercut as determined by ENGINEER and replaced with the appropriate fill material.

C. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades. Materials degraded by proof rolling a wet or saturated subgrade shall be replaced by CONTRACTOR as determined by ENGINEER at no cost to OWNER. Notify ENGINEER 3 days prior to proof rolling.

3.11 Subgrade Undercut Excavation

A. Unsuitable subgrade excavation shall be the operation of:

1. removing unsuitable soils as determined by ENGINEER, below the level of the ground after topsoil has been stripped in fill areas where the embankment is to be five (5) feet (1.5 m) or less in height to plan grade, or

2. the removal of unsuitable soils below the subgrade elevation, as determined by ENGINEER in cut areas after the subgrade has been established.

B. In fill areas, after topsoil has been stripped in accordance with Article 3.03 of this Section, ENGINEER will inspect the embankment area to certify the adequacy of the native soils and to determine the extent of any additional excavation of unsuitable soils prior to placing the first lift of the embankment.

C. In cut areas after the subgrade elevation has been established by the mass grading operation, ENGINEER will inspect the subgrade to determine the extent of any additional excavation of unsuitable soils.

D. The areas excavated of unsuitable material, unless otherwise specified in the Contract Documents, shall be backfilled with non-frost heaving material similar to the adjacent soil. However, in areas as determined by ENGINEER where free water due to seepage is present, the excavation shall be backfilled with Granular Material, Class II, and drainage shall be provided. Backfill shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified.

3.12 Subgrade Stabilization Fabric

A. Place Subgrade Stabilization Fabric on prepared subgrade or subbase in the manner and at the location as called for on the plans. Fabric shall be laid smooth and free of tension stress, wrinkles or creases.

B. Fabric strips shall be placed to provide a minimum overlap of 24 inches (600 mm) for each joint.

C. Fabric shall be placed so that the upper strip will overlap the next lower strip.

D. Should the geotextile be damaged during construction, the torn or punctured section shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus two feet (0.6 m) to adjacent undamaged geotextile in all directions.

3.13 Trimming and Finishing Earth Grade

A. After the earth grade has been constructed to the required grade, all stones and rocks more than 3 inches (75 mm) in diameter, appearing on the surface of the subgrade shall be removed.

B. Earth grade and the subgrade shall be trimmed to the grade called for on the Plans. Subgrade, where a subbase or base course is required, shall be trimmed to the established grade within ± 0.1 foot (30 mm). Where a subbase or base course is not required, the subgrade shall be trimmed to the established grade within ± 3/4 inch (20 mm).

C. Earth grade outside the subgrade shall be trimmed, all irregularities made smooth and the entire site or roadway completed to the required lines, grades, and cross sections. Backslopes and fill slopes shall be finished as either Class A or Class B slopes. Class A slopes shall be required unless otherwise specified in the Contract Documents.

1. Class A Slopes:

    a. Class A slopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.1 foot (30 mm) above or below the established grade measured at right angles to the slopes.

2. Class B Slopes:

    a. Class B backslopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.5 foot (150 mm) above or below the established grade measured at right angles to the slope. The degree of finish of the slopes shall be that obtainable from machine operations. The smoothness of surface finish ordinarily associated with template or string line and hand operations will not be required, but abrupt variations will not be permitted. Debris except sod, leaf mold and rotted forest litter shall be removed and loose clods of earth extending beyond the 0.5-foot (150 mm) tolerance shall be broken or removed.

    b. Class B fill slopes shall be finished to within 0.2 foot (60 mm) of the established grade and cross section from the outside shoulder line for a distance of three (3) linear feet (0.9 m) down the slope. The remainder of the completed fill slope shall conform to the requirements for Class B backslopes.

c. Where waste earth or other surplus material is deposited on fill slopes, the slopes may be flattened or otherwise altered as directed by ENGINEER, to produce a uniform cross section which blends with the topography and presents a pleasing appearance.

D. Where trees or other restrictions do not interfere, the tops of backslopes, bottoms of fill slopes and all other angles in the lines of the cross section shall be rounded to form vertical curves as shown on the Plans or as determined by ENGINEER. Transitions in length of vertical curves shall be gradual and shall present a uniform and attractive appearance. When ditches are constructed in peat, vertical curves may be omitted.

3.14 Subbase

A. Granular material for subbase shall be evenly spread and compacted as specified in MDOT Section 301.

B. Thickness of each layer placed shall be determined by the required density obtained but shall not exceed 15 inches (375 mm) in depth, loose measure.

C. Subbase shall be constructed to the alignment, grade and cross section shown on the Plans. Should the subgrade at any time prior to or during the placing of the subbase become soft or unstable so that rutting occurs in the subgrade, or if the subgrade material is forced up into the subbase material, the operation shall immediately cease and the mixed material shall be removed and disposed of. Subgrade shall be corrected, and new subbase material placed and compacted. This Work shall be considered incidental to the construction of the Project.

3.15 Scarify, Re-Grade and Compact Existing Subgrade

A. Existing subgrade (base) shall be scarified to a depth of 9-inches to the limits as shown on the plans. Subgrade shall then be re-shaped to the cross section as shown on the plans and compacted. Subgrade shall then be compacted to 95% of the maximum unit weight by rolling with a roller weighing not less than ten (10) tons (9000 kg).

3.16 Roadway Ditching

A. Ditching shall be constructed at the locations called for on the Plans or as determined by ENGINEER. Ditch may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans.

B. Excess material from the ditch construction shall be disposed of by CONTRACTOR at his expense.

C. Ditch section shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding or Section 32 9223, Sodding.

D. CONTRACTOR, at his expense, shall furnish, place and compact any additional material needed to construct the ditch at the location and cross sections called for on the Plans.

3.17 Right-of-Way Restoration

A. Right-of-way shall be restored in accordance with the type and location specified on the Plans. Right-of-way may be shaped by "Machine Grading" or another method approved by ENGINEER to achieve the cross section, line and grade shown on the Plans.

B. Excess material from the right-of-way restoration operation shall be disposed of by the CONTRACTOR at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.

C. Right-of-way shall be graded to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 9219, Seeding or Section 32 9223, Sodding.

D. CONTRACTOR, at his expense, shall furnish, place, and compact any additional fill, meeting the approval of ENGINEER, needed to construct the right-of-way to the cross sections called for on the Plans.

3.18 Machine Grading

A. Work of machine grading shall consist of light grading of such character that, in general, the excavation from ditches and roadbed will be utilized in shaping shoulders and adjacent shallow fills and the work can be performed by a blade grader or similar equipment. Machine grading shall apply on the sections shown on Plans or specified in the Proposal.

B. Work shall include all necessary scarifying, plowing, discing, moving and shaping the earth to develop the cross section shown on Plans.

C. Ditches shall be in reasonably close conformity with the line and grade as shown on the Plans or as directed and must drain runoff waters to outlets shown on the Plans or designated by ENGINEER.

D. Roadbed shall be finished to grade with a blade grader or equivalent equipment.

E. Intersections, approaches, entrances, and driveways shall be graded as shown or as directed, except that loading and hauling of earth will not be required as part of this Work.

3.19 Maintenance Aggregate

A. CONTRACTOR shall furnish and install 21A, 21AA or 22A maintenance aggregate to maintain pedestrian and traffic access. Aggregate shall be placed and compacted to maintain access in areas as determined by ENGINEER. Maintenance aggregate will be incidental to the Project unless otherwise specified in the Contract Documents.

3.20 Testing

A. During the course of the Work, ENGINEER may require testing for compaction, sieve analysis and moisture content of the backfill and subgrade materials.

B. Taking of samples and the testing required shall be performed by a testing laboratory suitable to OWNER and approved by ENGINEER. Cost for testing and sampling shall be at the expense of OWNER.

C. ENGINEER shall determine the location and number of samples to be made. The testing laboratory shall furnish the ENGINEER with two (2) certified copies of the results of all tests.

D. Testing procedures shall conform to current MDOT Standards for Construction.

E. Maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D, modified to include all the material passing the 1-inch (25 mm) sieve.

3.21 Defective Work

A. Any portion of the backfill, subbase or subgrade which is deficient in the specified density shall be corrected by methods meeting the approval of ENGINEER.

B. Extra testing or sampling required by ENGINEER, because of deficiencies, shall be at CONTRACTOR's expense.

End of Section

Section 31 2316
Structural Excavation and Backfill

Part 1 General

1.01 Scope of Work

A. This Section includes excavation for structures, removal and disposal of excavated materials, backfilling, backfill materials and compaction.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion and Sediment Control
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 1100: Clearing and Grubbing
D. Section 31 2200: Grading
E. Section 31 2319: Dewatering
F. Section 32 9219: Seeding
G. Section 33 1100: Water Utility Distribution Piping
H. Section 33 3000: Sanitary Utility Sewerage Piping
I. Section 33 3400: Sanitary Utility Force Mains
J. Section 33 4100: Storm Utility Drainage Piping

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Submittals

A. Testing laboratory shall provide ENGINEER with two (2) certified copies of the test results of the compaction of the backfill. The testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.05 Soil Erosion and Sedimentation Control

A. CONTRACTOR shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

C. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Granular Materials

A. Granular material gradation shall conform to the grading requirements for granular material, Classes I and II, as specified in MDOT, Section 902. Granular material shall be natural bank run sand.

2.02 Coarse Aggregate

A. Coarse aggregate gradation shall conform to coarse aggregate, 6A, as specified in MDOT, Section 902.

Part 3 Execution

3.01 Dewatering

A. Area within the vicinity of the new Work shall be dewatered in accordance with Section 31 2319, Dewatering prior to the excavation operation.

B. Depth of the dewatering shall be sufficient to allow the excavation to remain in a dry condition during the construction of the structure, including the excavating, backfilling and compacting operations.

3.02 Sheeting, Shoring, and Bracing

A. CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the excavated area as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the excavated area, and for the protection and safety of pedestrian and vehicular traffic.

B. CONTRACTOR shall be responsible for the complete design of all sheeting, shoring and bracing Work.

C. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil.

D. Prior to installing the sheeting, shoring or bracing, CONTRACTOR shall submit Plans for this Work to ENGINEER for informational purposes only.

E. Sheeting, shoring, and bracing, and excavation shall conform to current federal or state regulations for safety.

F. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to CONTRACTOR for sheeting, shoring or bracing left in place unless otherwise indicated in the Proposal.

G. Supports for pipes, conduits, etc., crossing the excavated area shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.

H. Furnishing, placing, maintaining and removing of sheeting, shoring, and bracing materials shall be at CONTRACTOR's expense unless otherwise indicated in the Proposal.

I. CONTRACTOR shall not remove the sheeting, shoring or bracing until the structure has obtained sufficient strength to support the external loads.

J. Sheeting, shoring and bracing material shall not come in contact with the structure, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the structure.

3.03 Cofferdams

A. A cofferdam shall consist of the maintenance, installation and removal of a substantially watertight enclosure or a well-point system or similar system, which will permit construction of the substructure, above seal or subfooting, in the dry and without damage to the Work. Alternate methods, where used in lieu of cofferdams, will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for the alternate method.

B. Stream diversion and earth dikes, where used in lieu of cofferdams or a well-point system will be permitted by authorization only. Such authorization will be considered only after receipt of a permit from all federal, local or State agencies with jurisdiction for such construction.

C. Interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms.

D. Cofferdams, caissons or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.

E. Cofferdams shall not be braced to substructure forms. They shall be constructed so as to protect the Work in place against damage from high water and to prevent injury to the foundation by erosion. No timber bracing shall extend into or remain in the finished concrete.

F. Cofferdams shall be removed in such a manner as not to disturb or mar the finished concrete. When called for on the Plans or where necessary in the Work, cofferdam sheeting shall be left in place.

G. Furnishing, construction, maintenance and removal of the cofferdams including pumping shall be at CONTRACTOR's expense. If CONTRACTOR elects to use a well-point system or similar system, he shall be responsible for any claims for damages resulting therefrom.

3.04 Excavation

A. Excavation shall include the site clearing and grubbing, the excavating and disposing of materials encountered, the supporting and protecting of structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.

B. Excavation shall also include the removal of existing structures, as shown on the Plans or as determined by ENGINEER.

C. Rock excavation, if applicable, shall be performed as a part of the excavation in accordance with specifications contained elsewhere.

D. CONTRACTOR shall keep the limits of his excavation operations within a reasonably close conformity with the location and grade, of each structure.

E. Excavated materials shall be temporarily stored in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. The excavated materials shall not be placed at such locations that will endanger the banks of the excavation by imposing loads thereon.

F. Excavation shall be of sufficient size to allow for the construction of the new Work, the placing and compacting of the backfill and for the dewatering operation.

G. When concrete is to bear on or against an excavated surface other than rock, special care shall be taken not to disturb the surface. The final removal of the foundation material to grade shall not be made until just prior to the placing of the concrete.

H. Concrete shall not be placed until the depth of the excavation has been checked and the suitability of foundation material has been reviewed by ENGINEER.

I. Excavated material, determined by ENGINEER as suitable for backfill may be used. All excess materials shall be disposed by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.

J. Elevations for the bottom of footings shall be subject to such changes as are necessary to insure a satisfactory foundation. Any changes required shall be reviewed by ENGINEER prior to making the change.

K. Surface of all rock or other hard material upon which concrete is to be placed shall be free of all loose fragments, cleaned and cut to a firm surface. The surface shall be level, stepped or serrated, as shown on the Plans.

L. Unsound material underlying proposed structures shall be removed and replaced with granular material approved by ENGINEER, in layers not exceeding six (6) inches (150 mm) in depth. Each layer shall be compacted to 95% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

3.05 Backfill

A. Backfill material shall be placed only after the new Work and backfill material have been inspected by ENGINEER.

B. Backfill shall not be placed against any portion of the new Work until the required curing, surface finishing and waterproofing of such portions have been completed. Backfill which will place an unequalized horizontal loading on the new Work shall not be placed until the concrete has attained at least 70% of its design strength. To equalize horizontal loadings, the required backfill around the new Work shall be placed on opposite sides at the same time.

C. Granular material shall be used for backfilling within three (3) feet (1 m) of manholes, chambers, valve wells, valve boxes, other pipeline structures, footings, piers, abutments, columns, walls, foundations, etc., unless otherwise indicated in the Contract Documents.

D. Spaces excavated and not occupied by the new Work or by the specified backfill material, shall be backfilled with suitable material from the excavation.

E. After the backfill has been placed and compacted to the flow line elevation of any weep holes indicated on the Plans, the back end of each weep hole shall be covered with not less than two (2) cubic feet (0.5 m^3) of coarse aggregate.

F. Large stones, boulders, broken rocks, concrete, and masonry shall not be used in the backfill.

G. Backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed earth grade, and its top surface shall be neatly graded. Fills around all new Work shall be trimmed to the lines shown on the Plans or as directed by ENGINEER.

3.06 Compacting Backfill

A. Backfill behind and around the new Work shall be placed in layers, not more than nine (9) inches in depth and shall be compacted to not less than 95% of the maximum unit weight.

B. Areas where the density does not affect the construction, as determined by ENGINEER, shall be compacted to not less than 90% of maximum unit weight.

C. Backfill material shall be placed as specified in MDOT, Section 206.03.B, except for the following modifications. Backfill material shall have a moisture content not greater than three (3) percent above optimum, at the time of compaction. If the material contains an excess of moisture, it shall be dried to the required moisture content before being installed.

D. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by ENGINEER, before the succeeding layer is started.

E. Compaction of the backfill will not be paid for separately but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 Cleanup

A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements.

B. Construction area shall be graded and left in a neat, workmanlike condition.

C. At a seasonally correct time, the disturbed area shall be raked, having topsoil placed thereon, fertilized and restored per the requirements of Section 32 9219, Seeding, or Section 32 9223, Sodding.

3.08 Testing

A. During the course of the Work, ENGINEER may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory approved by ENGINEER. The cost for testing and sampling shall be at the expense of OWNER.

B. Testing laboratory shall furnish ENGINEER with two (2) certified copies of the results of all tests. Testing procedures shall conform to current MDOT, Standards for Construction.

C. Maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method A, for granular materials conforming to MDOT, Class I, and Method D, for granular materials and all other soils.

3.09 Defective Work

A. Any portion of the backfill which is deficient in the specified density shall be corrected by the methods meeting the approval of ENGINEER. Extra testing or sampling required because of apparent deficiencies shall be at CONTRACTOR's expense.

End of Section

Section 31 2319
Dewatering

Part 1 General

1.01 Scope of Work

A. This Section includes all dewatering work complete with design of dewatering systems, construction and operation of dewatering systems, abandonment of dewatering systems, protection of personnel and structures, environmental protection and restoration.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 5713: Temporary Erosion and Sediment Control
C. Section 01 8900: Site Construction Performance Requirements
D. Section 31 2316: Structural Excavation and Backfill
E. Section 31 2333: Trenching and Backfilling
F. Section 03 3000: Cast-In-Place Concrete

1.03 Design of Dewatering Construction

A. Geotechnical Investigations made in relation to this Project are provided as reference documents. Interpretation of data and reports, performing additional investigations, and obtaining additional data for construction purposes is the responsibility of CONTRACTOR.

B. CONTRACTOR shall be responsible for the complete design of structures and methods proposed for dewatering the project site, including the implementation of materials, tools and equipment proposed for use in the Work. Temporary wiring associated with the dewatering shall comply with applicable portions of the National Electrical Code.

C. Provide monitoring wells as necessary to determine the groundwater levels along the alignment and shaft locations.

1.04 Soil Erosion and Sedimentation Control

A. Dewatering systems design and construction shall conform to the provisions of Part 91 Soil Erosion and Sedimentation Control, of Act 451 "Natural Resources and Environmental Protection Act" PA 451 of 1994; and Section 01 5713, Temporary Erosion and Sediment Control. Where applicable, CONTRACTOR shall obtain and pay for permits and inspections for dewatering construction in accordance with the provisions of PA 451, State of Michigan, 1994, and local government agencies having jurisdiction. No additional claim for compensation shall be allowed because of CONTRACTOR's failure to obtain or pay for such permits and inspections.

B. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work. Also, the measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

1.05 Federal, State, and Local Regulations

A. Dewatering operations shall conform to the requirements of all federal, state, and local agencies having jurisdiction.

B. Dewatering water discharged to streams, drains or sewers may require permits from federal, state or local agencies having jurisdiction. CONTRACTOR shall comply with all water quality requirements prior to discharging dewatering water. CONTRACTOR shall be responsible for testing and treatment required to meet water quality requirements prior to discharge. No discharges to sanitary sewers will be allowed without prior approval of local agencies with jurisdiction for the sanitary sewers.

1.06 Protection

A. Take steps necessary, during the Work of this Section, to protect surrounding property and adjacent buildings, private water supplies, roads, drains, sewers, structures and appurtenances. Adequate measures shall be taken to protect such property and construction from the effects of the dewatering operations.

1.07 Submittals

A. Submit detailed plans indicating proposed type and location of dewatering wells, type and location of collection/conveyance piping, and point of disposal of pumped water. Do not begin any dewatering work until submittals and supporting data have been reviewed by ENGINEER.

B. Dewatering system shall be designed by a professional with a minimum of seven years documented experience in the installation and design of dewatering systems. Submittal shall be signed and sealed by a registered professional engineer, stating that the proposed dewatering method is adequate to perform the required tasks.

Part 2 Products (Not Used)

Part 3 Execution

3.01 General

A. Provide electrical power from local utility. Provide stand-by power and any other required auxiliary dewatering equipment to assure continuous dewatering capability. Dewatering, where required, shall be continuous. Dewatering will not be stopped during work stoppage without approval of ENGINEER. Coordinate construction operations to minimize duration and extent of dewatering required.

B. Dewatering wells are to use properly designed filters to prevent the migration of soil fines into the well.

3.02 Monitoring and Control

A. During dewatering operations, monitor ground water level with piezometers to ensure the design or specified groundwater elevation is maintained. Install monitoring wells with screens below the excavation level as required. Install wells at minimum 200-foot intervals located between dewatering wells. Provide access to monitoring wells by ENGINEER.

B. Modify dewatering operation if geotechnical instrumentation or survey measurements indicate movement of structures, sheeting or embankments, or inability to lower groundwater as specified.

C. Inspect wells and lines on a daily basis to ensure integrity and watertightness. Keep fittings and connections watertight to ensure release of sulfide to atmosphere from groundwater does not occur.

3.03 Existing Drainage Conditions

A. Prior to beginning any work, verify in the field the location, type and capacity of existing drainage facilities and conditions which will affect the Work of this Section. No allowances shall be made for conditions found during the progress of the dewatering operations because of CONTRACTOR'S failure to verify such conditions.

3.04 Existing Structures and Utilities

A. CONTRACTOR shall make field verification of all existing structures and utilities at the site of the Work which are scheduled to remain, and which may be affected by the Work of this Section. CONTRACTOR shall be responsible for any damage to existing structures and/or utilities caused because of his Work and shall repair such damage at his expense to the satisfaction of ENGINEER or utility owner.

3.05 Drainage of Excavations

A. CONTRACTOR shall maintain all finished excavation Work free of water during the preparation of the subgrade and until the completion of the Work. No ground or surface water shall be discharged into existing sanitary sewer. No unit of Work shall be constructed under water except as otherwise determined by ENGINEER. Provide and maintain adequate dewatering equipment to remove and dispose of surface or groundwater entering excavations, trenches or other parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the construction is complete.

B. Excavations which extend down to or below the static groundwater elevation shall be dewatered by lowering and maintaining the groundwater level beneath such excavations a distance of not less than 12 inches (300 mm) below the bottom of the excavation. Drainage system methods shall not cause damage to wells or adjacent property. Outlet drainage piping and conduit shall be kept clean and free from sediment. CONTRACTOR shall be held responsible for the condition of all existing pipes, conduits and structures which he may use for drainage.

3.06 Dewatering Sumps and Pump Wells

A. Sumps and pump wells used as a part of the dewatering system shall be strongly sheathed and braced to protect the construction while in use. Tops of well casings must be covered to prevent animals and debris from entering and shall be 2 to 3 feet (0.6 to 0.9 m) above ground. Sumps and wells, when abandoned, shall be backfilled and compacted to the satisfaction of ENGINEER.

3.07 Drilling

A. Methods used in drilling wells associated with dewatering systems shall be the responsibility of CONTRACTOR and shall be acceptable to ENGINEER.

B. Drilling methods shall insure proper placement of well materials and shall not involve displacement of earth formations.

C. Drilling shall be done with first class equipment of proper type and in good condition, acceptable to ENGINEER.

3.08 Pumping

A. Equipment for pumping and pumping methods associated with dewatering systems shall be the responsibility of the CONTRACTOR and shall be acceptable to ENGINEER. CONTRACTOR shall construct or furnish adequate discharge piping to conduct and dispose of the water so as to prevent damage to existing structures or property. Pumping equipment shall be first class, acceptable to ENGINEER, of proper type and size for the Work and in good condition. Provide anchors and supports for pumping equipment.

3.09 Filling and Grading

A. Upon completion of dewatering Work for the Project, abandon and/or fill holes, trenches, ditches and other earth excavations created by the Work of this Section and not scheduled to remain. Do filling, backfilling and grading to restore excavations and earth banks to the lines and levels indicated on the Plans and as determined by ENGINEER. Earth fills shall be compacted to a density equal to that of the surrounding undisturbed earth.

End of Section

Section 31 2333
Trenching and Backfilling

Part 1 General

1.01 Scope of Work

A. This Section includes open trench construction for utility installation, complete with trenching, sheeting, bracing, bedding, bedding materials, backfilling, backfill materials, and compaction.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion and Sediment Control
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 1100: Clearing and Grubbing
D. Section 31 2200: Grading
E. Section 31 2316: Structural Excavation and Backfill
F. Section 33 1100: Water Utility Distribution Piping
G. Section 33 3000: Sanitary Utility Sewerage Piping
H. Section 33 3400: Sanitary Utility Force Mains
I. Section 33 4100: Storm Utility Drainage Piping

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Test Reports

A. Testing laboratory shall provide ENGINEER with two (2) certified copies of the test results of the compaction of the backfill.

B. Testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.05 Mix Design

A. Submit mix designs for any concrete or flowable fill mixtures to be used on the Project. Include certified test results for seven day and 28-day strengths, together with any technical information for admixtures.

1.06 Soil Erosion and Sedimentation Control

A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.

C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 5713, Temporary Erosion and Sediment Control.

Part 2 Products

2.01 Class II Granular Materials

A. Class II granular material gradation shall conform to the grading requirements for granular material Class II, as specified in MDOT, Section 902 except as follows. Class II granular material shall be natural bank run sand with a maximum size of 1½-inches (38 mm).

2.02 Crushed Stone Bedding

A. Crushed, angular, natural stone material, meeting the requirements of MDOT 21AA. Crushed concrete and slag are not allowed.

2.03 Concrete

A. Concrete shall conform to MDOT, Section 701, use grade S3; 3,000 psi (21 MPa) strength; Type I-A cement; 5.5 sacks cement per cubic yard (307 kg/m^3); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's review.

2.04 Flowable Fill for Backfilling

A. Materials:

1. Fly Ash: Fly Ash shall have a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).

2. Water: Water shall meet the requirements of ASTM C94.

3. Cement: ASTM C150 or C595, Type I or IA.

B. Mixture (Strength 100 - 120 psi, (690 - 825 kPa)):

1. Fly Ash: 2000 lbs/c.y. (1190 kg/m^3) min
2. Cement: 70 lbs/c.y. (40 kg/m^3) min
3. Water: Sufficient water to produce desired flowability, 700 lbs/c.y. (415kg/m^3) ±

C. Temperature of the flowable fill mix as manufactured and delivered shall be at least 50 degrees Fahrenheit (10 degrees Celsius). Flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.

Part 3 Execution

3.01 Dewatering

A. Area within the vicinity of the trenching operation shall be dewatered in accordance with Section 31 2319, Dewatering prior to the trenching operation.

B. Depth of the dewatering shall be sufficient to allow the trench excavating operation including backfilling and compacting to proceed in a dry condition.

3.02 Trench Excavation

A. Open cut trench excavation shall include the site clearing and grubbing, the excavating of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.

B. Trenching operation shall commence at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified on the Plans or directed by ENGINEER.

C. Trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by ENGINEER.

D. Excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property, public property or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.

E. Trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, for rigid pipe, the width of the trench from below the pipe bedding to 12 inches (300 mm) above the top of the pipe shall not exceed the following dimensions:

Diameter of Pipe	Width of Trench
6-inch thru 12-inch pipe (150 thru 300 mm)	30 inches wide (750 mm)
15-inch thru 36-inch pipe (375 thru 900 mm)	outside diameter plus 16 inches (400 mm)
42-inch thru 60-inch pipe (1050 thru 1500mm)	outside diameter plus 20 inches (500mm)
over 60-inch pipe (1500mm)	outside diameter plus 24 inches (600 mm)

F. Support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, CONTRACTOR shall install, at his expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or four (4) inches (100mm), whichever is greater, or at his expense, install another type bedding, approved by ENGINEER. Concrete encasement shall consist of 3,000 psi (21 MPa) strength concrete.

G. For flexible pipe, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 in. (400 mm) or the pipe outside diameter times 1.25, plus 12 in. (300 mm). Maximum trench width for flexible pipe shall not exceed the minimum width by more than 6-inches.

H. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, CONTRACTOR shall install, at his expense, crushed stone pipe bedding to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe.

I. When through, CONTRACTOR's construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, CONTRACTOR, at his expense, shall excavate below the normal trench bottom grade and shall fill the void with a large size aggregate or 3,000 psi (21 MPa) concrete as approved by ENGINEER to ensure that the pipe when laid in the proper bedding will maintain correct alignment and proper grade.

J. Trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.

3.03 Sheeting, Shoring, and Bracing

A. CONTRACTOR shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipe lines, conduits next to or crossing the trench, and the protection and safety of pedestrian and vehicular traffic.

B. CONTRACTOR shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil. Prior to installing the sheeting, shoring or bracing, CONTRACTOR shall submit Plans for this Work to ENGINEER for informational purposes only.

C. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.

D. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to CONTRACTOR for sheeting, shoring or bracing left in place.

E. Supports for pipes, conduits, etc., crossing the trench shall conform to the requirements of the owners of such facilities, and if necessary, shall be left in place.

F. The furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at CONTRACTOR's expense. CONTRACTOR shall not remove the trench sheeting, shoring and bracing unless the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads. Also the sheeting, shoring, and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

3.04 Pipe Bedding

A. Install and compact in six inch layers. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of the pipe. Work in and around pipe by hand to provide uniform support.

B. Rigid Pipe Bedding:

1. Rigid pipe bedding shall conform to ASTM C12, except as noted.

   a. Class R-A:

      (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/4 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. The top half of the pipe shall be covered with a monolithic plain concrete arch having a thickness of at least four (4) inches (100 mm) or 1/4 of the inside diameter of the pipe, whichever is greater, at the pipe crown and a minimum width equal to the outside diameter of the pipe plus eight (8) inches (200 mm) or 1-1/4 of the diameter of the pipe, whichever is greater.

   b. Class R-B:

      (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches (300 mm) above the top of the pipe shall be Class II granular material. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

   c. Class R-C:

      (1) Pipe shall be bedded in Class II granular material, placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches (300 mm) above the top of the pipe. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

C. Flexible Pipe Bedding:

   1. Flexible pipe bedding shall conform to ASTM D2321, except as noted. Continuous and uniform bedding shall be provided in the trench for all buried pipe.

      a. Class F-I:

         (1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm), and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches (300 mm).

(2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

b. Class F-II:

(1) Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm), or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline. Backfill from pipe horizontal centerline to a level not less than 12 inches (300 mm) above the top of the pipe shall be Class II granular material. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of pipe.

(2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

c. Class F-III:

(1) Pipe shall be bedded in Class II granular material, placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four (4) inches (100 mm) or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches (300 mm) above the top of the pipe. This material shall be placed in 6-inch (150 mm) layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches (300 mm) above the top of the pipe.

(2) Where allowable trench widths are exceeded, Class F-I bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

3.05 Backfilling Trenches

A. Backfill material shall be placed on sections of bedded pipes only after such pipe bedding and backfill materials have been approved by ENGINEER.

B. Trench backfilling shall follow the pipe laying as closely as possible. However, at no time shall the pipe laying in any trench precede backfilling of that trench by more than 100 feet (30 m), unless otherwise directed by ENGINEER.

C. Backfilling shall not be done in freezing weather except by permission of ENGINEER. Frozen materials shall not be used in trench backfilling.

D. Following trench backfill specifications are for use in that portion of the trench beyond the scope of the pipe bedding requirements which normally stops at a point 12 inches (300 mm) above the top of pipe.

1. Backfill material to be placed above pipe bedding shall be free of cinders, ashes, refuse, boulders, roots, stumps, trees, timbers, brush, debris, or other extraneous materials which in the opinion of ENGINEER, are unsuitable.

2. Rocks or stones having a dimension larger than six (6) inches (150 mm) shall not be placed within three (3) feet (1 m) of the top of the pipe.

3. Large stones may be placed in the remainder of the trench backfill only if well separated and arranged so that no interference with backfill settlement will result.

E. The type and method of backfilling is dependent on its location and function and shall conform to the following requirements:

1. Trench "A":

a. All other trenches shall be backfilled with suitable excavated material placed in uniform layers that can be adequately compacted and tested from the surface of that layer. Each layer shall be thoroughly compacted by approved mechanical methods to a density equivalent to the undisturbed adjacent soil or 90% of its maximum unit weight which ever is less.

2. Trench "B":

a. Trenches under road surfaces, pavement, curb, driveway, sidewalk and where the trench edge is within three (3) feet (1m) of the pavement and as noted on the plans shall be backfilled with natural bank run sand meeting the requirements of Class II granular material, unless otherwise indicated on the Plans. The material shall be placed in uniform layers that can be adequately compacted and tested from the surface of that layer and shall be compacted to 95% of the materials maximum unit weight. Trenches under pavement to be constructed in the near future, as noted or shown on the Plans, shall be backfilled with natural bank run sand, meeting the requirements of Class II granular material, unless otherwise indicated on the Plans, as herein provided.

b. Where a pipe is installed under an existing or proposed utility, the backfill between the two shall be natural bank run sand meeting the requirements of Class II granular material, unless otherwise indicated on the Plans, constructed as herein specified.

F. Unless otherwise specified on the Plans or as directed by ENGINEER, the trench backfill shall be carried to the adjacent existing ground.

G. Where any backfill or bedding as shown on the plans or specified is to be flowable fill, care shall be used to avoid displacing any pipes or structures due to fluid pressure. Pipes in backfill areas may need to be secured to avoid the bouyancy effect.

3.06 Compacting Trench "B" Backfill

A. Trench "B" backfill shall be compacted to 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by ENGINEER.

B. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil, to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 Cleanup

A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by CONTRACTOR, at his expense, as specified in Section 01 8900, Site Construction Performance Requirements. The construction area shall be leveled and left in a neat workmanlike condition.

B. At a seasonally correct time, approved by ENGINEER, the disturbed area shall be raked, having topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, or sodded in accordance with Section 32 9223, Sodding.

3.08 Field Testing

A. During the course of the Work, ENGINEER may require testing for compaction or density of the backfill. Taking of samples and the testing required shall be performed by a testing laboratory suitable to OWNER and approved by ENGINEER. The cost for testing and sampling shall be at the expense of OWNER.

B. Maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method D.

3.09 Defective Work

A. Any portion of the trench backfill which is deficient in the specified density shall be corrected by methods meeting the approval of ENGINEER.

B. Any extra testing or sampling required because of deficiencies shall be at CONTRACTOR's expense.

End of Section

Division 32
Exterior Improvements

Section 32 1123
Aggregate Base Courses

Part 1 General

1.01 Scope of Work

A. This Section includes aggregate base courses complete with aggregate materials constructed in preparation for paving or aggregate surfacing.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2313: Subgrade Preparation
D. Section 32 1216: Bituminous Paving
E. Section 32 1313: Concrete Paving

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

A. Finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in ten (10) feet (30 mm per 5 m).

1.05 Test Reports

A. Testing lab shall provide ENGINEER with two (2) certified copies of the test results of the thickness of the compacted aggregate. Core drilling, testing for thickness and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.06 Stockpiling Aggregate

A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.

B. Stockpiling of aggregate, in excess of four (4) feet (1.2 m) in depth, on the completed subbase or aggregate surface will not be permitted, except with the approval of ENGINEER.

1.07 Environmental Requirements

A. Comply with the requirements for aggregate base or surfacing installations due to outside ambient air temperatures specified under Article 3.08 of this Section.

Part 2 Products

2.01 Dense-Graded Aggregate

A. Dense-graded aggregate gradation shall conform to Series 21and 22, as specified in MDOT, Section 902.

2.02 Calcium Chloride Additives

A. Calcium chloride additives shall conform to ASTM D98 and as specified in MDOT, Section 903.

2.03 Water

A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Water from sources approved by the Michigan State Department of Public Health as potable may be used.

Part 3 Execution

3.01 Excavation Verification

A. Prior to the placing of any aggregate material, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades or subbases are adequate to receive the new Work. Correct all defects and deficiencies before proceeding with the Work.

3.02 Subgrade Conditions

A. Prior to the placing of any aggregate material, examine the subgrade or subbase to ascertain that it is adequate to receive the aggregate to be placed. If the subgrade or subbase remains wet after all surface water has been removed, ENGINEER may require the installation of edge drain.

3.03 Existing Improvements

A. Investigate and verify locations of existing improvements, including structures, to which the new Work will be in contact. Necessary adjustments in line and grade, to align the new Work with the existing improvements must be approved by ENGINEER, prior to any changes.

3.04 Preparation of Subgrade or Subbase

A. Subgrade or subbase shall be fine graded to the cross section indicated on the Contract Drawings, and shall be thoroughly compacted prior to the placing of the aggregate material.

3.05 Installation - General

A. Width, thickness, and type of aggregate materials shall be indicated on the Contract Drawings or as directed by ENGINEER.

B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by ENGINEER.

3.06 Installation of Aggregate Base Course

A. Aggregate base course shall be placed by a mechanical spreader or other approved means, in uniform layers to such a depth that when compacted, the course will have the thickness shown on the Contract Drawings.

B. Depth of any one layer, when compacted, shall not be more than 8 inches (200 mm). If the required compaction cannot be obtained for the full depth of the aggregate course spread, the thickness of each course shall be reduced or, with the approval of ENGINEER, adequate equipment shall be used to compact the aggregate to the required unit weight.

C. The subgrade or subbase shall be shaped to the specified crown and grade and maintained in a smooth condition. If hauling equipment causes ruts or holes in the subgrade or subbase, the hauling equipment will not be permitted on the subgrade or subbase, but shall be operated on the aggregate base course behind the spreader.

D. Aggregate shall be compacted to at least 98% of maximum unit weight by the use of approved pneumatic-tired compaction equipment or vibratory compactors.

E. Optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

F. When approved by ENGINEER, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.

G. Motor graders, trimmers or other approved equipment shall be used to shape the aggregate base course and maintain it until the surface course is placed.

H. When hauling material over the base course, subbase or subgrade, CONTRACTOR shall limit the weight and speed of his equipment to avoid damage to the subgrade, subbase or aggregate base course. If the subgrade, subbase or aggregate base course becomes rutted due to CONTRACTOR's operation, the subgrade, subbase or base course shall be removed and replaced, acceptable to ENGINEER, at CONTRACTOR's expense.

I. With the approval of ENGINEER, chloride additives may be used by CONTRACTOR to facilitate his compaction and maintenance of the aggregate surface. Amount and method of combining the chloride additives are at the option of CONTRACTOR and are at his expense.

3.07 Maintenance During Construction

A. Aggregate base course and aggregate surface shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.

B. CONTRACTOR, at his expense, shall provide additional materials needed to fill depressions or bind the aggregate.

3.08 Temperature Limitations

A. Aggregate materials shall not be placed when there are indications that the mixtures may become frozen before the maximum unit weight is obtained.

B. In no case shall the aggregate be placed on a frozen subgrade or base course unless otherwise directed by ENGINEER.

3.09 Testing

A. During the course of the Work, ENGINEER may require testing for compaction or density and for thickness of material. Testing and coring required shall be performed by a testing laboratory acceptable to OWNER and approved by ENGINEER. Cost for testing and coring shall be at the expense of OWNER.

B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 linear feet (120 m) per traffic lane. Lane width shall be as indicated on the Contract Drawings or as determined by ENGINEER.

1. If 2 lanes are constructed simultaneously, only one test is necessary to represent both lanes.

2. For areas such as intersections, entrances, cross-overs, ramps, widening strips, acceleration and deceleration lane, at least one depth measurement will be taken for each 1,200 square yards (1000 m^2) of such areas or fraction thereof.

3. Location of the depth measurement will be at the discretion of ENGINEER.

C. The maximum unit weight shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D.

3.10 Defective Work

A. Thickness:

1. Measurements of aggregate base course thickness will be made to the nearest 1/4 inch (5 mm).

a. Depths may be 1/2 inch (10 mm) less than the thickness indicated on the Contract Drawings provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness.

b. In determining the average in place thickness, measurements which are more than 1/2 inch (10 mm) in excess of the thickness indicated on the Contract Drawings will be considered as the specified thickness plus 1/2 inch (10 mm).

2. Locations of the depth measurements will be as specified herein unless otherwise directed by ENGINEER. Sections found to be deficient in depth shall be corrected by CONTRACTOR using methods approved by ENGINEER.

B. Weight:

1. When the aggregate material is measured by weight in Tons (or metric tons), the pay weights for aggregates will be the scale weight of the material, including admixtures, unless the moisture content is more than 6 percent.

a. Moisture tests will be made at the start of weighing operations and at any time thereafter when construction operations, weather conditions or any other cause may result in a change in the moisture content of the material.

b. If the tests indicate a moisture content in excess of six (6) percent, the excess over six (6) percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than six (6) percent.

End of Section

Section 32 1216
Bituminous Paving

Part 1 General

1.01 Scope of Work

A. This Section includes bituminous paving complete with bituminous materials; bituminous mixtures; installation of bituminous base course, bituminous wearing course, and bituminous curbs; construction of bituminous pavement, sidewalks, drive approaches, and tennis courts, cold milling and pulverizing existing pavements.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 1100: Clearing and Grubbing
D. Section 31 2313: Subgrade Preparation
E. Section 32 1123: Aggregate Base Courses
F. Section 32 1723: Pavement Markings

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - ASTM International

2. AASHTO - American Association of State Highways and Transportation Officials

3. MAPA - Michigan Asphalt Paving Association

4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

A. Following the final rolling, the surface will be tested longitudinally using a 10-foot (3 m) straightedge at locations selected by ENGINEER. Variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed the following limits:

1. For Bituminous Base Course Mixtures:

a. Multiple Courses:

(1) 3/8 inch (9 mm) for top course
(2) 3/4 inch (20 mm) for lower courses

2. For Bituminous Surface Course Mixtures:

a. Multiple Courses:

(1) 1/8 inch (3 mm) for top course
(2) 1/4 inch (5 mm) for lower courses

b. Single Course: 1/4 inch (5 mm)

B. Variations in excess of the specified tolerance shall be corrected as determined by ENGINEER.

1.05 Material Reports

A. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the ASTM Standards referred to in the Specifications.

B. CONTRACTOR shall provide ENGINEER, or his authorized representative, with the certified batch plant delivery tickets prior to the placing of the materials.

C. CONTRACTOR shall supply ENGINEER with a certified job mix design for each type of bituminous mixture used on this Project.

1.06 Test Reports

A. Testing lab shall provide ENGINEER with two (2) certified copies of the test results of the mix design and the thickness of the bituminous paving material. Core drilling, testing for mix design and thickness, and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.07 Environmental Requirements

A. Comply with the requirements for bituminous concrete installation due to outside ambient air temperatures specified under Article 3.22 of this Section.

Part 2 Products

2.01 Blended Aggregate

A. The blended aggregate shall conform to ASTM D692, D1073; AASHTO M29, and as specified in MDOT, Sections 501 and 902. Aggregates for bituminous mixtures shall conform to the applicable requirements of Table A: Composition of Bituminous Mixtures and Table B: Mix Design Criteria.

2.02 Mineral Filler

A. The mineral filler gradation shall conform to AASHTO M17 and to mineral filler, 3MF, as specified in MDOT, Section 902.12.

2.03 Anti-Foaming Agents

A. The anti-foaming agents shall conform to anti-foaming agents, as specified in MDOT, Section 904.

2.04 Asphalt Binder

A. Asphalt binder for use in production of bituminous mixtures shall Be Performance Graded Asphalt Binder, PG58-28, per MDOT Section 904, unless otherwise indicated on the Plans.

2.05 Liquid Asphalts

A. Liquid asphalts for use in pavement construction shall conform to ASTM D2026, D2027, and D2028, AASHTO M81 and M82, and as specified in MDOT, Section 904.

2.06 Emulsified Asphalt (Bond Coat)

A. Emulsified asphalt for use in pavement construction shall conform to ASTM D244, and as specified in MDOT, Section 904.

2.07 Composition of Mixtures

A. Bituminous mixtures shall be mixed and placed in accordance with applicable requirements specified in MDOT Section 501, except as otherwise specified in this Section.

B. Blended aggregate used for the bituminous wearing course on this Project shall have an Aggregate Wear Index (AWI) of 260, or higher.

C. Aggregates, mineral filler (if required), and asphalt binder shall be combined as necessary to produce a mixture proportioned within the master gradation range limits shown in Table A and meeting the uniformity tolerance limits shown in Table C.

D. Composition limits in Table A are shown in percent by weight, based on the total aggregate, including mineral filler, in the mixture.

E. Bituminous mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content (determined in accordance with MDOT Procedures Manual for Mix Design Processing), shall meet the requirements for stability, flow, voids in mineral aggregate (VMA), air voids, fines/binder ratio, fine aggregate angularity, L.A. Abrasion loss, and soft particles as specified in Table B, Mix Design Criteria.

F. Mixtures failing to meet the requirements specified in Table B will be rejected and the CONTRACTOR will be required to submit additional samples of bituminous mixtures until a combination of material is found which will produce a mixture meeting the Table B requirements.

G. If there is a change in the source of any of the aggregates, a new job-mix formula will be required.

H. After the job-mix formula is established, the aggregate gradation and the asphalt binder content of the bituminous mixture furnished for the Work shall be maintained within the Range 1 uniformity tolerance limits permitted for the job-mix formula as specified in Table C.

1. If two (2) consecutive aggregate gradations on one (1) sieve, or asphalt binder contents as determined by the field extractions are outside the Range 1 but within the Range 2 uniformity tolerance limits, CONTRACTOR shall suspend all operations. (Work days will be charged during the down time.)

2. Before resuming any production, CONTRACTOR shall make all necessary alterations to the materials or plant so that the job-mix formula can be maintained within the deviations permitted under Table C.

I. CONTRACTOR shall provide uniformity in the gradations of the aggregates placed in the cold feed bins so that the combination of aggregates produced for the mixture by blending the aggregates from two (2) or more cold feed bins will be uniformly fed by means of adjustable feeders onto a belt supplying the asphalt plant.

1. Feeders shall be equipped with cutoffs which will automatically stop the operations to the asphalt plant at any time the flow of any aggregate fraction is changed so as to affect the uniformity of the finished product.

J. CONTRACTOR has the option of using hot bins for proportioning the aggregates to meet the specified tolerances.

K. Aggregate gradation tests will be made on aggregate extracted from samples of bituminous mixture taken from the trucks as directed by ENGINEER. As a general guideline, samples will be taken at initial start of production and at other times when tests indicate that the aggregate gradation is fluctuating, truck samples will be taken at a frequency of one (1) sample per 250 Tons (225 metric tons) of mixture, but not more than four (4) samples per day. During other periods where tests indicate the aggregate gradation is stable, truck samples will be taken at a frequency of one (1) sample per 500 Tons (450 metric tons) of mixture, but no more than two (2) samples per day.

1. Mixtures exceeding the maximum tolerances listed in Range 2 under Table C, or exceeding the maximum limits specified for the master gradation range will be rejected and CONTRACTOR may be required to remove and replace any bituminous pavements which ENGINEER determines were constructed with mixtures in the excess of these tolerances.

2. Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans and in the Proposal.

Part 3 Execution

3.01 Excavation

A. Prior to the installation of any bituminous concrete pavement, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the bituminous pavement to be installed. Correct all defects and deficiencies before proceeding with the Work.

3.02 Subgrade and Base Course Conditions

A. Prior to the installation of any bituminous pavement, examine the subgrade and base course to ascertain that it is adequate to receive the bituminous concrete pavement to be installed. If the subgrade remains wet after all surface water has been removed, ENGINEER may require the installation of edge drain.

3.03 Existing Improvements

A. Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Adjustments in line and grade to align the new Work with the existing improvements must be approved by ENGINEER, prior to any changes.

3.04 Equipment Requirements

A. General:

1. CONTRACTOR shall furnish sufficient equipment for completing the Work in a timely and efficient manner.

2. Equipment shall be on the job site and ready for normal operation before the placing of material is started.

   a. Equipment shall be in good working order and of sufficient capacity that the operation can be continuous and a rate of production obtained which insures good workmanship, and eliminates overloading of the equipment or frequent interruptions or delays.

   b. Equipment shall be subject to inspections and testing during construction.

   c. Equipment shall conform to the requirements as specified in MDOT, Section 501 and as specified herein.

B. Pavers:

1. Paver shall be an approved self-powered machine capable of spreading and finishing the mixture in a uniform layer at the desired thickness and cross section and ready for compaction. The use of any machine in poor mechanical or worn condition, will not be permitted. Paver shall be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of surface being applied shall be screeded by an oscillating or vibrating screed.

2. Paver shall at all times produce a uniformly finished surface, free from tearing or other blemishes that would require hand work. Screed shall be adjustable to provide for tilting to secure the proper dray or compressive action necessary to produce the desired surface texture.

3. Paver shall be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved.

4. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to prevent segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.

5. When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. Extensions shall also be equipped with a continuation of the automatically controlled spreading augers. Screed and extensions shall be provided with an approved method of heat distribution.

6. Unless specified otherwise, bituminous pavers shall be equipped with an automatically controlled and activated screed and strike-off assembly capable of grade reference and transverse slope control. A manufacturer approved grade

referencing attachment, not less than 30 feet (9 m) in length, shall be used for all lower courses and the first lane of the wearing course. After the first lane of the wearing course has been placed, a 10-foot (3 m), or longer, grade referencing attachment may be substituted for constructing subsequent adjacent lanes of wearing course mixture.

7. A self-propelled mechanical spreader capable of maintaining the proper width, depth, and slope without causing segregation of the material, may be used for base courses and for surface courses less than eight (8) feet (2.4 m) in width.

8. When surfacing ramps or shoulders, or when the grade of a concrete gutter or other existing installation must be met, the manner of use of the automatic grade reference and slope control devices shall be determined by ENGINEER.

9. Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually for the remainder of the normal working day, provided this method of operation will produce results meeting the specification requirements.

C. Crushing Equipment:

1. Crushing equipment for pulverizing existing bituminous base course shall be an approved rotary reduction machine having positive depth control adjustments in increments of ½ inch (10 mm) and capable of reducing material which is at least six (6) inches (150 mm) in thickness. The machine shall be of a type designed by the manufacturer specifically for reduction in size of pavement material, in place, and be capable of reducing the pavement material to the specified size. Cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control. The rate of forward speed must be positively controlled in order to ensure consistent size of reduced material. The machine must be equipped with an accurate tachometer which is mounted in full view of the operator. Crushing equipment shall meet the approval of ENGINEER.

D. Cold Milling Machine:

1. Cold Milling machine for removing concrete or bituminous surfaces shall be equipped with automatically controlled and activated cutting drums that are capable of grade reference, transverse slope control, and produce a uniformly textured surface. An approved grade referencing attachment, not less than 30 feet (9 m) in length shall be used. Equipment for removing the concrete or bituminous surface shall be capable of accurately removing the surface, in one or more passes, to the required grade and cross section.

E. Joint Heaters:

1. Joint heaters shall be infrared or other approved heaters, equipped with an automatic ignition and extinguishing system to ensure that the heater operates only when the paver is moving. It shall be of sufficient length and heating capacity to adequately soften the edge of the mat. The heater shall be oriented parallel to the joint edge. The bituminous pavement shall not be heated by a direct open flame.

F. Rollers:

1. Steel-wheel rollers shall weight at least eight (8) Tons (7 metric tons) and shall be self-propelled, vibratory or static, tandem rollers or shall be self-propelled static 3-wheel rollers.

    a. Steel-wheel rollers shall be free from backlash, faulty steering mechanism, or worn king bolts.

    b. Steering device shall respond readily and permit the roller to be directed on the alignment desired.

    c. Rollers shall be equipped with wheel sprinklers and scrapers.

    d. Roller wheels shall be smooth and free from openings or projections which will mark the surface of the pavement.

2. Vibratory rollers shall have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph (.8 km/hr) and shall have provisions to lock in the manufacturer's recommended speed, the vibration per minute, and the amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.

3. Pneumatic-tired roller shall be of the self-propelled type with a total weight, including ballast, not greater than 30 tons (27 metric tons).

    a. It shall be equipped with a minimum of seven (7) wheels situated on the axles in such a way that the rear group of tires will not follow in the tracks of the forward group, but will be so spaced that a minimum tire path overlap of 1/2 inch (10 mm) is obtained.

    b. Tires shall be smooth and shall be capable of being inflated to or adapted to achieve a pressure necessary to provide ground-contact pressures of at least 80 pounds per square inch (550 kPa).

    c. Tire pressures shall not vary by more than five (5) pounds per square inch (35 kPa) between individual tires.

    d. CONTRACTOR shall furnish a tire gage which shall be available at all times to enable NGINEER to check the tire pressures.

    e. CONTRACTOR shall furnish ENGINEER charts or tabulations showing the contact areas and the contact pressures for the full range of tire inflation pressures and tire loadings for the type and size roller used.

4. Roller shall be equipped with a mechanism capable of reversing the motion of the roller smoothly. Roller shall be equipped with wheel sprinklers and scrapers or mats.

5. Rollers shall be of sufficient size to compact the bituminous mixture to the required density without tearing, displacing, or cracking the mat.

G. Chip Spreader:

1. Chip spreader shall be self-propelled and shall be equipped with pneumatic tires.

2. Spreader shall be equipped with a screen mounted below the metering gage.

3. Spreader shall be capable of spreading the cover material uniformly at widths of 3 to 12 feet (1 to 3.5 m), or separate spreaders shall be provided for the specific widths required.

a. Rate of discharge of the spreader shall be adjustable to spread uniform layers of 10 to 50 pounds per square yard (5 to 27 kg/m^2).

H. Bituminous Concrete Curbing Machine:

1. Bituminous concrete curbing machine shall be self-propelled and shall be capable of laying and satisfactorily compacting curved and straight line curb to the cross section specified on the Plans. It shall be equipped with templates for the cross sections required.

3.05 Preparation of Foundations

A. For bituminous base course mixtures required to be placed directly on the subgrade, the density, grade and cross section shall meet the approval of ENGINEER at the time of placement of any mixture.

B. Prior to placing any bituminous mixture, the surface of the existing pavement including joints and cracks shall be thoroughly cleaned of all dirt and debris.

C. Existing structures within the limits of the new Work shall be adjusted as specified in the Plans, or as directed by ENGINEER.

3.06 Preparation of Aggregate Base

A. Prior to the placing of any prime coats or any bituminous mixtures, the density, grade and cross section of the aggregate base shall meet the approval of the ENGINEER at the time of placement of any material.

B. Surfaces that have become too wet or too dry shall be reworked to provide the required density.

3.07 Preparation of Existing Pavement

A. This Work consists of preparation of the existing concrete road for resurfacing. All broken pavement or pavement not bonded to the base pavement, and loose bituminous surfacing or patches shall be removed. All longitudinal and transverse joints and cracks shall be cleaned in accordance with Article 3.14, Joint Cleanout. Butt joints at the end of surfacing sections and at intersections of adjoining streets shall be made in accordance with Article 3.08. Vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.08 Butt Joints

A. If butt joints are specified on the Plans, or by ENGINEER, the old surface shall be cut back for at least five (5) feet (1.5 m) to a depth of at least 1-inch (25 mm), for the full width of the joint. The vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.09 Edge Trimming

A. Trimming and truing the edge of an existing bituminous surface shall be performed as required to give a straight, sharp edge at the proper elevations.

B. The existing base under the bituminous surface shall be left undisturbed.

3.10 Removing Bituminous Surfacing

A. When removing an existing bituminous pavement, the edges of the area to be removed shall be cut along straight lines, either perpendicular or parallel to the direction of travel, for the full depth of the bituminous surfacing with the cut edge a minimum of 18 inches (450 mm) back from the disturbed edge of pavement.

B. The cutting of the edges and the breaking up of the bituminous material within the removal area, and the removing and disposing of the unsuitable material are included in the Work of removing bituminous surfacing.

3.11 Removing Bituminous Patches

A. Where the removal of bituminous patching material is specified on the Plans or as directed by ENGINEER, it shall be saw cut along the edges of the patched area to prevent the tearing of the adjoining pavement surfaces during the removal operation.

B. Cutting, removing and disposing of bituminous surfacing and unsuitable materials are included in the Work of removing bituminous patches.

3.12 Pulverization and Shaping of Existing Bituminous Base Course

A. This Work consists of scarifying, pulverizing, milling, crushing, adding new material if required, shaping, rolling, compacting, and proofrolling the crushed base to the proper elevation and slope.

B. Additional materials required to fill holes and voids shall be furnished at CONTRACTOR's expense. Additional aggregate, if required shall be 20A or 22A aggregate.

C. The material shall be scarified and uniformly pulverized to a maximum size of two inches (50 mm), in addition, 95 to 100 percent of the material shall have a particle size of 1-1/2 inches (40 mm) or smaller.

D. The material shall be scarified and uniformly pulverized, in one or more passes, to the depth specified on the Plans or as determined by ENGINEER.

E. The maximum length or width of roadbed to be scarified and pulverized at any one time shall be as specified on the Plans or as determined by ENGINEER.

F. The crushed material shall be rough graded to within 3/4 of an inch (20 mm) of the grade called for on the Plans, or as directed by ENGINEER. Additional aggregate shall be placed, if necessary, to attain the required cross sections.

G. After the material has been balanced, it shall be thoroughly mixed. In restrictive areas, the material to be mixed may be bladed into a windrow to provide working room for the mixer.

H. The mixed material shall be shaped and compacted in reasonably close conformity with the lines, grades, and cross sections shown on the Plans or as established by ENGINEER. Excess material shall be removed and disposed of by CONTRACTOR at his expense.

I. Finished rolling shall be done with a vibratory steel wheel roller.

J. Aggregate-bituminous pavement mixture shall be compacted to not less than 95 percent of the unit weight obtained by the AASHTO T180 test method. The test shall be made on the aggregate-bituminous mixture at the field moisture content existing during the compacting operation. Required density shall be maintained until the material has been surfaced.

K. Prior to the placing of any surface courses, the pulverized material shall be proofrolled. Proofrolling shall be accomplished with an 18,000 pound (82 000 kg) single axle load. Unstable areas shall be removed and backfilled.

3.13 Hand Patching

A. Where the filling of holes and depressions in the base or the replacing of the patches is specified on the Plans or as directed by ENGINEER, the filler material shall be an approved bituminous mixture.

B. The mixture selected will be dependent on the depth and size of the patch and the type of mixture and performance grade of the asphalt binder required.

C. Patches shall be compacted to the required grade by use of a machine vibrator or approved roller.

3.14 Joint Cleanout

A. Where joint cleanout is specified on the Plans or as directed by ENGINEER, the joint sealants and foreign material shall be removed to a minimum depth of 1-inch (25 mm) by approved mechanical or hand methods.

B. Removal and disposal of unsuitable materials and the removal and disposal of bituminous surface patches adjacent to joints are included in the Work for joint cleanout.

3.15 Repairing Pavement Joints

A. Where existing pavement joints and cracks are to be repaired, as specified on the Plans or as directed by ENGINEER, the existing bituminous surface and any loose or spalled concrete around the joints and cracks shall be removed.

B. Each joint or crack shall be cleaned and shall be filled with an approved mixture and the mixture shall be compacted with a vibratory machine or by an approved method.

3.16 Cold Milling Concrete or Bituminous Pavement

A. Where cold milling concrete or bituminous pavement is specified, the pavement shall be milled to the shape and cross section as shown on the plans. Immediately after cold milling, the surface shall be cleaned. CONTRACTOR shall remove and dispose of any resulting debris.

B. When allowed by ENGINEER, milling materials may be used for temporary wedging.

1. Prior to placing pavement, temporary wedging materials shall be removed and disposed of.

2. Wedging with milled materials is incidental to the Project.

3.17 General Bituminous Pavement Installation Requirements

A. The width, thickness and type of bituminous paving improvement shall be specified on the Plans, indicated in the Proposal or as determined by ENGINEER.

B. At street intersections, curb drops conforming to the current rules and regulations of Act 8, Michigan PA 1973, as amended, shall be provided for the construction of sidewalk ramps. In addition, curb drops for sidewalks and driveway approaches shall be provided in locations called for on the Plans or as determined by ENGINEER.

C. Existing improvements, including structures, shall be protected to prevent their surfaces from being discolored during application of bituminous materials.

3.18 Bituminous Prime Coat or Bond Coat

A. The prepared foundation shall be treated with bituminous material for prime coat or bond coat as specified. A bond coat shall be applied to each layer of bituminous mixture before the succeeding layer is placed.

B. Bituminous material shall be applied uniformly by means of a pressure distributor, and only in such areas as may be inaccessible to the regular distributor operation shall the bituminous material be applied by means of the hand spraying apparatus of the distributor.

1. Where necessary to accommodate traffic, the surface shall be treated half-width or as recommended by ENGINEER.

2. Foundation shall be free from moisture when the treatment is applied.

3. Under no circumstances shall pools of bituminous material be allowed to remain on the surface.

C. The amount of prime coat to be applied per square yard shall be 0.05 gal/s.y (250 ml/m^2) unless otherwise specified on the Plans or recommended by ENGINEER.

D. When prime coat is applied, the surface course shall not be placed until the prime coat has been properly cured. No blotting of the prime coat with aggregate in lieu of proper curing will be permitted.

E. Prime coat may be omitted or reduced when authorized by ENGINEER.

F. Bond coat shall be applied at the rate specified by ENGINEER. This rate will be between 0 and 0.10 gallons per square yard (0 to 450 ml/m^2) on the bituminous or concrete foundation and between 0 and 0.05 gallons per square yard (0 to 250 ml/m^2) between subsequent courses.

G. Bond coat material shall be applied ahead of the paving operation for a distance of at least 1,500 feet (450 m), depending on traffic conditions, as determined by ENGINEER. The surfacing shall not be placed until the bond coat has cured.

3.19 Transportation of Mixtures

A. The transportation of the mixtures as specified shall be in accordance with MDOT, Section 501.

3.20 Placing Bituminous Mixtures

A. Pavers will be required to have an automatically controlled and activated screed and strike-off assembly except when placing mixtures for:

1. Variable width sections;

2. Sections of pavement less than 1,000 feet(300 m) in length;

3. Placing the first course of a base course mixture on an earth grade or on a sand subbase; or,

4. Placing base course mixtures in widths less than eight (8) feet (2.5 m).

B. Bituminous base course mixtures shall not be placed in lifts exceeding three (3) inches (75 mm), unless otherwise approved by ENGINEER.

1. Approval to place lifts in excess of three (3) inches (75 mm) will be based on the ability of CONTRACTOR to place and compact the base course to the required cross section and within the specified tolerances.

C. For lifts of 2-1/2 inches (65 mm) or greater, a berm of shoulder material shall be banked against the outside edge of each layer of mixture placed unless the sequence of operations is such that the edges of the material are adequately confined and supported in some other manner.

1. The width of material placed shall be twice the height of the bituminous layer being placed but in no case less than a 6-inch (150 mm) width.

D. When the application rate for a bituminous wearing course exceeds 220 pounds per square yard (120 kg/m^2), the pavement shall be constructed in two (2) or more courses, unless otherwise specified on the Plans or as authorized by ENGINEER.

E. Bituminous mixture shall be placed by an approved self-propelled mechanical paver to such a depth that when compacted, it will have the thickness specified.

1. The mixture shall be dumped into the center of the hopper and care shall be exercised to avoid overloading the paver and spilling the mixture upon the base.

2. The paver speed shall be adjusted at the discretion of ENGINEER to that speed which, in his opinion, gives the best results for the type of paver being used and which coordinates satisfactorily with the rate of delivery of the mixture to the paver to provide a uniform rate of placing the mixture without intermittent operation of the paver.

F. When delays result in slowing paving operations such that the temperature of the mat immediately behind the screed falls below 170 degrees Fahrenheit (75 degrees Celsius), paving shall be stopped and a transverse construction joint placed.

G. Bituminous mixture shall be placed in one (1) or more layers as called for on the Plans or as approved by ENGINEER.

1. To take out irregularities in the existing road surface, wedging with bituminous mixture shall be done by placing several layers with the paver.

2. Corrections to the foundation by wedging with bituminous material shall be made by placing, compacting, and allowing the material to cool prior to paving.

H. Bituminous mixtures shall be placed using two (2) pavers in echelon or one (1) paver equipped with an approved joint heater.

1. ENGINEER may omit the use of the joint heater if the temperature of the previously placed mat does not fall below 170 degrees Fahrenheit (75 degrees Celsius) prior to placement of the adjacent course.

I. Echelon paving will be permitted when allowed by ENGINEER.

J. Cold joints will be permitted along acceleration and deceleration lanes, lanes less than full width, irregularly shaped sections, and at transverse joints.

1. Edges of the initial mat for all cold joints shall be painted with bituminous material before the bituminous mixture is placed in the adjacent section.

2. In placing the bituminous mixture adjacent to all joints, hand raking or brooming will be required to provide a dense smooth connection.

K. Connections with existing surfaces at the beginning and ending of resurfacing sections and at intersections shall be made by feathering out the mix, by constructing a butt joint, or as approved by ENGINEER.

L. When placing the bituminous mixture in a lane adjoining a previously placed lane, the mixture shall be placed such that it uniformly overlaps the first lane by two (2) to four (4) inches (50 to 100 mm) and is placed at a height above the cold mat equal to the breakdown roller depression on the hot mat.

1. Overlapping material shall be bumped, back onto the hot lane so that the roller will compress the excess material into the hot side of the joint.

2. If, in the opinion of ENGINEER, the overlap is excessive, the excess material shall be trimmed so as to leave an edge having a uniform thickness.

3. Excess material shall be discarded; it shall not be spread across the surface course.

M. If the lanes are being constructed with two (2) or more pavers in echelon, the loss depths of bituminous material from each paver shall match at the longitudinal joints.

3.21 Rolling and Compacting of Bituminous Mixtures

A. Each layer of bituminous mixture shall be compacted with approved rollers. At least two (2) rollers will be required when the mixture lay-down rate exceeds 800 square yards (650 m^2) per hour.

B. Steel 3-wheel rollers may be used for initial compaction immediately following the paver.

C. The final rolling operation on each layer of bituminous mixture shall be accomplished by use of tandem steel-wheel rollers or by use of vibratory rollers operated in the static mode.

D. Roller wheels shall be kept properly moistened with water.

E. Pneumatic-tired rollers shall be operated in a competent manner and shall not mark or rut the surface or displace the pavement edges.

1. Pneumatic-tired roller shall be ballasted to obtain the required ground-contact pressures as directed by ENGINEER.

2. To obtain a uniformly textured mat and the desired pavement density, ENGINEER may recommend CONTRACTOR to raise or lower tire pressures at any time during the rolling operations.

3. Roller operations shall be conducted in such a manner as to prevent scuffing or chatter marks in the pavement surface.

4. The number of passes made by the pneumatic-tired roller shall not be less than two (2) round trip passes over each area.

F. Rolling of the mixture shall begin as soon after placing without undue displacement, picking up the mat, or cracking.

1. Rolling shall start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the drive wheel of the roller.

2. Alternate trips of the roller shall be of slightly different lengths.

3. The maximum roller speed shall not exceed the manufacturer's recommended speed for the type of mixture or thickness of layer being placed.

G. When compacting an adjoining lane, the longitudinal joint shall be rolled first with the roller supported mainly on the cold lane with only three (3) to six (6) inches (75 to 150 mm) of the roller extending onto the freshly placed bituminous material.

H. Finish rolling shall continue until all roller marks are eliminated.

I. Pneumatic-tired rollers will not be permitted on wearing courses.

J. Areas too narrow to be rolled directly by standard 8-Ton (7 metric ton) tandem rollers shall be compacted by self-propelled trench rollers of suitable width, approved by ENGINEER, and weighting not less than 300 pounds per inch of width (5500 kg/m).

K. Skin patching on an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective shall be removed and replaced at CONTRACTOR's expense.

L. See Article 3.31 of this Section for compaction test.

3.22 Weather and Seasonal Limitations

A. Bituminous mixtures shall not be placed nor the prime coat or bond coat applied when rain is threatening or when the moisture on the existing surface would prevent satisfactory bonding.

B. Unless otherwise approved by ENGINEER in writing, minimum mixture temperature limitations at the time of placement, and seasonal limitations for placing bituminous mixtures shall be in accordance with the following:

C. Seasonal Limitations:

1. Upper Peninsula ..... June 1 - Oct 15
2. Lower Peninsula, north of M-46 ..... May 15 - Nov 1
3. Lower Peninsula, south of M-46 ..... May 5 - Nov 15

Mix Temperature Placement Limitations:			
Temperature of Surface being Overlayed °F (°C)	Rate of Application of Bituminous Material, lbs/syd (kg/m^3)		
	< 120 (65)	120 – 200 (65 – 110)	> 200 (110)
35 – 39 (2 – 4)	-	-	329 (165)
70 – 78 (21 – 25)	302 (150)	289 (142)	275 (135)
79 – 86 (26 – 30)	289 (142)	275 (135)	275 (135)
86 and Over	275 (135)	275 (135)	275 (135)

D. Bituminous paving will not be allowed below these minimum temperatures, nor when there is frost on the grade or existing surface.

3.23 Heating Bituminous Materials

A. Bituminous material which requires heating before application shall be heated in such a manner as to insure a uniform temperature throughout the entire mass with efficient and positive control at all times. It shall be heated to a temperature consistent with the type of material used and only to such temperature as will insure the necessary fluidity.

1. Excessively high temperatures shall be avoided.

2. A thermometer shall be provided to enable ENGINEER to observe the temperature at any time.

3. Bituminous material which has been overheated will be rejected.

B. Asphalt emulsion shall be circulated continuously when heated above atmospheric temperature so as to prevent it from separating.

1. Heating of asphalt emulsion to the required temperature for application shall be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by means of a circulating heater.

2. Asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected.

3.24 Patching

A. Where patching is required on a bituminous surface or concrete surface because of small holes or pitted surface, the holes shall be cleaned of all dirt and foreign material.

B. The bituminous patching material shall be placed, struck off and compacted so that when completed, the patch shall be flush with the adjacent pavement. The compaction may be done with a hand tamper, vibratory compactor or roller.

C. When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill shall be compacted to not less than 95% of the maximum unit weight.

An aggregate base material of not less than 12 inches (300 mm) compacted thickness, or a bituminous base of the specified thickness, shall be used. The top of the base shall be 2 to 2-1/2 inches (50 to 65 mm) below the surface of the adjacent pavement. Bituminous patching material shall be placed and compacted.

D. The surface of the bituminous patch shall be smooth and shall not vary more than 1/4 inch (5 mm) from the crown and grade of the adjacent pavement. Variations over 1/4 inch (5 mm) from the established grade shall be corrected as determined by ENGINEER.

3.25 Chip Seal

A. Seal coating shall consist of 1 or more applications of bituminous material applied to the prepared surface and 1 or more coverings of coarse or fine aggregate applied to the bituminous material.

B. Asphalt Emulsion shall be HFRS-2M or CRS-2M and aggregate shall be MDOT 29A unless otherwise specified on the plans.

C. Cover materials used for seal coating shall be sufficiently dry when it comes in contact with bituminous material. The moisture content shall not exceed 3 percent by weight, dry basis. Satisfactory means shall be provided for the protection of the coating materials against excessive moisture by covering stockpiles, by aeration or through manipulation.

D. The bituminous material specified for surface coat shall be uniformly applied by means of the pressure distributor in the number of applications provided and in the amount per square yard as determined by ENGINEER. Each application of bituminous material shall cure sufficiently to prevent displacement or pickup by traffic or construction equipment before a succeeding application of bituminous material is made.

E. Following the application of surface coat bituminous material, the cover material shall be uniformly spread over the surface by means of approved mechanical spreaders, in the amount per square yard as specified or as determined by ENGINEER. Truck wheels shall ride on spread cover material and not on bituminous material.

F. Irregularities or deficiencies in the uniformity of the cover aggregate on the surface shall be corrected by hand spreading and dragging.

G. Following the spreading of each course of cover material, the surface shall be rolled by means of approved rollers.

H. Rolling shall immediately follow the placing of cover material before the bituminous material has set. At no time shall there be more than 300 feet (90 m) of unrolled cover material. No cover material shall be left unrolled for more than five (5) minutes.

I. Sufficient rolling shall be done to embed the cover material in the bituminous material without crushing the aggregate.

J. For areas deficient in cover material after completion of the surface treatment, additional cover material shall be added. For areas with excessive cover material, the excess cover material shall be removed before the next seal is applied. Final application of cover material shall be swept with a power broom.

K. Completed surface shall be maintained with a drag, broom or other approved equipment to keep the material well distributed on the road until all cover material possible has been embedded in the bituminous material. The length of time required for this maintenance will be from 2 to 5 days, as determined by ENGINEER, depending on the weather and the materials used.

3.26 Bituminous Concrete Curb

A. Bituminous concrete curb shall be constructed to the design specified on the Plans or as approved by ENGINEER and shall include the conditioning and treating of the surface on which the curb is to be placed.

B. Materials used in the construction and installation of bituminous concrete curbing shall meet the requirements as specified in Part 2, Products of this Section, and as specified in MDOT, Section 904.

C. Bituminous concrete curb mixture shall be 13 or 13A as specified in this Section and in accordance with MDOT, Section 501, unless otherwise approved by ENGINEER.

D. Bituminous curb shall be constructed to conform to the Plans or as determined by ENGINEER. The method of construction shall conform to MDOT, Section 805, unless otherwise specified.

E. Bituminous mixture shall be thoroughly compacted by a curbing machine to the cross section shown on the Plans, or as determined by ENGINEER. The curb shall be formed to the density to produce a tight surface texture. Curbs showing segregation, slumping, or misalignment shall be removed and replaced at CONTRACTOR's expense.

F. When specified on the Plans or as directed by ENGINEER, an application of asphalt emulsion or other approved bituminous coating shall be applied to the finished curb at the joint of the curb and pavement, or to the inside face of the curb, or to both, as a protective seal.

G. Backfilling behind the curb shall not commence until the bituminous mixture has cured.

H. Backfill material shall be placed and thoroughly tamped and compacted to the satisfaction of ENGINEER, without disturbing the curb, and shall be left in a neat and workmanlike condition.

3.27 Bituminous Approaches, Sidewalks, and Shoulders

A. This Work shall consist of constructing a bituminous surface course as specified on the Plans, or as approved by ENGINEER. Bituminous surface course shall be placed on a prepared foundation.

B. Bituminous materials used shall be as specified on the Plans, or as approved by ENGINEER. Materials acceptable for use are specified in Part 2 of this Section, and as specified in MDOT, Section 904.

C. Bituminous approach mixture shall be in accordance with MDOT, Section 501, unless otherwise approved by ENGINEER.

D. Existing pavement or aggregate base shall be prepared to receive the bituminous surface course as specified in this Section.

E. Bituminous prime and bond coats used shall meet the requirements specified in this Section. Care shall be taken to prevent spreading of bituminous material on adjoining surfaces. When approved by ENGINEER, the prime coat may be omitted.

F. The bituminous mixture shall be placed to the thickness specified on the Plans or as determined by ENGINEER.

G. Placing the bituminous mixture shall conform to this Section.

H. When approved by ENGINEER, the paver used for placing bituminous approaches and sidewalks will not be required to have an automatically controlled or activated screed or strike-off assembly or the corresponding grade referencing equipment. Also, with approval from ENGINEER, only one (1) roller may be used with each paver.

3.28 Tennis Courts

A. Bituminous tennis courts shall be constructed to the cross section shown on the Plans, or as determined by ENGINEER.

B. Materials used in the construction of the bituminous tennis court shall meet the requirements specified in Part 2 of this Section, and as specified in MDOT, Section 904.

C. Bituminous base course mixture shall be 13 or 11A as specified in this Section and MDOT, Section 501 unless otherwise specified on the plans.

D. Bituminous surface course mixture shall be 4C, 13A or 36A as specified in this Section and MDOT Section 502, unless otherwise specified on the plans.

E. Asphalt content and performance grade shall be determined by the job mix formula submitted by the CONTRACTOR and approved by ENGINEER.

F. Bituminous base course and wearing course shall be constructed to conform to the Plan. The method of construction shall conform to MDOT Section 502, unless otherwise specified.

G. Bituminous bond coat used shall meet the requirements specified in this Section.

H. The rate of application shall be 0.05 - 0.10 gallons per square yard (225 to 450 ml/m^2).

I. For the preparation of the foundation to receive the bituminous base course and bituminous surface course, see the appropriate Articles in Part 3 of this Section.

J. Bituminous base course, if required, and the bituminous surface course shall be installed to thickness shown on the Plans. The method of installation of mixtures shall conform to this Section.

3.29 Cleanup

A. Area adjacent to the new Work shall be backfilled with sound earth of topsoil quality.

B. Backfill shall be compacted, leveled and left in a neat, workmanlike condition. At a seasonally correct time the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, or sodded in accordance with Section 32 9223, Sodding.

3.30 Monument Boxes

A. Government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnished and installed by CONTRACTOR and shall be East Jordan Iron Works No. 1570, or approved equal.

B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.31 Testing

A. During the course of the Work, ENGINEER may require testing for mix designs, aggregate gradation, and physical properties, bitumen content, compaction or density, and thickness of material. Testing and coring required shall be performed by a testing laboratory approved by ENGINEER. Cost for testing and coring shall be at the expense of OWNER. The testing laboratory shall furnish ENGINEER with two certified copies of the results of all tests.

B. Testing procedures shall conform to current MDOT Standards for Construction.

C. Testing of asphalt binders, liquid asphalts, asphalt emulsions, tars shall conform to MDOT, Section 904.

D. Rolling shall proceed until the required compaction is attained and the amount of rolling required shall be based on the test results of a nuclear gage or on using a specified minimum number of rollers. When the total tonnage for the Project is in excess of 1,000 Tons (900 metric tons), the nuclear gage method will be used to govern the compactive requirements.

E. Control density for the bituminous mixture to be placed, will be determined by use of a modified Marshall Test.

F. Control Density:

1. During CONTRACTOR's start-up operations, a rolling procedure to attain the control density will be established.

    a. Rolling procedure will be based on the number and type of rollers used and the rolling pattern.

    b. Goal of the compactive effort will be to establish a rolling procedure which will achieve 100% of the control density but in any case, the density achieved shall not be less than 95% of the control density.

    c. Density values less than 98% will be sufficient cause for ENGINEER to require an adjustment in the number or type of rollers being used or in the rolling pattern.

2. Once the procedure has been established on the start-up section, the procedure shall be used for the remainder of the mixture to be placed, unless subsequent tests indicate a need to change the number of rollers or the rolling pattern.

3. If difficulties are encountered or if there is a significant change in aggregate or bitumen content, ENGINEER will determine the control density for the new mixture and require CONTRACTOR to again establish the number and type of rollers and the rolling pattern required on the new mixture to attain the control density. Compactive procedures thus determined shall be used when placing the remainder of that mixture.

4. Density checks will be made at the discretion of ENGINEER to determine if the compactive procedure being used is achieving the required density, or if a change in procedure is necessary.

5. Each layer of bituminous mixture shall be compacted to at least 95% of the control density, using the established procedure.

3.32 Price Adjustments

A. Samples of asphalt binder may be taken prior to incorporation into the mixture and from the bituminous mixture. Where results of tests on these samples deviate from specification requirements, the affected material will be subject to price adjustments on the following basis:

1. When the test results deviate from the limits specified in MDOT, Table 904-1, Performance Graded Asphalt Binder Specification, by ten (10) percent or more, the mixture produced will be evaluated by ENGINEER and if in his judgment the defective pavement warrants removal, CONTRACTOR shall remove and replace the affected area at his expense. If it is determined that the removal is not required, the Contract unit price of the affected mixture will be reduced by ten (10) percent.

2. Core samples may be taken on the completed Work. If the results from testing of the core samples indicates a deficiency in the completed Work, ENGINEER will evaluate the test results and will recommend removal and replacement or a credit to OWNER.

Table A: Composition of Mixtures										
Mixture No.	2B	2C	3B	3C	4B	4C	13	13A	11A	36A
Binder %	4-6	4-6	4.5-7	4.5-7	5-8	5-8	5-8	5-8	4-6	5.5-8
Percent Passing Indicated Sieve										
1-1/2" (37.5 mm)	100	100							100	
1" (25 mm)	99-100	99-100	100	100					90-100	
3/4" (19 mm)	90 max	90 max	99-100	99-100	100	100	100	100	70-95	
1/2" (12.5 mm)	78 max	78 max	90 max	90 max	99-100	99-100	75-95	75-95	55-85	100
3/8" (9.5 mm)	70 max	70 max	77 max	77 max	90 max	90 max	60-90	60-90	40-80	92-100
No. 4 (4.75 mm)	52 max	52 max	57 max	57 max	67 max	67 max	45-80	45-80	25-65	65-90
No. 8 (2.36 mm)	15-40	15-40	15-45	15-45	15-52	15-52	30-65	30-65	15-50	55-75
No. 16 (1.18 mm)	30 max	30 max	33 max	33 max	37 max	37 max	20-50	20-50	10-40	
No. 30 (600 um)	22 max	22 max	25 max	25 max	27 max	27 max	15-40	15-40	7-32	50-20
No. 50 (300 um)	17 max	17 max	19 max	19 max	20 max	20 max	10-25	10-25	5-20	
No. 100 (150 um)	15 max	15 max	15 max	15 max	15 max	15 max	5-15	5-15	4-12	
No. 200 (75 um)	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-6	3-10
Crushed Min. %	50	90	50	90	50	90	0	25	25	60

Table B: Mix Design Criteria										
Mixture No.	2B	2C	3B	3C	4B	4C	13	13A	11A	36A
VMA Min. %	13.5	13.5	15	15	16	16	15.5	15.5	13.5	16.5
Air Voids % Target (1)	3	3	3.5	3.5	3.5	3.5	3	3	3	3
Fines/Binder Ratio Max. (2)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Fine Aggregate Angularity Min. (3)	3	4	3	4	3	4	2	2.5	2.5	3
Flow-in. (mm)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)	.08-.16 (2.0-4.0)
L.A. Abrasion Max. % loss (4)	40	40	40	40	40	40	40	40	50	40
Soft Particle Max. % (5)	12	12	12	12	8	8	8	8	12	8
Stability Min. Pounds (kN)	1200 (5.3)	1200 (5.3)	1200 (5.3)	1200 (5.3)	1200 (5.3)	1200 (5.3)	900 (4.0)	900 (4.0)	900 (4.0)	900 (4.0)

Notes:

(1) The JMF target may be adjusted in the field, prior to placement, to meet the project design criteria for a specific application; for example, 2.0 percent air voids on shoulders or bike paths.
(2) Fines/Binder Ratio. The ratio of aggregate material finer than the No. 200 (75 um) sieve to asphalt binder content by weight including fines and bituminous contributed by reclaimed asphalt pavement (RAP).
(3) The fine aggregate angularity of blended aggregate, determined by MTM 118, must meet the minimum requirement. In mixtures containing RAP, the required minimum fine aggregate angularity must be met by virgin material.
(4) Los Angeles abrasion loss must be met for the composite mixture; however, each individual aggregate must be less than 50.
(5) The sum of the shale, siltstone, structurally weak, and clay-ironstone particles shall not exceed 8.0 percent for aggregates used in top course. The sum of the shale, siltstone, structurally weak, and clay-ironstone shall not exceed 12 percent for base and leveling courses.

Table C: Uniformity Tolerance Limits For Bituminous Mixtures						
Type of Course	Range (a)	Percentage Passing Designated Sieves				Asphalt Binder Content
		(b)	No. 8 2.35 mm	No. 30 600 um	No. 200 75 um	
Top and Leveling Course	Range 1	± 5.0	± 5.0	± 4.0	± 1.0	± 0.40
	Range 2	± 8.0	± 8.0	± 6.0	± 2.0	± 0.50
Base Courses	Range 1	± 7.0	± 7.0	± 6.0	± 2.0	± 0.40
	Range 2	± 9.0	± 9.0	± 9.0	± 3.0	± 0.50

Notes:

(1) This range allows for normal mixture and testing variations. The mixture shall be proportioned to test as closely as possible to the Job Mix Formula.
(2) This includes all sieve sizes No. 4 (4.75 mm) and larger listed on the Job Mix Formula.

Table A[1]: Composition of Mixtures									
Total Percent Passing Indicated Sieve (a)									
Mixture No.	No. 1800 No. 1500 No. 1300 (36A)(36B)	No. 1800 No. 1500 No. 1300 (20AAA)	No. 1100 (36A) (36B)	NO. 1100 (20AA)	NO. 1100 (20A)	No. 900 (20AA)	No. 900 (20A)	No. 900 (20B)	No. 700 No. 500 (20C)
1-1/2" (37.5 mm)	-	-	-	-	-	-	-	-	100
1" (25 mm)	-	-	-	-	-	-	-	-	80-100
3/4" (19 mm)	-	100	-	100	100	100	100	100	-
1/2" (12.5 mm)	100	90- 00	100	90-100	-	90-100	-	-	-
3/8" (9.5 mm)	92-100	65- 5	92-100	65-95	60-90	65-95	60-90	60-95	55-90
No. 4 (4.75 mm)	65-90	55- 5	65-90	-	-	-	-	-	-
No. 8 (2.36 mm)	55-75	45- 0	55-75	45-70	40-65	45-70	40-65	40-70	30-55
No. 30 (600 um)	25-50	20- 5	25-50	20-45	20-40	20-45	20-40	20-45	15-40
No. 200 (75 um)(b)	4 -10	3-0	4-10	3-10	3-10	3-10	3-10	3-10	3-10
Binder % (c)	5-9	5- 9	5-9	5-7	5-7	5-7	5-8	5-8	3-6
Crushed Min. %	(d)	60	(d)	40	25	40	25	-	-

Notes:

(a) Composition limits are shown in percent by weight, based on the total aggregate, including mineral filler in the mixture.
(b) The Job-Mix-Formula shall have a minimum total percent passing a No. 200 sieve of 5.0 percent.
(c) The percent of bitumen in the mixture shown in Table A1 is a range and the actual bitumen content in the production mixture shall be as determined by the Job-Mix-Formula. For mixtures No. 900, 1100, 1300, 1500, and 1800 placed in two courses, the leveling course will be designed to have up to 0.5 percent less bitumen than the optimum specified for the top course. Mixtures No. 500 and 700 will be designed to have a target air void of 4.0 percent.
(d) 36A = 60%, 36B = 40%

Table B[1]: Mix Design Criteria					
Mixture No.	Aggregate Required	Stability Pounds (Minimum)	Flow (.00 inch)	VMA % (Minimum)	Air Voids % Target
500	20jC	500	-	13.0	4.0
700	20C	700	8-16	13.0	4.0
900	20B, 20A, 20AA	900	8-16	13.5	2.5
1100	20A, 20AA, 36A, 36B	1100	8-16	13.5	3.0
1300	20AAA, 36A, 36B	1300	8-16	14.0	3.0
1500	20AAA, 36A, 36B	1500	8-16	14.0	3.0
1800	20AAA, 36A, 36B	1800	9-16	14.0	3.0

End of Section

Section 32 1313
Concrete Paving

Part 1 General

1.01 Scope of Work

A. This Section includes both plain and reinforced portland cement concrete paving complete with concrete material admixtures, joints, forms, equipment requirements, field quality control and appurtenances required to complete the portland cement concrete paving Work indicated on the Plans.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 31 2313: Subgrade Preparation
C. Section 31 2319: Dewatering
D. Section 32 1123: Aggregate Base Courses
E. Section 32 1723: Pavement Markings
F. Section 32 9219: Seeding
G. Section 32 9223: Sodding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications.

1. ASTM - ASTM International

2. AASHTO - American Association of State Highway and Transportation Officials

3. ACPA - American Concrete Paving Association

4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Material Reports

A. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the Standards referred to in the Specifications.

B. CONTRACTOR shall submit a list of his source of material supply to ENGINEER for review prior to placing any order.

C. CONTRACTOR shall provide ENGINEER, prior to the actual delivery of the ready-mixed concrete, the mix design as required by paragraph 5.3.2 of ASTM C94.

1.05 Thickness and Compressive Strength Reports

A. The testing lab shall provide the ENGINEER with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. The core drilling, testing for thickness and compressive strength, and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.06 Water Quality Test Reports

A. The testing lab shall provide ENGINEER with two (2) certified copies of the test results of the quality of water to be used in the concrete.

B. Sampling and testing of water quality shall be in accordance with AASHTO T-26 requirements, and the certification of the tests' results shall be performed by a testing laboratory approved by ENGINEER.

1.07 Request for Material Variance

A. Requests for variances in the materials, as specified, shall be made in writing to ENGINEER.

B. Two (2) copies of the request shall be submitted for ENGINEER's review and approval.

1.08 Environmental Requirements

A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Articles 3.21 and 3.22 of this Section.

B. Comply with the requirements for protecting new Work against damage from rain, as specified under Article 3.20 of this Section.

C. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Article 3.21 of this Section.

Part 2 Products

2.01 Cement

A. Cement shall be low alkali, air-entraining Portland cement conforming to ASTM C150, Type IA or Type IIIA.

2.02 Fine Aggregates

A. Fine aggregate gradation shall conform to ASTM C33 and to fine aggregate, 2NS, as specified in MDOT Section 902.

2.03 Coarse Aggregate

A. Coarse aggregate gradation shall conform to ASTM C33 and to coarse aggregate, 6A, or 6AA as specified in MDOT Section 902.

2.04 Water

A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.

B. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without testing.

C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be used in Concrete, AASHTO T-26, and specified in MDOT Section 911.

2.05 Concrete Admixtures

A. Air-Entraining Admixtures:

1. Air-entraining admixtures for concrete shall conform to ASTM C260 and as specified in MDOT Section 903.

B. Concrete Accelerators:

1. Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to ASTM C494, Type C or Type E.

2. Calcium chloride in flake or pellet form shall conform to ASTM D98, Type S, Grade 1 or grade 2, flake or pellet form, and as specified in MDOT Section 903.

3. Calcium chloride in solution form shall conform to MDOT Section 903.

C. Water-Reducing and Water-Reducing Retarding Admixtures:

1. Water-reducing admixtures and water-reducing retarding admixtures shall conform to ASTM C494, Type A or Type D, except that neither type of admixture shall contain calcium chloride, and as specified in MDOT Section 903.

D. Pozzolanic Admixtures:

1. Fly Ash shall conform to ASTM C618, Type F, and as specified in MDOT Section 901.

2. Ground granulated blast furnace slag shall conform to ASTM C989, Grade 100, minimum.

2.06 Concrete Curing Compounds

A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 903.05.

B. Transparent membrane curing compound for curing base course concrete shall conform to ASTM C309, Type 1-D, Class B Vehicle, and as specified in MDOT, Section 903.05.

2.07 Lane Tie Bars

A. Bar reinforcement for pavement tie bars shall conform to ASTM A706, or Grade 60 of ASTM A615, A616-96a, or A617-96a, and as specified in MDOT Section 914.

2.08 Steel Welded Wire Fabric

A. Welded steel wire fabric for concrete mesh reinforcement shall conform to ASTM A185, MDOT Section 905, and shall be fabricated as shown on the Plans.

2.09 Dowel Bars

A. Dowel Bars and basket assemblies for Transverse expansion and contraction joints shall be ASTM A615 Grade 40 and conform to MDOT Section 914.

2.10 Steel Hook Bolts

A. Hook bolts shall conform to ASTM A706, or Grade 60 of ASTM A615, A616-96a, or A617-96a. Hook bolts shall be 5/8 inch (16 mm) diameter. Along the edge of existing concrete, expansion anchored hook bolts shall be used.

2.11 Joint Fillers

A. Fiber joint filler material for expansion joints shall conform to ASTM D1751, and as specified in MDOT, Section 914.03.

B. Bituminous premolded joint filler material shall conform to ASTM D994 and AASHTO M33.

C. Polyethylene premolded joint filler for pressure relief joints shall be a flexible, low-density, expanded, extruded polyethylene plank. Polyethylene plank shall be formed by the expansion of polyethylene base resin in an extrusion process and shall be homogeneous, closed-cell and multi-cellular.

2.12 Joint Sealants

A. Hot-poured type joint sealant shall conform to AASHTO M301 or ASTM D6690 Type II and as specified in MDOT Section 914.

B. Cold-applied, single component type, joint sealant shall conform to ASTM D5893.

2.13 Concrete Mix

A. Concrete shall contain a minimum of six (6) sacks, 94 pounds per sack, of cement per cubic yard (335 kg/m^3) and shall yield a minimum compressive strength of 3,500 psi (24 Mpa) when cured in a moist room at a temperature within a range of 65 to 75 degrees Fahrenheit (18^o to 24^o Celsius) for a period of 28 days.

1. Mixes with less than six sacks of cement per cubic yard with water reducers, pozzolans, ground granulated blast furnace slag (GGBFS), etc., may be used when approved by ENGINEER, providing CONTRACTOR provides documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3,500 psi when tested under field conditions.

2. GGBFS or Flay Ash must replace cement on a pound for pound basis. The fly ash quantity may not exceed 15%, GGBFS quantity shall be not less than 25% and not more than 40%. Maximum total replacement of cement shall not exceed 40%.

B. Cement shall be air-entraining Portland cement ASTM C150, Type IA. If high-early strength concrete is desired, Type IIIA is required.

C. High early strength concrete shall be 4500 psi (31 MPa), 7 sacks cement per cubic yard (390 kg/m^3) with a water reducer. Water cement ratio shall be between 0.38 and 0.39.

D. Air content of the concrete shall be dependent on the maximum size aggregate as follows:

Size of Aggregate in inches (mm)	Air by Volume (in % ±1%)
1-1/2, 2, or 2-1/2 (40 to 65 mm)	5
3/4 or 1 (20 to 25 mm)	6
3/8 or ½ (9 or 10 mm)	7-1/2

E. Slump of the concrete shall be between 1-1/2 and 2-1/2 inches (40 to 65 mm) where machine methods are used for striking off and consolidating the concrete. If ENGINEER permits hand finishing, the slump may be increased to 3-1/2 inches (90 mm).

F. Ready-mixed concrete shall be in accordance with ASTM C94, Alternate 2, and shall yield a minimum compressive strength of 3,500 psi (24 Mpa) when cured in a moist room at a temperature within a range of 65 to 75 degrees Fahrenheit (18 to 24 Celsius) for a period of 28 days.

G. ENGINEER shall be provided with the mix design for review and approval, prior to the actual delivery of the concrete.

Part 3 Execution

3.01 Verification of Excavation and Forming

A. Prior to the installation of any concrete, examine the excavation and forms for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the concrete to be installed.

B. Correct defects and deficiencies before proceeding with the Work.

3.02 Verification of Subgrade Conditions

A. Prior to the installing of any concrete, examine the subgrade to ascertain that it is adequate to receive the concrete to be installed. If the subgrade remains wet after all surface water has been removed ENGINEER may require the installation of edge drain.

3.03 Existing Improvements

A. Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Make necessary adjustments in line and grade to align the new Work with the existing improvements after approval by ENGINEER.

3.04 Batch Plant

A. An adequate site for the batch plant shall be obtained by CONTRACTOR, at his expense. The site shall be maintained, and the plant operated in accordance with the conditions and requirements established by the community in which the plant is located.

3.05 Fine Grading

A. Subgrade shall be fine graded to the cross section shown on the Plans and shall be thoroughly compacted prior to the placing of forms or concrete.

3.06 Installation - General

A. The width, thickness, and type of concrete pavement shall be specified on the Plans or as approved by ENGINEER.

B. At street intersections, curb drops, conforming to the current rules and regulations of Act 8, Michigan PA 1973, shall be provided for the construction of sidewalk ramps. In addition, curb drops for sidewalk and driveway approaches shall be provided as specified in locations called for on the Plans or as approved by ENGINEER.

C. Construction operations shall be restricted to the existing right-of-way. If additional area is required, CONTRACTOR shall furnish ENGINEER with written permission from the property owner for any part of the operation he conducts outside the established right-of-way.

D. CONTRACTOR shall maintain traffic access at all intersections. Vehicle access shall also be maintained to all commercial and public properties and elsewhere as designated by ENGINEER.

3.07 Equipment Requirements

A. General:

1. Approved, mechanical concrete placing and finishing equipment shall be used for concrete paving except for gapped areas or where otherwise approved by ENGINEER.

2. CONTRACTOR shall furnish sufficient equipment for the placing of concrete pavement.

3. Equipment shall be on the job site and ready for normal operation before the paving operation is started.

4. Equipment shall be in good working order.

5. Equipment shall be subject to inspections and testing during construction.

6. Equipment shall be of sufficient capacity that the paver can operate continuously and obtain a rate of production that insures good workmanship and eliminates overloading of equipment or frequent interruptions or delays.

7. Equipment operating on or near the pavement shall be equipped with rubber-tired wheels.

B. Forms:

1. Except when paving with a slip-form paver, forms shall be used and shall be made of metal, having an approved section, which shall insure their rigidity under impact, thrust and weight of the heaviest machine carried on them.

a. The thickness of the metal shall be not less than 1/4 of an inch (5 mm), except that a minimum thickness of 3/16 of an inch (4.5 mm) will be permitted if the form is a trapezoidal cross section.

2. Forms shall have a minimum length of ten (10) feet (3 m) and a depth not less than the edge thickness of the Work prescribed, except the subgrade may be a maximum of 1-inch (25 mm) lower than the bottom of the forms when so approved by ENGINEER.

   a. The width of the base in direct bearing on the soil shall be not less than 0.75 of the form depth except that a width of less than eight (8) inches (200 mm) will not be permitted.

3. Each 10-foot (3 m) section of form shall have at least three (3) stake pockets. The forms shall be straight, free from distortion, and shall show no vertical variation greater than 1/8 of an inch (3 mm) in 10-foot lengths (3 m) from the true plane surface on the top of the form when tested with a 10-foot (3 m) straightedge and shall show no lateral variation greater than 1/4 of an inch (5 mm) from the true plane surface on the vertical face of the form when tested with a 10-foot (3 m) straightedge.

4. Approved wood or flexible forms and hand finishing will be required on all pavement where the radius for the edge of the pavement is less than 200 feet (60 m).

5. The method of connection between form sections shall be such that a locked joint is formed free from vertical movement in excess of 1/8 of an inch (3 mm) and from horizontal movement in excess of 1/4 of an inch (5 mm) under the impact, thrust and weight of the heaviest machine carried on the forms.

6. Sufficient forms shall be provided so that it will not be necessary to remove them in less than 12 hours, or longer if required, after the concrete has been placed.

C. Subgrade Roller or Compactor:

1. Equipment shall be self-propelled steel-wheeled or a pneumatic-tired roller weighing not less than eight (8) Tons (7 metric tons) or a self-propelled vibratory compactor of adequate size to compact the subgrade to the required density.

D. Subgrade Planer:

1. Steel-shod subgrade planer supported by two (2) flanged wheels resting on the side forms may be used for trimming the subgrade in small areas when approved by ENGINEER.

2. Steel-shod template shall be adjustable to fit the shape of the bottom of the pavement and shall have adequate connection to a rigid frame to maintain the crown.

3. Planer shall be of sufficient weight to plane off all high spots encountered.

E. Base Trimmer:

1. For slip-form construction, a powered, self-propelled base trimmer will be required. This base trimmer shall be capable of trimming the base to the required cross section.

F. Water Supply Equipment:

1. Pumps and pipe lines shall be such capacity and nature as to insure an ample supply and adequate pressure of water, simultaneously, for all the requirements of machinery, mixing, sprinkling subgrade, and other requirements of the Work

2. Water may be supplied in tank wagons to augment inadequate pipe lines or to replace them entirely if a sufficient number of units are employed.

G. Finishing Machine:

1. Finishing machine shall be power driven and of an approved type which will strike off and compact the concrete with a screeding and troweling action.

a. Machine shall be capable of finishing the concrete in the manner specified herein, and shall provide a minimum of two (2) oscillating screeds.

2. A combination concrete spreader/finishing machine (i.e.: Pav-Saver®) may be used for residential streets not exceeding 100-feet (305 m) in length and 18-feet (3.7 m) in width or when approve by ENGINEER.

a. The combination type machine must have suitable automatic vibrators, strike-off bars, augers, screeds, finishing pan, etc., in accordance with the requirements of this section, to produce a densely compacted, homogeneous concrete slab, true to line, grade and cross section.

H. Concrete Spreader:

1. An approved concrete spreader with a strike-off board or a separate strike-off shall be used to level each layer of concrete, before placing of reinforcement, and before finishing the concrete.

a. It shall have sufficient weight and rigidity to retain its shape under working conditions to properly strike off the concrete.

b. Two separate spreaders are not required where an approved mesh depresser type machine is used.

2. A concrete spreader is not required for the construction of residential street concrete pavement when approved by ENGINEER.

I. Vibratory Screed:

1. An approved hand-propelled vibratory screed shall be provided for use in gapped areas at driveways and intersections, and where machine methods are not feasible to screed and consolidate the concrete.

a. Gaps finished by this method shall be limited to one (1) joint spacing in length and one (1) single lane width.

2. Screed shall consist of a steel-shod strike board having a minimum thickness of two (2) inches (50 mm) and equipped with a gasoline engine capable of producing at least 5,000 vibrations per minute.

a. Other vibratory screeds may be approved by ENGINEER.

J. Membrane Sprayer:

1. A mechanically-pumped pressure sprayer capable of applying a continuous uniform film of curing compound will be required.

2. Equipment shall provide adequate stirring of the compound during application.

K. Slip-Form Paving Equipment:

1. When pavement is placed by the slip-form method, the slip-form paving equipment shall spread, consolidate, screed, and mechanically float the freshly-placed concrete in such a manner that only a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement.

2. The machine shall be equipped to vibrate the concrete for the full width and depth of the pavement being placed.

L. Floats:

1. Mechanical float shall be a combination float finisher. Where a mechanical float is an integral part of a slip-form paver, a separate mechanical float will not be required.

2. A float finisher shall consist of a machine having two (2) screeds and be equipped with a suspended pan float. The second screed and the pan float shall be suspended in such a manner that they operate independently of the side forms.

3. A mechanical float will not be required for the construction of residential street concrete pavement.

M. Footbridge:

1. A movable bridge shall be provided when necessary to satisfactorily finish the pavement or construct joints. The bridge shall be designed and constructed so that it will not come in contact with the concrete.

N. Transverse Float:

1. This float shall be made of metal and shall be at least ten (10) feet (3 m) in length and of the box or channel type with a floating face at least six (6) inches (150 mm) in width. It shall be constructed so as to be light in weight, rigid and free from warps.

O. Vibrator:

1. Vibrator for consolidating the concrete along the faces of the forms and adjacent to joints shall be an approved electric or mechanical vibrator of an internal type, not less than 2 inches (50 mm) in diameter.

2. It shall have minimum frequency of 5,000 vibrations per minute for a tube 2 inches (50 mm) in diameter, 3,600 vibrations per minute for a tube 4 inches (100 mm) in diameter, or a proportionate frequency for an intermediate size.

3. At least 2 vibrators shall be provided for each concrete paving unit on the project.

4. Vibrators used adjacent to the forms in conventional paving shall be connected with the equipment on which they are mounted such that vibration of the concrete will start automatically with the forward movement of the equipment and stop automatically whenever forward movement stops.

P. Form Tamper:

1. A mechanical form tamper of approved design will be required on all projects. It shall be capable of thoroughly and uniformly compacting the soil under the forms.

Q. Strike-Off for Reinforcement:

1. An approved strike-off shall be used to level the concrete before placing the pavement reinforcement.

2. It shall be adjustable and shall be supported by two (2) flanged wheels on each end which rest on the side forms.

3. It shall have sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete.

4. An approved hand strike-off resting on the forms shall be used for irregular areas.

5. The strike-off may be a part of the concrete spreader or a finishing machine.

R. Lane Tie Bar Installer:

1. When not placed on approved chairs, lane tie bars shall be installed by use of an approved mechanical device.

S. Reinforcement Carrier:

1. Reinforcement not placed on chairs shall be transferred from the hauling equipment to a movable bridge which spans the pavement being cast or placed by other approved means which will not result in contamination of the concrete.

2. Bridge shall be capable of carrying the reinforcement load without appreciably deflecting the forms.

T. Joint Filling and Sealing Equipment:

1. Equipment for filling and sealing joints shall be available for inspection and testing at least 48 hours prior to its use.

2. Heating kettle for hot poured sealing material shall be of the indirect-heating or double boiler type, using oil as the heat transfer medium. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.

    a. CONTRACTOR shall demonstrate that the equipment proposed for use will consistently produce a joint sealer of proper pouring consistency.

3. Hot-poured sealing material shall be applied directly from the heating kettle; the kettle shall be equipped with a pressure pump, hose and nozzle suitable for forcing the sealing material to the bottom of the joint and completely filling the joint.

    a. The rate of application shall be controlled so as to completely fill the joint and not spill the material on the surface of the pavement.

    b. The hose and nozzle shall maintain the temperature of the sealing materials so that the loss in temperature is not over 10 degrees Fahrenheit (12° Celsius) between the nozzle and the heating tank.

    c. Heat from a direct flame on the nozzle shall not be used to maintain the proper temperature of the sealing material.

    d. Eeating equipment shall be mounted on rubber-tired wheels, and only rubber-tired equipment shall be used to move the heating equipment on the pavement.

4. Cold applied sealing compound shall be applied by means of pressure equipment that will force the material to the bottom of the joint and completely fill the joint without overflowing onto the surface of the pavement.

5. Sealing machine shall include a mechanical mixer capable of mixing the sealing components into a uniform, homogeneous mass.

U. Preformed Neoprene Joint Sealing Equipment:

1. Equipment for applying the lubricant and installing the preformed joint seal may be either power or hand operated equipment suitable for installing the joint seal as recommended by the manufacturer.

V. Sandblasting Equipment or Power Wire Brush:

1. Sandblasting equipment shall be of proper size and capacity to obtain the cleaning specified and shall operate at a nozzle pressure adequate for the performance of the Work. Nozzles shall be of proper diameter in relation to the width of joint and shall be replaced as necessary due to enlargement by wear.

2. A power wire brush may be used in place of sandblasting equipment.

W. Air Compressors:

1. Air compressors shall be portable and capable of furnishing sufficient air to maintain a nozzle pressure adequate to remove all loose fragments of concrete and foreign material from the joints.

2. Suitable traps shall be employed to maintain the compressed air free of oil and moisture.

X. Power Broom:

1. A mechanical broom with pickup suitable for cleaning the pavement will be required.

Y. Concrete Saw:

1. Two (2) self-propelled concrete saws which are adequately powered to cut hardened concrete to a minimum depth as shown on the Plans will be required.

2. Minimum thickness of the saw blade shall be 3/16 of an inch (5 mm). Saws shall be equipped with suitable guards.

Z. Miscellaneous Equipment**:**

1. Small tools to completely and satisfactorily finish the Work, including straightedges for testing pavement and forms, shall be provided by CONTRACTOR.

3.08 Placement of Forms

A. Forms shall be placed and checked for line and grade at least 500 feet (150 m) in advance of placing concrete.

B. Forms shall be adequately staked and braced to resist the pressure of concrete and the thrust of the equipment.

C. Forms shall have uniform bearing on the subgrade throughout their entire length and width.

D. After setting the forms to grade, thoroughly tamp both the inside and outside with an approved mechanical form tamper.

E. Forms shall be thoroughly cleaned before they are placed.

F. Forms shall be neatly and tightly joined, and shall be securely staked by at least three (3) stakes per form.

G. Forms shall be oiled before concrete is placed against them.

H. Forms shall be checked for line and grade, after being set.

I. Forms showing a variance from the staked line by more than 1/4 inch (5 mm) or from the staked grade by more than 1/8 inch (3 mm) in ten (10) feet (3 m) shall be adjusted.

J. Where the use of flexible forms are required, sufficient back bracing shall be provided to prevent undue deflection of the forms during placement of the concrete.

3.09 Placing Concrete

A. Placing of concrete should not commence or continue until the condition of the subgrade has been approved by ENGINEER.

B. Concrete shall be spread or distributed as soon as placed. If a mechanical spreader is not used, the concrete shall be deposited in a manner that requires a minimum of re-handling to avoid segregation and separation of materials. Concrete shall be deposited to a height sufficiently above grade so that when consolidated and finished it shall conform to the required finished grades.

C. Concrete along the faces of forms and adjacent to joints shall be consolidated and compacted to fill all voids.

D. Forms shall not be vibrated to consolidate the concrete.

E. When the pavement is placed in two (2) layers, the first layer may be cast three (3) to six (6) inches (75 to 150 mm) narrower on each side than the proposed pavement slab, so that the full depth of pavement, at the edges, will be cast with the second layer. Equipment shall vibrate concrete placed full depth for the complete width and depth of the pavement being placed. For concrete placed in two (2) layers, only the second layer will be required to be vibrated.

F. Placing of concrete shall be continuous as much as possible between transverse joints.

G. Whenever a temporary halt in operation occurs, the concrete and unfinished end of the slab shall be covered with wet burlap or plastic.

H. If the interruption of Work continues for more than 20 minutes, a construction joint shall be placed, provided the proposed construction joint is 15 feet (4.5 m) or more from the last joint for reinforced pavement and at last ten (10) feet (3 m) or more from the last joint in plain concrete pavement. Sections of pavement shorter in lengths will not be permitted and, if constructed, shall be removed and replaced at CONTRACTOR's expense.

I. Integral curbs, where specified or required, shall be constructed monolithic with the pavement slab. Curb material shall be placed before the pavement has started its initial set and shall be of the same mix as the concrete pavement.

J. Base and back forms will be required when constructing straight curbs, and back forms with templates of the required curb shape shall be used when constructing rolled and mountable curbs. Curb concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which the curb shall be given a final finish to match the texture of the pavement.

K. After removing forms, any visible areas of honeycomb or minor defects shall be immediately filled with mortar, having one part of Portland cement and two parts fine aggregate, and shall be applied with a wooden float.

L. Where adjacent pavement lanes are constructed in separate pours, no equipment shall be operated upon recently placed concrete until the pavement has attained at least 85% of the design strength as determined by testing cores taken from the project, or until the pavement is 14 days old, at the option of ENGINEER.

M. Equipment wheels operating on the pavement, shall operate at least one foot (300 mm) from the edge of the pavement. Equipment wheels shall be rubber-tired.

N. The paver shall not be permitted on the new slab until the pavement has attained full design strength. The paver shall not operate on any new slab without using wood mats having an approved thickness and width to insure that the pavement will not be marked or structurally damaged.

O. Pavers are not permitted to operate on residential streets.

P. If the curing compound is damaged, it shall be repaired by spraying additional curing compound on the damaged areas as soon as the Work is completed.

Q. The filler strip on pavement widening projects shall be poured as soon as possible but not later than the first working day following the placing of the slab.

R. At intersections and where access is required to property along the Project, construction shall be completed by gapping the proposed pavement. Load transfer, contraction, of end-of-pour joint devices shall be placed at the gapped ends of the pavement.

S. In lieu of pavement gapping, CONTRACTOR may elect to place a temporary bridge, of a design approved by ENGINEER, to provide access. Furnishing, placing, maintaining, and removing the bridge shall be at CONTRACTOR's expense.

3.10 Placing Pavement Reinforcing

A. Where reinforcement is required, the sheets or mats shall be placed at the depth below the surface of the finished pavement, as shown on the Plans.

B. Pavement reinforcement shall be shipped and delivered to the Work in flat sheets or mats.

C. Adjacent sheets or mats shall be lapped, as indicated on the Plans, and shall be fastened to each other in no less than two (2) places in each pavement lane.

D. Where the width of pavement varies, the reinforcement requirements shall be the same as called for on the Plans. Split sheets or mats may be used to conform to the particular pavement configuration. Side laps shall not be less than the spacing of the longitudinal wires or bars.

E. On widening Projects where the pavement slab is less than six (6) feet (1.8 m) in width, 1/2 inch (10 mm) diameter longitudinal reinforcing bars may be substituted for standard reinforcement, providing the bars are spaced not more than 12 inches (300 mm) center-to-center. The first bar shall be not more than three (3) inches (75 mm) from the edges of the widened slab, and the bars shall be lapped a minimum of 12 inches (300 mm).

F. Reinforcement shall be installed by one of the following methods:

1. Chairs upon which reinforcement is to be mounted shall support the reinforcement and shall have such bearing on the base that there will be no undue penetration of the base. Maximum spacing of the chairs shall be sufficient to maintain the reinforcement at the specified depth. The reinforcement shall be placed directly from the hauling unit unto the chairs.

2. When reinforcement is placed between two (2) layers of concrete, the first layer shall be mechanically spread and struck off to the required depth below the proposed finished surface. Reinforcement shall be placed directly from the carrier onto the struck off concrete.

3. Any area where the use of the mechanical spreader or mechanical strike-off is not feasible, the reinforcement shall be mounted on chairs.

3.11 Joints

A. General:

1. Longitudinal and transverse joints shall conform to the details and shall be constructed at the locations shown on the Plans or as directed by ENGINEER.

2. Joints shall be constructed true to line with their faces perpendicular to the surface of the pavement.

3. Transverse joints shall be constructed at right angles to the centerline of the pavement, unless otherwise called for on the Plans or as determined by ENGINEER. Joints shall not vary more than 1/4 of an inch (5 mm) from a true line.

4. The surface of the pavement adjacent to all joints shall be finished to a true surface. Where indicated on the Plans, joints shall be edged to the radius shown or a minimum 1/4 inch (5 mm) radius. Surface across the joints shall be tested with a ten (10) foot (3 m) straightedge as the joints are finished and any irregularities shall be corrected before the concrete has hardened.

5. When pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints of the first slab. In the case of widening existing pavements, transverse joints shall be placed as shown on the Plans, or as directed by ENGINEER.

6. Keyways, where required, shall be accurately formed with templates of metal, wood, or paper securely pinned in place. The gauge or thickness of the material in the templates shall be such that the full keyway, as specified, is formed in the correct location.

B. Longitudinal Joints:

1. General:

a. Longitudinal joints shall be sawed, longitudinal lane tie joint with tie bars or bulkhead construction joints with hook bolts.

b. Where called for on the Plans a keyway shall be constructed in the bulkhead construction joint.

2. Longitudinal Lane Tie Joint (D):

a. Longitudinal lane tie joints with tie bars shall be planes of weakness formed by sawing a groove in the hardened concrete according to the alignment, width and depth shown on the Plans.

b. Tie bars of the type, diameter and length called for on the Plans, shall be placed at the required depth parallel to the finished surface, at right angles to the joint and at the uniform spacing also called for on the Plans or as approved by ENGINEER.

c. Bar chairs shall be used to support the lane tie bars or the lane tie bars may be installed by use of a mechanical device, approved by ENGINEER. Placing of lane tie bars in the concrete by hand methods will not be permitted.

d. The joint shall be sawed as soon as the concrete will not spall or not more than 3 days after placement, and shall be completed before traffic of any kind uses the pavement. Immediately following the sawing of the joint, the slurry resulting from the sawing operation shall be completely removed from the joint, and the immediate area by flushing with a jet of water under pressure.

e. The joint shall be blown out with a jet of compressed air to remove the flushing water. After the joint is dry it shall be cleaned out with a jet of compressed air with a working pressure of at least 90 psi (620 kPa) and then shall be sealed in accordance with Article 3.18, with an application of an approved hot or cold applied type joint sealing compound. Sealing compound shall be applied with approved pressure type equipment with the nozzle extending into the groove and the groove shall be filled until the sealer overlaps the pavement about 1/8 of an inch (3 mm).

3. Longitudinal Bulkhead Construction Joint (D):

a. Longitudinal bulkhead construction joints with hook bolts shall be used in part-width construction of concrete pavement and elsewhere as shown on the Plans, or as approved by ENGINEER. Size, spacing, and depth of the hook bolts below the surface of the pavement shall be as shown on the Plans.

b. For slip-form paving, lane ties of an approved type may be substituted for hook bolts and shall be spaced at 30-inch (750 mm) centers, unless otherwise indicated on the Plans. Lane ties for slip-form paving shall be placed in the concrete with a pneumatic powered installer or equipment producing equal results. Lane ties, which are not set with adequate consolidation of the concrete or are not within 30 degrees of being perpendicular to the pavement edge in a horizontal plane, shall be replaced with drilled-in expansion-anchored lane ties.

c. Where a bulkhead joint is to be constructed, hook bolts and couplings shall be attached to the forms and shall be held in position during the placing and finishing of the concrete so as to permit the removal of the pavement forms without damage to the concrete or hook bolt assembly. Ends of the couplings shall be protected so that the concrete, dirt or other materials cannot enter the couplings and prevent a satisfactory connection with either hook bolt.

d. Where hook bolts or lane ties are installed for use in future pavement widening, in curb or curb and gutter construction, a rust preventive oil shall be inserted into the open end of the couplings immediately after removal of the pavement forms by means of a hand operated pump in sufficient quantity to completely cover the internal threads. After application of the protective oil, neoprene or plastic plugs shall be inserted into the ends of the couplings to completely seal the opening without protruding outside of the couplings more than 3/8 inch (9 mm).

e. Concrete shall be edged with a tool having the radius of curvature and depth of lip shown on the Plans. The second pour of concrete shall be edged with a longer lipped edging tool than that used on the first concrete pour.

f. After the concrete has cured for the required time, all extraneous material shall be removed from the joint and the joint then sealed with an approved hot-poured or cold-applied elastic-type compound. The use of sandblasters and a jet of compressed air will be required to clean the joint before sealing.

C. Transverse Joints:

1. General:

a. Transverse joints shall be contraction joints, plane of weakness joints, dummy joints, expansion joints, construction joints, end-of-pour joints and pressure relief joints.

2. Contraction Joints (C):

a. Contraction joints shall consist of a load transfer unit and a joint groove formed by sawing. Contraction joints shall be constructed as indicated on the Plans and shall be spaced a maximum of every 57'-3" (17.5 m) or as provided for elsewhere.

b. The load transfer unit shall be epoxy coated dowel bars, spaced and arranged in the positions indicated on the Plans, accurately held in place by an approved metal device so as to be perpendicular to the plane of the cross section of the pavement and parallel to the centerline at a distance from the surface equal to 1/2 the thickness of the slab.

c. This device shall consist of connected transverse and longitudinal members arranged to hold each dowel so firmly that its final position after concreting operations shall not vary more than 1/8 of an inch per foot of length (3 mm per meter) from its designated line and grade. The device shall be such as will permit the joint to be completely assembled alongside the Work, and it shall be sufficiently rigid so that the joint can be lifted into place on the subgrade as a unit.

d. One end of each dowel bar shall be free to move in the slab as the concrete contracts and expands. To accomplish this, 2/3 the length of each dowel shall be thoroughly lubricated with liquid asphalt. The liquid asphalt coating shall be applied to a sawed end of the dowel bar or, in the case of dowel bars with sheared ends, a metal cap shall be placed on the coated end of the dowel bar. The asphalt coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing the dowels in the joint. The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end of the bar.

3. Plane of Weakness Joints (WT):

a. Plane of Weakness joints shall be placed in plain concrete pavements only and is to be constructed immediately after the finishing operation has been completed. A groove shall be formed in the plastic concrete with a metal forming bar to the depth indicated on the Plans. A premolded bituminous filler strip shall be placed in the groove formed by the metal bar, from a bridge operating on the pavement forms. The concrete shall then be floated against the sides of the filler, and the joint edged to a 1/8 inch (3 mm) radius.

4. Plane of Weakness Joint for Concrete Base Course (WTB):

a. Dummy joints shall be placed in reinforced concrete pavements only where called for on the Plans. It shall be constructed immediately after the finishing operation has been completed by forming a groove in the plastic concrete with a metal forming strip into which expanded polystyrene or other approved temporary filler is placed. The material shall be installed flush with the surface of the pavement and the area on both sides of the joint shall be finished. Transverse joints with a temporary filler shall not be edged. The pavement reinforcement shall be continuous through this joint.

5. Expansion Joints (E) and (E_1):

a. Expansion joints (E_1) shall consist of a load transfer unit and a premolded fiber filler and shall be used on reinforced concrete pavements or where shown on the plans.

b. Expansion joints (E) shall consist of a premolded fiber filler without the load transfer unit and shall be used for joints in concrete capping, end connections with structures or existing pavements, plain concrete pavements, and other places where shown on the Plans where installation of the load transfer unit is not feasible as approved by ENGINEER.

c. The load transfer units shall be assembled and the epoxy coated bars lubricated with liquid asphalt. Liquid-asphalt-coated end of each bar shall be provided with a close fitting metal cap.

d. The fiber filler shall extend the full depth and width of the joint. After installation, the top shall be not less than 1/2 inch (10 mm) and no more than 1-inch (25 mm) below the finished surface. It shall be furnished in lengths not less than the lane widths being poured. Where additional partial lengths are necessary, the minimum length of load transfer unit and premolded fiber filler shall be sufficient to span two (2) dowel bar spacings. Where more than one (1) section is allowed and used in a joint, the sections shall be securely joined together.

e. Expansion joints in curb lanes with integral curb, the fiber filler used in the pavement shall extend completely through the curb section. The fiber filler placed in the curb above the slab shall be 1-inch (25 mm) in width.

f. During installation, the joint shall be held in place by an approved installing device which shall be securely staked. The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least 10-gage material having flanges not less than 1-1/2 inches (40 mm) in depth. The channel cap shall be shaped to the proposed crown of the pavement and shall extend over the full length of the filler.

6. Pressure Relief Joints (PR):

a. The method of constructing a pressure relief joint shall be as indicated on the Plans.

b. Pressure relief joint material shall be a flexible, low-density, expanded, extruded polyethylene plank. Joint material shall be cut off to 1/2 inch (10 mm) below the top of the pavement surface and shall extend entirely through and to within 1/2 inch (10 mm) of the face and top of the curb.

7. End of Pour Joints and Construction Joints:

a. End of pour joints in reinforced pavement shall be formed by placing a bulkhead and installing a load transfer device, as specified for contraction joints, except that the ends of the dowel bars shall not be lubricated. The load transfer device shall be so installed that each dowel bar will be embedded in the concrete for 1/2 of its length.

b. When the next pour is made, a space for hot-poured rubber joint filler shall be provided by placing temporary filler in the fresh concrete. End-of-pour joints shall be constructed using 2-piece dowels and a bulkhead and shall be placed where it is anticipated that three (3) days or more will elapse between the casting of adjacent pours.

c. Construction and end-of-pour joints shall be sealed as specified for transverse contraction joints.

d. End of pour joints in plain concrete pavements shall be formed by placing a bulkhead, fiber keyway, and installing 1/2 inch (10 mm) diameter deformed bars, 30 inches (75 mm) in length, at 18-inch (450 mm) intervals across the end of the pavement.

e. The pavement across the end of both slabs shall be thickened and the joint shall be edged and sealed.

8. Transverse joints in a concrete pavement shall extend entirely through the integral curb. The material used to construct the joint in the curb shall be of the same kind as provided for the pavement.

9. Bituminous fiber filler shall be used to construct the expansion joints in the integral curb of reinforced concrete pavements. The thickness of the fiber filler material in the curb above the gutter shall be 1-inch (25 mm). Joint material shall be precut so as to conform to the geometric shape and cross-sectional area of the curb, and shall be placed in intimate contact with the filler material in the pavement.

10. The edges of transverse joints in the integral curb shall be rounded with an approved finishing tool, having a radius of 1/4 inch (5 mm).

3.12 Consolidating and Finishing

A. The sequence of operations after the placing of concrete shall be: striking off and consolidating, floating, straightedging and finishing with burlap drag, edging and final finishing with burlap drag.

B. Mechanical methods shall be employed to strike off and consolidate or compact the concrete, except in gapped areas or where the pavement width will not permit the use of machine methods. Gaps less than 1 joint opening in length may be finished by hand methods, provided they are finished in single-lane widths.

C. Strike off, consolidate and compact the concrete to such an elevation that when all finishing operations are completed, the surface will conform to the required finished grade and cross section. At least 4 inches (100 mm) of concrete above the finished pavement grade shall be maintained ahead of the screed for its entire length. In consolidating the surface of the pavement, on residential street construction when a single screed finishing machine is used, it shall operate over each section of the pavement twice. Only sufficient mortar shall be worked to the surface to provide a dense smooth finish. Excessive operation of the machine over a given area will not be permitted. Segregated particles of coarse aggregate which may collect in front of the screed shall be thoroughly mixed by hand with the mass of concrete already on the subgrade.

D. If it is not possible to use mechanical equipment on irregular areas, an approved, self-propelled vibratory screed shall be employed to strike off and properly consolidate the concrete surface to the required finish grade. Where it is not possible to use a vibratory screed, a hand strike board of an approved design, will be permitted. The entire area of the pavement shall be consolidated to insure an absence of voids.

E. Strike-off boards shall be moved forward with a combined longitudinal and transverse motion, with neither end raised from the side forms during the process. A slight amount of excess concrete shall be kept in front of the front edge at all times. When striking off and consolidating by hand, pours will be limited to single lanes or 1/4 of intersections.

F. After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating by a mechanical method unless the pavement is permitted to be constructed in single lane widths.

G. Where mechanical floating is an integral part of the operation of a slip-form paver, separate mechanical floating methods will not be required.

H. Mechanical longitudinal floating will not be required for residential street construction.

I. When mechanical equipment is not used for floating, a transverse float at least 10 feet (3 m) in length shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved ahead 1/2 of its length and the operation repeated.

J. Care shall be taken to preserve the crown and cross section of the pavement. Float finishing operation shall not proceed until the concrete has attained a consistency so that no excess concrete is carried ahead of the float but the entire surface can be floated and sealed.

K. Immediately following the float finishes and while the concrete is still plastic, CONTRACTOR shall test the slab surface for trueness by means of a 10-foot (3 m) straightedge or acceptable float.

L. The straightedge shall be placed at the center of the slab with the blade parallel to the centerline and pulled slowly and uniformly to the edge. This operation shall be repeated until the surface of the concrete is free from irregularities and makes contact at all points with the bottom of the straightedge. The straightedge shall then be moved forward 1/2 its length and the operations repeated.

M. Depressions found in the surface shall be filled with fresh concrete and consolidated by floating with a long-handled float not less than 10 feet (3 m) in length. Float may also be used to smooth sections of the surface that may have become rough or torn by dragging with the straightedge.

N. For pavement constructed by the slip-form method, the edge settlement shall be determined as soon as practical after paving operations begin. Edge settlement in excess of 3/8 inch (9 mm) shall be corrected before the concrete has hardened. When edge settlements in excess of 1/4 inch (5 mm) persist, paving shall be suspended and operational corrections made before ENGINEER will permit the resumption of paving. If CONTRACTOR consistently fails to construct pavement within these tolerances, the use of slip-form methods shall be discontinued and pavement placed by means of conventional forms. When paving is accomplished by the slip-form paving method, all mortar paste shall be wiped from the sides of the slab.

O. The surface shall then be tested for smoothness with the straightedge. During this operation, the contact of the straightedge with the concrete shall be uniform over the entire length tested. At the time of testing, the surface shall be free from soft mortar or excessive water. The testing straightedge shall be used for this purpose only.

P. Where the float finisher method is not utilized, as soon as the hand floating is completed, all laitance, surplus water, and inert material shall be worked entirely off the pavement and the surface made smooth by dragging with a rigid straightedge 10 feet (3 m) in length and the surface shall be tested.

Q. As soon as all excessive moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap or cotton fabric, not less than 5 feet (1.5 m) nor more than 6 feet (1.8 m) in width, over the full width of the pavement. Burlap or cotton drag shall be pulled by a bridge supported on a pavement forms. Fabric shall be renewed as often as necessary to obtain the required texture.

R. Immediately after the initial finishing with burlap, the edges of the slab and all specified joints shall be finished with an edging tool to the radii indicated on the Plans. Pavement shall then be given a final finish by dragging the damp burlap or cotton fabric over that portion of the pavement disturbed by the edging operation.

3.13 Surface Requirements

A. High spots in the surface, exceeding 1/8 inch (3 mm) from the straightedge but not more than 1/2 inch in 10 feet (10 mm in 3 m) shall be removed or reduced by rubbing with a carborundum brick and water until contact with coarse aggregate is made.

1. If contact with coarse aggregate is made before reaching an acceptable tolerance, such high spots shall be removed by an approved surface-grinding machine before acceptance of the pavement.

B. High spots in excess of 1/2 inch in 10 feet (10 mm in 3 m) will be evaluated by ENGINEER and if the Work is rejected, it shall be removed and replaced at CONTRACTOR's expense. CONTRACTOR shall take immediate steps to eliminate the cause of the defective surface.

3.14 Curing

A. After the finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of white membrane curing compound.

B. Compound shall be applied in a continuous uniform film by means of mechanically pumped pressure sprayer equipment at a rate of 1 gallon per 200 square feet (4 L per 20 m^2) of surface. Curing compound shall not be thinned. The equipment shall provide adequate stirring of the compound during application. Equipment for applying the compound must be on the Project and approved by ENGINEER before Work is started.

C. Hand-spray equipment will be permitted only for the application of the curing compound over the sides of the slab, and for any minor damaged areas. If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, CONTRACTOR will be required to apply a new coat of material to the affected areas. The treated surface shall be protected by CONTRACTOR from injury for a period of at least 7 days. Traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the Work including the removal of any high spots, provided any damage to the film is immediately repaired by the application of a second coat of the compound.

D. Immediately after the forms are removed, the entire area of the side of the slab shall be coated with the curing compound at the rate specified for the pavement surfacing.

E. CONTRACTOR shall provide on the Project sufficient burlap or polyethylene coverings for the protection of the pavement in case of rain or breakdown of the spray equipment. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.

3.15 Removal of Forms

A. Forms may be removed from freshly placed concrete after it has set for 12 hours, provided it can be done without damage to the pavement or curb edge.

1. If during form removal the pavement or curb edge is being damaged, the form removal shall cease until the concrete has attained greater strength.

2. The period of time for removing forms may be increased or decreased when approved by ENGINEER.

B. Immediately after removal of the forms, the ends of all joints shall be cleaned, and any visible areas of honeycomb or minor defects shall be filled with mortar, composed of 1-part Portland cement and 2 parts fine aggregate from the same source as used in the pavement, applied with a wooden float.

1. Immediate steps shall be taken by CONTRACTOR to correct the conditions contributing to these defects.

2. The sides of the pavement shall be sprayed with curing compound immediately upon removal of the forms, except where honeycombed areas are to be pointed, and them immediately cured.

C. Forms and pins shall not be placed on new pavement that is being cured with membrane.

3.16 Sawing Joints

A. General:

1. Contraction joints, longitudinal lane-tie joints with tie bars, and end of pour joints shall be sawed.

2. Joints shall be sawed before any traffic is permitted on the pavement. The concrete saw will be permitted on the pavement to saw the joints, but the water supply truck will not be permitted on the pavement until the compressive strength is not less than 3,000 psi (21 MPa). When permitted on the pavement, the water supply truck must be kept a minimum of 50 feet (15 m) behind the sawing operation. At least two (2) approved concrete saws shall be available for use at all times, and one saw shall be capable of sawing a joint groove 2-1/2 inches (65 mm) deep.

3. The saw cut for transverse end-of-pour joints shall be made to receive the joint sealing material.

4. Longitudinal lane-tie joints with the tie bars shall be sawed in accordance with the alignment and dimensions indicated on the Plans.

5. For joints formed in one operation, the joint groove shall be sawed before any transverse cracks develop. Raveling or spalling along the joint shall be repaired as specified in Article 3.17 of this Section.

B. Transverse contraction joints shall be sawed in two stages:

1. Stage 1 Sawing:

a. The first stage shall be a relief cut directly over the center of the load transfer assembly. The initial relief cut shall be made as soon as the saw can be placed on the freshly poured concrete, and the sawing shall continue as long as the pavement can support the saw without making or appreciably raveling of the joint.

b. When water is not used in the sawing operation, membrane curing compound shall be applied immediately.

c. When water is used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the cut and from the immediate area by flushing with a jet of water. Additional membrane curing compound shall be applied within 12 hours after the relief cut has been made.

C. Stage 2 Sawing:

1. Second stage sawing of joints shall not start until the concrete has cured for a minimum of 48 hours. The joint groove shall be centered over the relief cut and sawed to the specified dimensions shown on the Plans plus any increase in width of the relief cut due to shrinkage or contraction. The groove width tolerance shall be ± 1/16 inch (2 mm).

2. Joints sawed without the use of water shall be blown clean of all foreign material by a jet of compressed air.

3. If water was used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the groove and the immediate area by flushing with a jet of water and then blown dry with compressed air.

4. Transverse joint grooves shall receive a final cleaning with a jet of compressed air adequate to remove all foreign material, just prior to permanent sealing.

5. If the specified seal is not installed within seven days of final sawing, the joint groove shall be temporarily sealed with a suitable material or device to prevent the infiltration of foreign material.

6. Traffic shall not be permitted over the full width joint grooves prior to the installation of either the permanent seal or temporary seal.

3.17 Patching Joints

A. General:

1. After the joints have been sawed and cleaned, they shall be inspected for spalls and voids.

2. Loose, unsound or damaged concrete shall be removed to the satisfaction of ENGINEER.

3. Spalls and voids will be classified as minor, intermediate or major spalls and shall be repaired accordingly.

B. Minor Spalls:

1. Spalls or voids which have increased the specified size of the joint groove beyond any of the following limits, but less than 36 square inches (250 cm^2), shall be repaired by patching with an approved epoxy mortar before the seal is installed.

2. Spalls which extend more than 1/4 inch (5 mm) from the joint face and over 1/2 inch (10 mm) below the surface of the pavement.

3. Spalls which extend more than 1/4 inch (5 mm) from the joint face and two (2) inches (50 mm) or more in length, regardless of the depth of spall below the surface of the pavement. Void areas larger than 1/2 inch (10 mm) in diameter in the upper 1-inch (25 mm) of the joint face or larger than 1-inch (25 mm) in diameter regardless of location.

4. Spalled concrete surface shall be thoroughly cleaned by sandblasting, power-wire brushing, or hand-wire brushing. The patch area shall then be blown clean with a jet of compressed air. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.

5. Concrete shall be clean and dry when the epoxy resin mortar is placed. The surface shall be made free of frost by heating with a clean source of heat, approved by ENGINEER, until dry. Care shall be taken not to damage the concrete by heating.

6. Epoxy binder will be a mixture of 2 parts epoxy resin to 1 part curing agent by volume, or as approved by ENGINEER.

7. Epoxy resin compound shall be mixed in a clean metal or polyethylene container with approved stirrer operating at 250 to 500 rpm. While the epoxy resin is being mixed, the curing agent compound shall be gradually added. The mixture shall then be stirred for a minimum of 3 minutes until it is uniform.

8. After the epoxy binder is thoroughly mixed, a small portion shall be reserved for priming. The dry 2MS sand shall be uniformly blended into the balance of the mixture to give an epoxy mortar of stiff or trowellable consistency. One part of mixed binder to about 3.5 parts of dry sand, by volume, will usually give a workable mix.

9. Spalled surface shall be primed with the freshly mixed epoxy binder scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the epoxy mortar must bond.

10. Immediately after priming, the epoxy mortar shall be placed in the spalled area and finished to the shape of the original pavement surface. If the bond coat is not tacky when the mortar is placed, a second application shall be made. The edge of the patch shall conform with the rest of the joint groove. Dry 2NS sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently so that it will not be damaged during sealing operations, the polyethylene insert shall be carefully removed. Joints shall receive a final cleaning with a jet of compressed air to remove al foreign material.

11. When the temperature of the air and the pavement is above 50 degrees Fahrenheit (10° Celsius), the hot poured elastic type joint seal may be placed on the day following the placing of the epoxy resin mortar patch. When the temperature of the air and the concrete is below 50 degrees Fahrenheit (10° Celsius), the time of curing required for the epoxy mortar shall be as determined by ENGINEER.

C. Intermediate Spalls:

1. Spalls larger than 36 square inches (250 cm^2), but not extending below the reinforcing mat, shall be repaired by sawing and chiseling out the unsound concrete and patching with Portland cement mortar.

2. A saw cut at least 1-inch (25 mm) deep shall be made parallel to the joint groove at the outer extremity of the spalled area. The concrete shall be chipped out to the saw cut so that a vertical face is present at the back of the repair area, and the two ends of the repair area shall be trimmed to approximately vertical faces.

3. The area to be repaired shall be sandblasted to remove all loose particles and then blown clean with a jet of compressed air to remove the sand and all other foreign materials. The repair area shall be flushed with clean water and the excess water shall be blown out with compressed air.

4. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.

5. The bottom and vertical faces of the repair area shall be primed with a grout of creamy consistency made with a 1:1 mixture of Portland cement and 2NS sand with water.

6. Prime coat will be scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the Portland cement mortar must bond. Cement grout shall be carefully applied to the rough surfaces of the spall area and shall be applied immediately prior to placing of fresh mortar so that the prime coat is wet when covered by mortar.

7. Portland cement patching material shall be tamped into the repair area and finished level to the pavement surface. Portland cement mortar shall consist of 1-part Portland cement 2 parts 2NS sand with a water content of not more than four (4) gallons per sack of cement (35 L per 100 kg of cement). A liquid air-entraining agent to maintain an air content of 8% to 11% shall be added. Calcium chloride in an amount of 1 percent of the cement content may be added as an accelerator, if approved by ENGINEER.

8. The edge of the patch at the joint face shall conform with the rest of the joint groove.

9. White membrane curing compound shall be sprayed on the patch surface immediately after the mortar is cast and finished. After 72 hours the polyethylene form shall be carefully removed and all patched joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.

D. Major Spalls:

1. When a joint is damaged beneath the depth of the reinforcing mat, it shall be considered a major repair. These major repairs shall be handled on an individual basis under the direction of ENGINEER.

3.18 Sealing Joints

A. Transverse expansion, contraction, construction, and longitudinal bulkhead construction joints shall be filled and sealed with an approved hot-poured elastic type compound.

B. Longitudinal lane-tie joints shall be pressure filled and sealed with either an approved hot-poured or cold-applied elastic type compound. These sealing compounds shall not be placed when the atmospheric or pavement temperatures are less than 50° Fahrenheit (10° Celsius) or when the weather is rainy or foggy.

C. After the shoulders are completed and the pavement has cured, the joints and pavement surfaces on each side of the joints shall be cleaned of extraneous matter. The cleaning shall be done by sandblasting or other methods approved by ENGINEER that will be equally effective in cleaning the concrete. The dust and sand present after the sandblasting or cleaning shall be removed by a jet of compressed air. Hand tools shall be used to remove stones and other foreign materials from the joint groove.

D. Immediately after the joints are cleaned with the compressed air, and with the surface of the concrete in the joint dry, the joint shall be sealed with an approved hot-poured elastic type compound.

E. The hot-poured compound shall be melted in an approved double boiler type kettle. Direct heating will not be permitted. Also, any sealing material heated in excess of the safe heating temperature shall not be used in the Work.

F. During the process of pouring the joints, ENGINEER may, at his discretion, require that sufficient compound be taken from the melting unit to make flow tests. ENGINEER may require CONTRACTOR to modify his method of heating or of charging the heating unit with compound that will produce satisfactory results.

G. Pouring shall be from the melting kettle equipped with an approved pressure pump hose and nozzle. When authorized by ENGINEER, the sealing compound may be poured with a hand-type pouring pot for curbs and short miscellaneous joint lengths, provided a satisfactory joint is obtained.

H. Pouring of the sealing compound shall be done so as to fill the joint to 1/4 inch (5 mm) below top of pavement. Sealing compound spilled on the surface of the pavement shall be removed immediately. After the first pour has cooled to the temperature of the pavement and settled, a second pour shall be made to bring the sealing compound to 1/4 inch (5 mm) of the surface of the pavement. Traffic shall not be permitted over the poured joint until the compound has hardened sufficiently to resist pickup.

I. Longitudinal lane-tie joints shall be cleaned and immediately filled with either an approved hot-poured or cold-applied elastic type compound. Sealing compounds shall be applied with pressure equipment, capable of completely filling the joint.

J. To protect hot-poured and cold-applied sealing compound while it is curing and to prevent pickup by traffic, the sealed joint shall be covered with a strip of paper, 1-1/2 inches (40 mm) wide, or other approved means, immediately following application of the compound. The paper strip shall be left in place until worn off by traffic.

3.19 Traffic Control

A. Provide all measures necessary to protect and maintain traffic and to protect the Work in accordance with Section 01 5000, Temporary Facilities Controls, and with the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.).

3.20 Protection against Rain

A. CONTRACTOR shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened.

1. For this Work, CONTRACTOR shall have available on the job site at all times enough burlap or 6-mil (150 μm) thick polyethylene film to cover and protect one day's Work.

B. When rain appears eminent, all operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.

C. Curing compound shall be applied to any areas where the compound has been disturbed or washed away. Protection of the new concrete against rain shall be at CONTRACTOR's expense.

3.21 Cold Weather Protection

A. Any time there is a danger of freezing temperatures, CONTRACTOR shall have available on-site a sufficient amount of clean, dry straw or hay or polyethylene film or other approved materials to cover at least 1 day's production. Cold weather protection shall be at CONTRACTOR's expense.

B. The source of the temperature shall be taken from forecasts prepared by the local weather bureau, recognized as the Official Weather Bureau for the area the new Work is being constructed. The predicted low temperature shall be that forecast to occur during the next 24 hours.

C. Frozen material shall not be charged into the mixer at any time.

D. Frost or ice shall be removed from the forms and any steel used in the pavement, prior to placing concrete.

E. Concrete shall not be placed directly upon a frozen subgrade. The subgrade shall be covered with a layer of straw or hay 12 inches (300 mm) in thickness to protect it against freezing. The straw or hay shall be removed from the finished subgrade immediately ahead of paving operations and piled along the line of construction for use in covering the finished pavement. Prior to the placing of concrete, the subgrade shall be cleaned of loose straw and otherwise prepared in a manner satisfactory to ENGINEER. Other covering materials as approved by ENGINEER may be used to prevent subgrade freezing.

F. To accelerate hardening of the concrete when the temperature of the air in the shade and away from artificial heat is between 45 and 40 degrees Fahrenheit (7° to 4° Celsius), calcium chloride shall be added to the mix at the rate approved by ENGINEER. The calcium chloride shall be spread on the materials immediately before discharging into the drum of the mixer. A method approved by ENGINEER, shall be used for measuring the amount of dry calcium chloride to be added to each batch of concrete. The calcium chloride shall not be placed in contact with the cement.

G. Immediately after finishing of the concrete and as soon as hardening of the concrete will permit, the pavement shall be covered and the protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 pounds per square inch (21 MPa) or for a minimum period of 14 days or as approved by ENGINEER.

H. The protective covering shall be placed around and over the forms and it shall extend beyond the edge of the pavement for a distance at least equal to the depth of covering required.

I. When removing forms, the protective covering should be removed for as short a time as possible and should be replaced promptly to prevent loss of heat.

J. The mixing and placing of concrete shall stop in sufficient time each day to permit finishing of the concrete and the placing of the required protective covering during daylight hours.

K. The requirements specified herein for the curing and protection of concrete in cold weather are minimum requirements, and CONTRACTOR shall be responsible for the quality and strength of the concrete placed. Concrete damaged by frost action shall be removed and replaced at CONTRACTOR's expense.

L. Between October 15 and May 15, when the predicted low temperature is to be below 35 degrees Fahrenheit (2° Celsius) at any time within 72 hours after placing the pavement, the pavement shall be protected and such protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 psi. (21 MPa), or for a minimum period of 14 days, unless otherwise authorized by ENGINEER.

M. Special Protection:

1. No pavement may be placed between October 15 and May 15, unless it is specifically provided for in the Contract Documents, or authorized by ENGINEER, except that in no case shall concrete be placed when the predicted high temperature is to be below 35 degrees Fahrenheit (2° Celsius), without written permission of ENGINEER. When paving is permitted during the period, the following requirements shall apply:

2. The temperature of the concrete at the time it is placed on the subgrade shall be not less than 50 degrees Fahrenheit (10° Celsius), nor more than 85 degrees Fahrenheit (30° Celsius).

3. In order to maintain a mix temperature between 50 degrees Fahrenheit (10° Celsius) and 85 degrees Fahrenheit (30° Celsius) the mixing water or the aggregates, or both, shall be heated as required by ENGINEER. The water and the aggregates shall be heated to a temperature of not more than 150 degrees Fahrenheit (65° Celsius). The heating of aggregates shall be done by the use of steam pipe under the aggregate piles, or by free steam discharged into the aggregate piles, or by steam pipe in the batching bins. The heating of the water and the aggregates shall be controlled so that there will not be any large differences in temperature from batch-to-batch.

4. When there is any danger of the predicted low temperature dropping below 35 degrees Fahrenheit (2° Celsius) all the necessary materials for covering and protecting the concrete, equipment for heating the water and aggregates, when required, and calcium chloride shall be on the Project and available for immediate use for the required method of curing and cold weather protection before any pavement is placed.

5. For predicted low temperatures from 35 to 25 degrees Fahrenheit (2 to -4° C) either 1-layer of waterproof paper blankets or 1-foot (300 mm) of loose dry straw or hay shall be placed.

6. For predicted low temperatures of 20 to 25 degrees Fahrenheit (-7 to -4° Celsius) 1-layer of waterproof paper blankets and 1-foot (300 mm) of loose dry straw or hay shall be placed.

7. For predicted low temperatures less than 20 degrees Fahrenheit (-7° Celsius) the minimum requirement for cold weather protection will be 1-layer of waterproof paper blankets and 1-foot (300 mm) of loose dry straw or hay overlayed with a waterproof protective covering consisting of tarpaulins, paper blankets, polyethylene sheeting or other approved material.

N. When temperature are such that special protection is required as specified above, all concrete placed within the proceeding 72 hours shall be similarly protected.

O. When special protection is started, it shall be continued until design strength is reached in accordance with the above requirements unless warmer temperatures prevail for a period of at least 48 hours. Permission to eliminate special protection for such a period shall be as approved by ENGINEER.

P. Protection of the new concrete against cold weather including ordinary and special protection shall be at CONTRACTOR's expense.

3.22 Concrete Temperature Limitations

A. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit (32°Celsius).

3.23 Curb Drop

A. Curb drops shall be provided for existing and future sidewalk ramps, for approaches for existing driveways and at other locations as determined by ENGINEER.

B. Curb drops for sidewalks shall be in accordance with the current rules and regulations of Act 8, Michigan PA 1973, as amended. Curb drops for drive approaches shall be centered with the existing driveway at the property line.

C. Width of the residential curb drop shall be equal to the width of the driveway determined at the property line plus four feet. Unless otherwise approved by ENGINEER, the minimum width of the residential curb drop shall be 14 feet (4.5 m).

3.24 Shoulders

A. Shoulders shall be constructed according to the lines, grades, and cross section shown on the Plans and as specified for the particular type of shoulder material required. Shoulders shall be done in such sequence with the surfacing operations that they will be completed not more than seven (7) days after the expiration of the curing period, unless otherwise directed by ENGINEER.

B. Aggregate shoulders, when called for, shall be constructed according to the requirements specified under Section 32 1123, Aggregate Base Courses.

3.25 Cleanup

A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality.

B. Backfill shall be compacted, leveled and left in a neat, workmanlike condition.

C. At a seasonally correct time approved by ENGINEER, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, or sodded in accordance with Section 329223, Sodding.

3.26 Opening Pavement

A. ENGINEER reserves the right to require that curing operations be discontinued when the concrete has reached 85% of the design strength, and to require that the shoulders be completed and the slab be opened to traffic.

3.27 Monument Boxes

A. Government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnishing and installed by CONTRACTOR.

B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation.

C. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place.

D. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition and kind of construction, unless otherwise provided.

3.28 Testing

A. During the course of the Work, ENGINEER may require the taking of standard test scores and cylinders, by a testing laboratory acceptable to OWNER and approved by ENGINEER. Cost of testing and coring shall be at the expense of OWNER.

B. For each lane of Work:

1. A minimum of one (1) cylinder for testing compressive strength shall be made for each 500 linear feet (150 m), or fraction thereof, or as determined by ENGINEER.

2. A minimum of two (2) cores for testing compressive strength and for checking thickness shall be drilled each 500 feet (150 m), or fraction thereof.

3. The making of cylinders, the drilling of cores and testing shall be at the expense of OWNER.

C. Slump tests for consistency of Portland cement concrete shall be made in accordance with ASTM C143 and C172.

D. In the event the test results on a core indicates a deficiency in either thickness or compressive strength or in the event the test results on a cylinder indicates a deficiency in compressive strength, the following adjustments in the unit price for concrete shall be made based on the average of 3 cores:

Thickness	
Under Required Thickness	**Percent of Reduction in Unit Price**
0" to 1/4"	None
by more than a 1/4", but not exceeding a ½"	20
by more than a 1/2", but not exceeding 1"	50
by more than 1"	Remove & Replace

Comprehensive Strength	
Under Required Compressive Strength	**Percent of Reduction in Unit Price**
0 to 150 psi (0 to 1 MPa)	None
by more than 150 psi, but not exceeding 300 psi (1 MPa to 2 MPa)	20
by more than 300 psi, but not exceeding 500 psi (2 MPa to 3.5 MPa)	50
by more than 500 psi (Greater than 3.5 MPa)	Remove & Replace

E. Reduction in the unit price are additive, that is if an area is deficient by 3/8 of an inch (9 mm) and is under strength by 200 psi (1.4 MPa), the total reduction is 20% plus 20% or a reduction of 40%.

F. The area of a deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet (6 m) from it, when possible.

G. The extra core drilling and testing shall be at CONTRACTOR's expense.

End of Section

Section 32 1315
Sidewalks and Driveways

Part 1 General

1.01 Scope of Work

A. This Section includes sidewalks, sidewalk ramps, driveways, and drive approaches complete with concrete materials, concrete curing compounds, joint materials, field quality control and appurtenances.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 31 1100: Clearing and Grubbing
C. Section 31 2313: Subgrade Preparation
D. Section 32 9219: Seeding
E. Section 32 9223: Sodding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - American Society of Testing and Materials

2. AASHTO - American Association of State Highway and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Submittals

A. Written permission for the use of all local disposal sites shall be obtained and copies shall be furnished to ENGINEER.

B. At the request of ENGINEER, CONTRACTOR shall provide ENGINEER with certification that the various materials to be used conform to the ASTM Standards referred to in the Specification.

1.05 Test Reports

A. ENGINEER shall be provided with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. Core drilling, testing for thickness and compressive strength and the certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.06 Environmental Requirements

A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Article 3.11 of this Section.

1.07 Protection

A. Comply with the requirements for protecting new Work against damage from rain, as specified under Article 3.11 of this Section.

B. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Article 3.11 of this Section.

Part 2 Products

2.01 Concrete

A. Concrete shall be in accordance with MDOT Section 601 or 701, use Grade P1 or S2, 3,500 psi (24 MPa) strength; Type IA cement; 6.0 sacks cement per cubic yard (335 kg/m^3); 6A coarse aggregate; 2NS fine aggregate; 6.5% ± 1.5% air content; 3-inch (75 mm) maximum slump; no admixtures without ENGINEER's approval. Type IIIA cement may be used for high-early strength concrete.

2.02 Ready-Mixed Concrete

A. Ready-mixed concrete shall conform to ASTM C94, Alternate 2.

2.03 Water

A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without test. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T26, and as specified in MDOT Section 911.

2.04 Concrete Curing Compounds

A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 903.

2.05 Premolded Joint Filler

A. Fiber joint filler for expansion joints shall conform to ASTM D1751. Filler shall be of the thickness, as specified herein, or on the Plans, or as approved by NGINEER.

2.06 Steel Hook Bolts

A. Hook bolts shall conform to ASTM A706, or Grade 60 of ASTM A615, A616-96a, or A617-96a. Hook bolts shall be 5/8 inch (16 mm) diameter.

2.07 Joint Sealant

A. Hot-poured type joint sealant shall conform to ASTM D6690 Type II and as specified in MDOT Section 914.

2.08 Concrete Mix

A. Concrete shall contain a minimum of six sacks, 94 pounds per sack, of cement per cubic yard (335 kg/m^3) and shall yield a minimum compressive strength of 3,500 psi (24 MPa) at 28 days.

B. Cement shall be air-entraining Portland cement ASTM C150, Type 1A. If high-early strength concrete is desired, Type IIIA is required.

C. High-early concrete can be obtained for small areas by the addition of one sack of cement, Type 1A, per cubic yard of concrete (56 kg/m^3).

D. The air content of the concrete shall be 6.5%± 1.5% by volume.

E. Maximum slump of the concrete shall be three (3) inches (75 mm).

F. Ready-mixed concrete in accordance with ASTM C94, Alternate 2, shall be used, unless a written request for other than ready-mixed concrete has been submitted, reviewed and approved by ENGINEER.

Part 3 Execution

3.01 Verification of Excavation and Forming

A. Prior to the installation of any concrete, examine the excavation and forms for the proper grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades are adequate to receive the concrete to be installed.

B. Correct all defects and deficiencies before proceeding with the Work.

3.02 Existing Improvements

A. Investigate and verify location of existing improvements to which the new Work is to be connected.

B. Adjustments in line and grade to align the new Work with the existing improvements must be approved by ENGINEER, prior to any change.

3.03 Forming

A. Forms shall be of wood or metal, straight and free from warp, clean, and of sufficient strength to resist springing during the process of depositing concrete against them.

B. Forms shall be the full depth of the concrete.

3.04 Sidewalks, Sidewalk Ramps, Driveways, and Driveway Approaches

A. Unless otherwise noted in the Contract Documents, all sidewalks and sidewalk ramps shall be four (4) inches (100 mm) thick except at driveways, where the thickness of the sidewalks shall be six (6) inches (150 mm).

B. Sidewalks shall be five (5) feet (1.5 m) wide unless otherwise noted on Plans, and shall slope 1/4 inch per foot (20 mm/m) towards the surface drainage side which in general will be towards the center of the road.

C. Normally sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1-foot (300 mm) from the property line.

D. Driveways and approaches shall be six (6) inches (150 mm) thick. The width of driveways and driveway approaches shall be as specified on the Plans or as determined by ENGINEER.

3.05 Remove Curb for Curb Drop

A. Construction of sidewalk ramps within street intersections where curbed pavement exists shall conform to the current rules and regulations of Act 8, Michigan PA 1973.

B. Where there is no proper curb drop for the sidewalk ramp or driveway approach, CONTRACTOR shall saw cut, to full depth of pavement, and remove a minimum of an 18-inch (450 mm) wide curb and gutter section. When mountable curbs are present, CONTRACTOR shall remove a 24-inch (600 mm) wide curb and gutter section for the construction of sidewalk ramp, as specified above.

C. Length of curb and gutter removal shall be determined by ENGINEER in the field but shall be at least as wide as the proposed sidewalk ramp plus 1-foot (300 mm) on each side.

D. Removed curb and gutter section shall be replaced with material, equal to what was removed and the joint sealed with hot poured rubber asphalt.

E. CONTRACTOR shall install 5/8 inch (15 mm) diameter self tapping hook bolts, in the existing concrete pavement as indicated on the Plans prior to placing concrete for the removed curb and gutter section.

F. Curbs may be cut or ground down with an approved concrete grinder when the final results will leave the cut or ground down curb in a smooth, clean condition acceptable to ENGINEER. Curbs that are cut or ground down that are not acceptable to ENGINEER, shall be removed and replaced as specified above at no additional cost.

3.06 Placement of Forms

A. Wood forms, straight and free from warp, of nominal depth may be used for sidewalk sections less than 25 feet (7.5 m) in length.

B. Forms shall be staked to line and grade in a manner that will prevent deflection and settlement.

C. When unit slab areas are to be poured, slab division forms shall be so placed that the slab division joints will be straight and continuous.

D. Forms shall be set for sidewalk ramps to provide a grade toward the centerline of the right-of-way in accordance with current standards. The grade shall be uniform, except as may be necessary to eliminate short grade changes.

E. Forms shall be oiled before placing concrete. Forms shall remain in place at least 12 hours after the concrete is placed. There shall be sufficient forms placed ahead of the pouring operations to maintain uninterrupted placement of concrete.

F. The use of slip form pavers can be allowed when approved by ENGINEER in lieu of the construction system described above.

3.07 Joints

A. Transverse and longitudinal expansion and plane-of- weakness joints shall be constructed at the locations specified herein, or as indicated on the Plans or as approved by ENGINEER.

B. Transverse expansion joints shall be placed for the full width and depth of the new Work. The transverse expansion joints placed against any existing pavement shall be a minimum of 6 inches (150 mm) deep but no less than the thickness of the concrete being placed.

C. Longitudinal expansion joints shall conform to the same requirements as transverse expansion joints.

D. Joints shall be constructed true to line with their faces perpendicular to the surface of the sidewalk. The top shall be slightly below the finished surface of the sidewalk. Transverse joints shall be constructed at right angles to the centerline of the sidewalk and longitudinal joints shall be constructed parallel to the centerline or as determined by ENGINEER.

E. Unless otherwise specified on the Plans or unless otherwise determined by ENGINEER, when the sidewalk is constructed in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with like joints in the adjacent slab. Also, in the case of widening existing sidewalks, transverse joints shall be placed in line with like joint in the existing sidewalk.

F. Transverse expansion joints, 1/2 inch (10 mm) thick, shall be placed through the sidewalk at uniform intervals of not more than 50 feet (15 m) and elsewhere as shown on the Plans, or as determined by ENGINEER.

G. Expansion joints, 1/2 inch (10 mm) thick, shall also be placed between the sidewalk and back of abutting parallel curb, buildings or other rigid structures, concrete driveways and driveway approaches. The expansion joint between sidewalks and buildings shall be placed 1-foot from the property line and parallel to it.

H. Expansion joints, 1-inch (25 mm) thick, shall be placed between sidewalk ramps or driveway approaches and the back of curbs.

I. Plane-of-weakness joints shall be formed every 5 feet (1.5 m) and shall be produced by use of slab divisions forms extending to the full depth of the concrete or by cutting joints in the concrete, after floating, to a depth equal to 1/4 the thickness of the sidewalk. Cut joints shall not be less than 1/8 inch (3 mm) nor more than 1/4 inch (5 mm) in width and shall be finished smooth and shall be at right angles to the centerline of the sidewalk.

3.08 Placing and Finishing Concrete

A. Concrete shall be placed on a prepared unfrozen, smooth, leveled, rolled and properly compacted base as indicated on the Plans. The surface of the subbase shall be moist with no visible water present prior to placement of the concrete.

B. Concrete shall be deposited, in a single layer, to the depth specified in the Plans or in the Proposal. Concrete shall be thoroughly spaded or vibrated and compacted to fill in all the voids along the forms and joints. Concrete shall be struck off with a strike board until all voids are removed and the surface has the required grade and cross section as indicated on the Plans.

C. The surface of the concrete shall be floated just enough to produce a smooth surface free from irregularities. All edges and joints shall be rounded with an edger having a 1/4 inch (5 mm) radius. The surface of sidewalks, driveways and approaches shall be broomed to slightly roughen the surface.

D. The surface of sidewalk ramps shall be textured with a coarse broom transversely to the ramp slope. The texture on sidewalk ramps shall be coarser than the remainder of the sidewalk.

3.09 Curing

A. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the concrete (and sides if slip-forming is used) shall be completely coated and sealed with a uniform layer of white membrane curing compound.

B. The curing compound shall not be thinned. The curing compound shall be applied at the rate of 1-gallon per 200 square feet (4 L per 20 m^2) of surface.

3.10 Barricades

A. Suitable barricades and lights shall be placed around all newly poured sidewalks, sidewalk ramps, driveways, driveway approaches and curb and gutter section in order to protect the new Work from damage from pedestrians, vehicles and others until the concrete has hardened.

B. Barricades shall be left in place for a minimum of two (2) days, except for driveway approaches and curb and gutter section. Barricades shall remain in place for a minimum of three (3) days.

C. Concrete that suffers surface or structural damage shall be removed and replaced by CONTRACTOR at his expense.

3.11 Protection

A. CONTRACTOR shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened. For this Work CONTRACTOR shall have available on the job site at all times enough burlap or 6-mil thick polyethylene film to cover and protect one (1) day's work. When rain appears eminent, operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary. Curing compound shall be applied to any areas where the compound has been disturbed or washed away.

B. If concrete is placed between October 15 and May 15, CONTRACTOR shall have available on the site sufficient amount of clean, dry straw or hay to cover one day's production. If the temperature reaches 40 degrees Fahrenheit (4 degrees Celsius) and is falling, the hay or straw shall be placed 12 inches (305 mm) thick, immediately after the curing compound is applied. If the temperature is 30 degrees Fahrenheit (-1 degrees Celsius) and falling the curing shall be by 6-mil thick polyurethane film placed on the concrete as soon as the surface moisture has disappeared, and then covered with 12 inches (300 mm) of straw or hay.

C. Also, whenever the temperature in the shade falls below 50 degrees Fahrenheit (10 degrees Celsius), the water, sand and coarse aggregate shall be heated in that order sufficiently to maintain a uniform temperature of the concrete at between 70 degrees Fahrenheit and 80 degrees Fahrenheit (21 to 27 degrees Celsius).

D. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit (32 degrees Celsius).

3.12 Cleanup

A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality. Backfill shall be compacted, leveled and left in a neat, workmanlike condition.

B. At a seasonally correct time approved by ENGINEER, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, or sodded in accordance with Section 32 9223, Sodding.

3.13 Testing

A. ENGINEER may require that a minimum of two cores be drilled from the sidewalk for each 500 (or fraction thereof) linear foot (150 m) section placed. At least one (1) core out of two (2) required will be taken from the sidewalk at the driveway. One (1) core may be required from every 20 (or fraction thereof) of driveway approaches or sidewalk ramps installed.

B. Cores shall be checked for depth and compressive strength. Core drilling and tests shall be done by a testing laboratory designated by OWNER and at the expense of OWNER. The testing laboratory shall furnish ENGINEER with two (2) certified copies of the test results.

C. In the event the test results on a core indicates a deficiency in either thickness or compressive strength the following adjustments in the unit price for concrete shall be made:

Thickness	
Under Required Thickness	**Percent of Reduction in Unit Price**
0" to 1/4"	None
by more than a 1/4", but not exceeding a ½"	20
by more than a 1/2", but not exceeding 1"	50
by more than 1"	Remove & Replace

Compressive Strength	
Under Required Compressive Strength	**Percent of Reduction in Unit Price**
0 to 150 psi	None
by more than 150 psi, but not exceeding 300 psi	20
by more than 300 psi, but not exceeding 500 psi	50
by more than 500 psi	Remove & Replace

D. The area of the deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet (6 m) from it when possible. Extra core drilling and testing shall be at the expense of CONTRACTOR. Reductions due to deficiencies in thickness or compressive strength are additive, that is, if an area is deficient by 3/8 inch (9 mm) and under strength by 200 psi (1.3 MPa), the total reduction is 20% plus 20% or 40% reduction.

End of Section

Section 32 1500
Aggregate Surfacing

Part 1 General

1.01 Scope of Work

A. This section includes the requirements for constructing aggregate surfacing.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2313: Subgrade Preparation
D. Section 32 1216: Bituminous Paving
E. Section 32 1313: Concrete Paving
F. Section 32 9219: Seeding

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM – American Society of Testing and Materials

2. AASHTO – American Association of State Highways and Transportation Officials

3. MDOT – Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Allowable Tolerances

A. The finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in 10 feet (30 mm per 5 m).

1.05 Test Reports

A. Testing lab shall provide ENGINEER with 2 certified copies of the test results of the thickness of the compacted aggregate. Core drilling, testing for thickness and certification of the test results shall be performed by a testing laboratory approved by ENGINEER.

1.06 Stockpiling Aggregate

A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.

B. Stockpiling of aggregate, in excess of 4 feet (1.2 m) in depth, on the completed subbase or aggregate surface will not be permitted, except with the approval of ENGINEER.

1.07 Environmental Requirements

A. Comply with the requirements for aggregate base or surfacing installations due to outside ambient air temperatures specified under Article 3.10 of this Section.

Part 2 Products

2.01 Dense-Graded Aggregate

A. The dense-graded aggregate gradation shall conform to dense-graded aggregate, Series 22 and 23 as specified in MDOT Section 902.

2.02 Calcium Chloride Additives

A. The calcium chloride additives shall conform to ASTM D98 and as specified in MDOT Section 903.

2.03 Water

A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Water from sources approved by the Michigan State Department of Public Health as potable may be used.

Part 3 Execution

3.01 Excavation Verification

A. Prior to the placing of any aggregate material, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades or subbases are adequate to receive the new Work. Correct defects and deficiencies before proceeding with the Work.

3.02 Subgrade Conditions

A. Prior to the placing of any aggregate material, examine the subgrade or subbase to ascertain that it is adequate to receive the aggregate to be placed. If the subgrade or subbase remains wet after all surface water has been removed, ENGINEER may require the installation of edge drain.

3.03 Existing Base

A. Prior to the placing of any aggregate material for surfacing, examine the existing base for grade and condition to receive the new Work. Ascertain that the base is adequately compacted to receive the aggregate surfacing to be installed. Correct defects and deficiencies before proceeding with the Work.

3.04 Existing Improvements

A. Investigate and verify locations of existing improvements, including structures, to which the new Work will be in contact.

B. Necessary adjustments in line and grade, to align the new Work with the existing improvements must be approved by ENGINEER, prior to any changes.

3.05 Preparation of Subgrade or Subbase

A. Subgrade or subbase shall be fine graded to the cross section indicated on the Plans, and shall be thoroughly compacted prior to the placing of the aggregate material.

3.06 Installation - General

A. Width, thickness, and type of aggregate materials shall be indicated on the Plans or as directed by ENGINEER.

B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by ENGINEER.

3.07 Aggregate Surface Course

A. Where the base for the new aggregate surface course is an existing aggregate surface, the existing surfacing, shall be either graded or scarified and graded to remove irregularities and to provide a bond between the old and new surfaces.

B. Aggregate surface course shall be placed by a mechanical spreader or other approved means, in uniform layers to such a depth that when compacted, the course will have the thickness shown on the Plans.

C. Depth of the surface course, when compacted, shall not exceed 6 inches (150 mm), unless otherwise specified on the Plans or directed by ENGINEER. Aggregate shall be of a uniform mixture when placed on the prepared base. It shall be uniformly spread and then trimmed with a road grader, trimmer or other approved means until the surface is free from waves and irregularities. Trimming shall be alternated by rolling with a pneumatic-tired or tamping type roller. The entire operation shall continue until the surface course is compacted to at least 95% of maximum unit weight.

D. When the operation is completed, the surface course shall conform to the required lines, grades and cross sections.

E. Optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

F. When approved by ENGINEER, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.

G. With the approval of ENGINEER, chloride additives may be used by CONTRACTOR to facilitate his compaction and maintenance of the aggregate surface. Amount and method of combining the chloride additives are at the option of CONTRACTOR and are at his expense.

3.08 Aggregate Shoulders and Approaches

A. Construction of shoulders and approaches shall be of the material, width and depth as shown on the Plans.

B. When shoulders and approaches are specified by class, they shall conform to MDOT Section 307 for shoulders and approaches specified as: Class I, Class II, Class III or Class IV.

C. The subgrade for the shoulders and approaches shall be graded to an elevation below the finished surface that will permit the placing of the specified thickness of materials.

D. The subgrade of shoulders and approaches shall be approved by ENGINEER prior to the placing of aggregate.

E. The aggregate shall be placed on the prepared subgrade by a mechanical spreader or other approved means, to a depth of not more than 5 inches (125 mm). If the specified thickness exceeds 5 inches (125 mm), the shoulder or approach shall be constructed in two or more courses.

F. Dumping the aggregate on the road surface and grading it onto the shoulder or approach will not be permitted.

G. The aggregate shall be compacted to not less than 100% of the maximum unit weight for the first 5 feet (1.5 m) outside of the pavement edge and 98% of the maximum unit weight for the remainder of the area. When the operation is completed, the surface course shall conform to the required lines, grades and cross sections.

H. On resurfacing projects, the existing aggregate shoulder or approach shall be scarified prior to the placing of new aggregate materials. The placement of aggregate shall proceed the placing of the top course of bituminous mixture on the adjoining pavement. Final shaping and compaction of the shoulder or approach shall follow the placement of the top course of bituminous mixture unless otherwise directed by ENGINEER.

I. The optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.

J. When approved by ENGINEER, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.

K. With the approval of ENGINEER, chloride additives may be used by CONTRACTOR to facilitate his compaction and maintenance of the aggregate surface. Amount and method of combining the chloride additives are at the option of CONTRACTOR and are at his expense.

3.09 Maintenance During Construction

A. Aggregate surface shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.

B. CONTRACTOR, at his expense, shall provide additional materials needed to fill depressions or bind the aggregate.

3.10 Temperature Limitations

A. Aggregate materials shall not be placed when there are indications that the mixtures may become frozen before the maximum unit weight is obtained.

B. In no case shall the aggregate be placed on a frozen subgrade or base course unless otherwise directed by ENGINEER.

3.11 Cleanup

A. Immediately following the compacting of the surface course, the voids on both sides of the aggregate course shall be backfilled with sound earth of topsoil quality.

B. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.

C. At a seasonally correct time approved by NGINEER, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding or sodded in accordance with Section 32 9223, Sodding.

3.12 Opening Aggregate Surfaced Roads

A. ENGINEER reserves the right to open the aggregate surfacing to traffic at any time during construction.

3.13 Monument Boxes

A. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnished and installed by CONTRACTOR and shall be East Jordan Iron Works No. 1570, or approved equal.

B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. Adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.14 Testing

A. During the course of the Work, the ENGINEER may require testing for compaction or density and for thickness of material. Testing and coring required shall be performed by a testing laboratory acceptable to OWNER and approved by ENGINEER. The cost for testing and coring shall be at the expense of OWNER.

B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 linear feet (120 m) per traffic lane. The lane width shall be as indicated on the Plans or as determined by ENGINEER. If 2 lanes are constructed simultaneously, only one test is necessary to represent both lanes. For areas such as intersections, entrances, cross-overs, ramps, widening strips, acceleration and deceleration lane, at least one depth measurement will be taken for each 1,200 square yards (1000 m^2) of such areas or fraction thereof. The location of the depth measurement will be at the discretion of ENGINEER.

C. The maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D.

3.15 Defective Work

A. Thickness:

1. Measurements of aggregate base and/or surface course thickness will be made to the nearest 1/4 inch (5 mm). Depths may be 1/2 inch (10 mm) less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness. In determining the average in place thickness, measurements which are more than 1/2 inch (10 mm) in excess of the thickness indicated on the Plans will be considered as the specified thickness plus 1/2 inch (10 mm).

2. Locations of the depth measurements will be as specified herein unless otherwise directed by ENGINEER. Sections found to be deficient in depth shall be corrected by CONTRACTOR using methods approved by ENGINEER.

B. Weight:

1. When the aggregate material is measured by weight in Tons (or metric tons), the pay weights for aggregates will be the scale weight of the material, including admixtures, unless the moisture content is more than 6 percent.

2. Moisture tests will be made at the start of weighing operations and at any time thereafter when construction operations, weather conditions or any other cause may result in a change in the moisture content of the material.

3. If the tests indicate a moisture content in excess of 6 percent, the excess over 6 percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than 6 percent.

End of Section

Section 32 1723
Pavement Markings

Part 1 General

1.01 Scope of Work

A. This Section includes pavement markings complete with materials, layout of markings and preparation of pavement surfaces.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ASTM - American Society of Testing and Materials

2. AASHTO - American Association of State Highways and Transportation Officials

3. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 Requirements of Regulatory Agencies

A. Where applicable pavement markings shall conform to the current requirements of the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.) issued under provisions of the Michigan Vehicle Code, Act 300, PA 1949, as amended.

1.05 Submittal of Manufacturer's Literature

A. Submit manufacturer's literature of all paints to be used in the Work. Manufacturer's literature shall show paint: type, texture, color, temperature limitations, recommended use, spreading rate, drying time, and cleanup.

1.06 Product Delivery, Storage and Handling

A. Deliver all materials to the Project site in original, unopened waterproof containers. Packaging containers shall bear manufacturing labels intact and legible. The label shall contain the following information: name and address of manufacturer, shipping point, trademark or trade name, kind of paint, formula, amount in U.S. gallons, date of manufacture and lot number, type of paint and AASHTO Specification Number.

B. Store all materials in waterproof containers, under protective covering, off the ground and away from extreme heat or cold until ready for use.

C. Handling of materials shall be in accordance with the manufacturer's recommendations.

1.07 Environmental Requirements

A. CONTRACTOR shall comply with the appropriate environmental limitations (air temperature, pavement temperature, and relative humidity) as outlined in the MDOT Section 811.03.

Part 2 Products

2.01 Regular Dry Traffic Marking Paint

A. Regular drying pavement marking paint in white and yellow colors shall conform to AASHTO M248, Type N traffic paint and shall meet the current MDOT specified ingredients for regular drying traffic paint and shall be selected from MDOT's Qualified Products List.

2.02 Fast Dry Polyester Pavement Marking Paint

A. Fast drying pavement marking paint in white and yellow colors shall conform to AASHTO M248, Type F traffic paint and shall meet the current MDOT specified ingredients for fast drying traffic paint and shall be selected from MDOT's Qualified Products List.

2.03 Waterborne Pavement Marking Paint

A. Waterborne pavement marking material in white and yellow colors shall conform to the current MDOT Specifications for waterborne pavement markings and shall be selected from MDOT's Qualified Products List.

2.04 Thermoplastic Pavement Markings

A. Hot applied thermoplastic pavement markings in white and yellow colors shall conform to AASHTO M249, white and yellow thermoplastic striping materials (solid form), shall meet the current MDOT Specifications for hot applied thermoplastic paving marking and shall be selected from MDOT's Qualified Products List.

2.05 Cold Plastic Pavement Markings

A. Preformed cold plastic pavement markers in white and yellow colors shall conform to the current MDOT Specifications for cold applied plastic pavement markings and shall be selected from MDOT's Qualified Products List.

2.06 Polyurea Pavement Markings

A. Two-component, polyurea pavement marking material in white and yellow colors shall conform to the current MDOT Specifications and shall be selected from MDOT's Qualified Products List.

2.07 Temporary Pavement Marking Tape

A. Temporary Pavement Markings Type R and Type NR shall conform to MDOT Section 922.06.A and shall be selected from MDOT's Qualified Products list.

2.08 Glass Beads

A. Glass beads for reflectorizing white and yellow paint markings of pavement by the drop-in method on fresh paint stripes shall conform to the current MDOT Section 920.02 for glass beads for use in pavement markings for the type of paint specified.

Part 3 Execution

3.01 Verification of Existing Conditions

A. Prior to the placing of any pavement markings, examine the limits of the new Work and ascertain that the existing surfaces are adequate to receive the material to be installed.

3.02 Preparation of Surface

A. Surfaces to be painted must be thoroughly dry and free from dirt, loose paint, oil, grease, wax and other contaminants.

B. Costs incurred for removing and disposing of unsuitable materials in preparation of the surfaces to receive the new Work, shall be incidental to the price paid for the pavement markings.

3.03 Performance - General

A. Pavement marking operation shall be limited to the type of Work and the limits as specified on the Plans. If additional area is required by CONTRACTOR for storage of equipment or supplies, CONTRACTOR shall furnish ENGINEER with written permission obtained from the property owner of the storage area, permitting the storage.

B. Unless otherwise specified on the Plans or approved by ENGINEER, CONTRACTOR shall conduct his operations and use of his equipment in such a manner that traffic will be maintained throughout the Project.

C. For Work within public rights-of-way and other areas as determined by ENGINEER, the provisions for maintaining traffic shall be as specified in the Michigan Manual of Uniform Traffic Control Devices, and MDOT specifications for traveling convoys. Costs incurred in maintaining traffic shall be at CONTRACTOR's expense.

D. CONTRACTOR's equipment shall have sufficient paint capacity to enable sustained pavement marking operations and shall be equipped so as to assure uniform application of the paint and thermoplastic pavement markings.

1. Equipment shall have mechanical bead dispensers or pressurized bead dispensers. In general, the equipment shall be that necessary to accomplish the marking operations in a safe, efficient, and workmanlike manner.

2. For parking lots and other small areas, approved portable equipment and use of hand methods will be allowed.

E. The color of the paint, and the width or type of markings shall be as specified on the Plans or as directed by ENGINEER.

F. Markings shall be applied so that they adhere adequately to the surface.

G. Markings shall be applied in accordance with the applicable requirements of MDOT Section 811 for permanent pavement markings or Section 812.03 for temporary pavement markings. Unless otherwise specified, removal of temporary pavement markings shall be incidental to the Project.

3.04 Layout for Markings

A. Layout work necessary for the location and placing of markings, as specified on the Plans or as determined by ENGINEER, shall be the responsibility of CONTRACTOR and shall be at his expense.

3.05 Application of Waterborne Markings

A. Waterborne paint shall be applied when the air temperature is 50 degrees Fahrenheit or higher and the pavement is dry.

B. CONTRACTOR shall be responsible for making the decision to apply waterborne paint on any specific day when there is a high probability of rain in the forecast. If applied lines are washed away because of rain, CONTRACTOR shall be responsible for re-applying the lines at no additional expense to OWNER.

C. Waterborne pavement marking materials may be placed immediately on new bituminous pavement. Waterborne pavement marking material shall not be placed before May 1, or after October 1.

D. Waterborne paint shall be applied with an application thickness of 15-mil and 8-mil dry thickness. Glass beads shall be added at the rate of 32 pounds per mile per 4-inch line, during the application process.

3.06 Application of Pre-formed Hot-Applied Thermoplastic Markings

A. Since subsurface moisture can be present in amounts sufficient to affect proper bonding of the hot-applied thermoplastic material, CONTRACTOR shall be responsible for insuring that the pavement is free of excess moisture that may effect proper bonding prior to beginning work.

B. Testing for moisture shall be documented and provided to ENGINEER.

C. Minimum ambient air temperature shall be 48 degrees Fahrenheit and rising at the start of marking operations. If work is started and the air temperature falls below 45 degrees Fahrenheit, and continual cooling is indicated, all work shall be stopped. The minimum pavement temperature is 50 degrees Fahrenheit.

D. Thermoplastic material shall be heated and applied within the temperature range recommended by the manufacturer. Thermoplastic material shall not be placed before May 14, or after October 1.

3.07 Application of Polyurea Pavement Markings

A. Polyurea pavement markings shall not be applied over existing non-polyurea pavement markings. Existing non-polyurea pavement marking shall be completely removed before applying polyurea pavement markings. Remove curing compounds from concrete pavement. Apply at 15 to 25-mil thickness. Pavement shall be clean and dry. Pavement temperature shall be 40 degrees Fahrenheit or higher unless otherwise approved by ENGINEER.

3.08 Tolerances

A. New markings and/or retraced markings shall be placed, with reasonable tolerance, in their proper locations.

B. Incorrect or misplaced markings shall be obliterated and remarked in accordance with ENGINEER's instructions. Costs incurred to obliterate and remark incorrect or misplaced markings will be at CONTRACTOR's expense.

3.09 Protection of Markings

A. Protection of the wet paint and thermoplastic pavement markings shall be the responsibility of CONTRACTOR, and all costs incurred to provide the protection will be at his expense.

3.10 Weather and Time Limitations

A. Markings shall not be placed when rain is threatening or when the surface to be painted is wet.

B. Pavement marking shall be performed during the period May 1 to November 1, unless otherwise approved in writing by ENGINEER. No markings shall be applied when the air temperature is less than 50 degrees Fahrenheit (10 degrees Celsius), as determined by ENGINEER.

End of Section

Section 32 9000
Plantings

Part 1 General

1.01 Scope of Work

A. This Section includes furnishing trees, shrubs and ground cover as shown on the Plans, complete with the digging and preparation of holes, furnishing and placing of topsoil, planting, pruning, watering, fertilizing and cultivating; weed control fabric, and such other materials necessary to complete the Work and insure proper and hardy growth.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Performance Requirements:

1.03 Source Quality Control

A. Trees, shrubs and ground cover shall comply with the state and federal laws with respect to inspection for plant diseases and insect infestation.

1.04 Reference Standards

A. AAN - American Association of Nurserymen

B. AANLS - American Association of Nurserymen Landscape Standards

C. ANSI - American National Standards Institute

D. ASTM - American Society for Testing and Materials

E. MDOT - Michigan Department of Transportation Standard Specifications for Construction, 2003

1.05 Submittals

A. CONTRACTOR shall submit to ENGINEER certificates of inspection for plant diseases and insect infestation.

B. Submit a certified analysis of imported topsoil from each off-site source prior to delivery. Deficiencies shall be corrected at CONTRACTOR's expense.

C. Submit sample of mulch and planting mixture prior to delivery to site.

D. Submit product data for anti-desiccants, tree wound dressing and herbicides prior to use.

1.06 Plant Selection and Inspection

A. Trees shall be inspected and accepted prior to planting. CONTRACTOR may elect either of the following options as applicable:

B. For sources within 120 miles of the site, ENGINEER will tag the trees at the source. CONTRACTOR shall request, in writing, at least two weeks prior to any desired inspection date, inspection and approval of the trees at the source. Approved trees will be tagged by ENGINEER and the tag shall remain on the tree until planting and final inspection. CONTRACTOR shall accompany ENGINEER on the inspection.

C. Otherwise, the trees will be delivered to the site. Trees approved for use will be tagged by ENGINEER and the tag shall remain on the tree until planting and final inspection. Rejected trees will not be tagged and shall be immediately removed from the site, and new trees shall be brought in for inspection and approval.

D. Plant material shall be subject to approval by ENGINEER at the site prior to planting.

1.07 Preparation of Shipments

A. Plant material shall be clearly labeled as to species and variety. The label or tag shall be securely attached to each plant and shall show the scientific name of the plant. Unless otherwise shown on the Plans, all plants shall be balled and burlapped or container grown.

B. In preparation for spring planting, balling operations for balled and burlapped stock shall be completed prior to "bud break." In preparation for fall planting of deciduous plants, balling operations shall not commence until after the plants have begun to "harden off." Stock shall be dug and packed with care immediately prior to shipment. Plants shall be dug and transported so as to provide and retain a firm ball of earth. Roots shall be carefully protected with wet straw, moss or other material. Root balls shall be adequately protected from rain or sudden changes in the weather. Balled and burlapped plants will not be accepted if the balls of earth are loosened or broken or wrapped with material made from synthetics or plastic.

C. Plants furnished in containers shall have their roots well established in the soil mass and shall have grown in the container for at least one (1) growing season. Containers shall be of a size large enough to provide an earth-root mass of adequate diameter and depth for the stem diameter and plant height or spread, as established by accepted nursery practice. No container grown stock will be accepted if it is root bound.

D. Transporting of all nursery stock shall be in an enclosed or covered vehicle. Deliver plant material immediately prior to planting. Keep plant material moist.

E. Plants will be rejected when the ball of earth surrounding the roots has been cracked or broken prior to or during the planting.

F. Plants shall be rejected when the burlap, stakes, or ropes required in connection with transplanting have been displaced prior to final acceptance.

1.08 Storage and Handling

A. Roots of plants shall be kept moist and adequately protected by topsoil or other approved covering until planted.

B. Trunks and branches of trees shall be carefully protected from injury of any kind during all operations of digging, loading, transporting and planting. Trees that are injured may be rejected.

1.09 Planting Season

A. Planting seasons for deciduous plants shall be between March 1 and June 1 and from October 1 until the ground becomes frozen, except that, when unusual planting conditions exist or when container-grown material is used, these planting seasons may be altered. When approved by ENGINEER, plants, having a ball of earth attached, may be planted during the summer months, provided adequate moisture will and can be applied to the plants.

B. Planting season for evergreen plants shall be between March 1 and June 1.

1.10 Guarantee and Acceptance

A. CONTRACTOR shall warrant that all trees have been grown, transported, handled and planted properly so as to be in a vigorous growing condition at the start of the establishment period.

B. Trees, shrubs and ground cover shall be guaranteed for the establishment period(s). CONTRACTOR shall replace all trees, shrubs and ground cover showing defective growth, more than 20% dieback, disease, insect infestation or other impairing defects during the Establishment Period with sound, healthy, vigorous growing trees, shrubs and ground cover at no additional expense to OWNER and in accordance with the plans and specifications.

C. At the end of the Establishment Period, CONTRACTOR shall request final acceptance. Final acceptance will be made by ENGINEER and OWNER provided the trees are healthy and all requirements of the Project have been fulfilled.

1.11 Experience and Qualifications

A. CONTRACTOR or Subcontractor must be experienced and capable of completing the Work so that the plant materials are in a healthy, vigorous growing condition at the end of the Project. In order to show that CONTRACTOR or Subcontractor is capable of completing the Work in successfully, when requested by ENGINEER, CONTRACTOR shall submit references from the last five (5) projects of a similar nature. Failure to show successful completion of the last five projects of a similar nature may result in CONTRACTOR or Subcontractor being deemed unacceptable for this Work on this Project.

Part 2 Products

2.01 Trees and Shrubs

A. Trees and shrubs shall conform to the requirements of AANLS and as specified herein.

B. Plant material shall conform to the sizes given in the plant list or Proposal. Measurements such as spread, ball size, number of canes, quality designations, etc. shall be in accordance with AAN “American Standard for Nursery Stock”.

C. Plant material shall be typical for their species or variety and shall be sound, healthy, vigorous, and free from plant diseases and insect pests or their eggs. They shall have healthy, well developed root systems.

D. Plants designated “B&B” shall be balled and burlapped. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be securely wrapped with burlap and bound with cord.

E. No balled and burlapped plant shall be planted if the ball is cracked or broken. No planting with rot proof burlap or ties shall be permitted. Sand balls are not acceptable.

F. Trees shall be nursery grown stock which has been pruned to encourage single main stems, compact fibrous root systems and symmetrical branching. Trees of the same species shall be uniform in height and spread. Trees shall be free from all insects, diseases, mechanical injuries or other objectionable features. Root balls shall be of the sizes specified in AANLS for the tree root system.

G. Container-grown stock shall have been grown in the containers for one (1) growing season minimum. Plants showing "Pot Bound" root ends will not be accepted.

H. Trees caliper for trees less than 4-inch (100 mm) caliper shall be determined at a point six (6) inches (150mm) above ground when installed. Trees above 4-inch (100 mm) caliper shall be measured at a point twelve (12) inches (300 mm) above the ground.

I. Ornamental trees and shrubs shall be well formed and shall have a crown typical of the species or variety. Low-branched crown types shall be furnished, unless the Plans or Proposal specify a tree form or a bush form. Material shall be balled and burlapped, unless otherwise indicated. Plant stock shall have grown to the required size in a normal progressive manner. Heading-back plants to meet sizes called for on the Plans will not be permitted.

J. Evergreen trees will require ball and burlap or other adequate root protection. Tops shall be of a form typical to the species and not unnaturally sheared or color treated. Anti-desiccant protection may be required for evergreen trees.

K. Plant material shall be nursery grown at sources in the same or higher hardiness zone as determined by the latest edition of the Plant Hardiness Zone Map, Agricultural Research Service, U.S. Department of Agriculture.

L. Substitutions will be permitted only upon submission of proof that specified plants are not obtainable and with the authorization of ENGINEER. Requests for substitutions and price adjustments due to substitutions must be submitted in accordance with the General Conditions.

2.02 Mulching

A. Mulching material shall be one of the following as specified on the plans.

1. Compost:

a. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable as defined in P.A. 641 as amended and shall be in compliance with all federal and state laws. The compost shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor. The mixture shall be free of glass, plastic, metal, and other contaminants, as well as

viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.

b. Manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.

c. The composition of the compost shall be within the following range of values:

(1)	Soil pH	6 to 7.5
(2)	Soluble Salts	2 to 5 mmho/cm
(3)	Carbon/Nitrogen Ratio	13 to 20 parts C to 1 part N
(4)	Inerts	< 1%
(5)	Organic matter	35 to 55 %
(6)	Nitrogen	1 to 2 %
(7)	Phosphorus	0.2 to 0.8 %
(8)	Potassium	y0.5 to 1.5 %
(9)	Unit Weight	535 to 775 Kg/m3
(10)	Moisture Content	40 to 50 %
(11)	Particle Size	< 20 mm maximum
(12)	Water Holding Capacity	> 100%
(13)	Heavy Metals	None

d. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

e. Temperature: The compost material must have undergone the procedure to significantly reduce the pathogen level as referenced in EPA 40 CFR, Part 257 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations. The temperature must be maintained at 40° C for 5 days with a temperature exceeding 55° C for at least 4 hours.

f. Pathogens and Trace Elements: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.

g. To comply with the annual filing requirements with the Michigan Department of Agriculture, Pesticide and Plant Management Division, the supplier of the compost shall certify that the compost meets Michigan P.A. 641 as amended and EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.

h. A data sheet shall accompany the certification. The data sheet shall show the following:

(1) Standard compost total nutrient test results, including N, P, K, Ca, Mg, Mn, Cu, Fe total carbon, pH, as provided by an acceptable testing laboratory

(3) Organic content

(4) Inert contamination

(5) Soluble salts

(6) Carbon/Nitrogen ratio

(7) Proof of maturity/stability acceptable to the Michigan Department of Agriculture

i. The certification and data sheets shall be mailed annually to the Michigan Department of Agriculture, Agriculture Environment Coordinator. The date shall be included on which the compost test results were mailed to the Michigan Department of Agriculture.

2. Wood Chips:

a. Wood chips shall be the product of a mechanical chipper.

b. Chips shall not include twigs, chopped leaves, or pine needles. Suitability of chip material and size will be determined by visual inspection by ENGINEER.

c. Wood chips shall be produced from trees free of any insects and diseases.

3. Shredded Bark:

a. Shredded bark shall consist of tree bark which has been stripped and shredded from saw logs by means of a debarking machine.

b. Shredded bark shall be produced from trees free of any insect and diseases.

c. Material shall be sufficiently fine and free from extraneous material so that it will readily pass through a conventional mulch blower.

4. Double Shredded Bark:

a. Double processed shredded bark mulch shall be shredded bark mulch which has been processed twice.

2.03 Topsoil

A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than one (1) inch (25 mm) in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

1. pH ..... 5.0 to 7.5
2. soluble salts ..... 500 ppm max
3. organic content ..... 5% to 30%
4. silt content ..... 35% to 50%

5. clay content ..... 5% to 10%
6. deleterious mat'l* ..... 5% max

*rock, gravel, stone, sticks, roots, sod, etc.

B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8-inch (15 mm) maximum mesh screen prior to delivery to the Project site. ENGINEER shall review source and final screen results prior to release of topsoil. CONTRACTOR shall submit a certified analysis of the topsoil from each source to ENGINEER. Topsoil shall be placed in 4-inch (100 mm) minimum thickness throughout, or as specified in the plans or Specifications.

C. CONTRACTOR shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at his own expense.

2.04 Sand

A. Sand for planting mixture shall be clean, course, ungraded sand conforming to ASTM C3 for fine aggregates.

2.05 Fertilizer

A. Fertilizer shall be Agriform 21-Gram Planting Tablets Plus Minors, or ENGINEER-approved equal. Planting Tablets shall be tightly compressed, long-lasting and slow-release with an N-P-K analysis of 20-10-5. Apply at manufacturer's recommendations and soil analysis.

2.06 Peat

A. Granulated raw Canadian peat or baled Canadian peat, containing not more than 9% mineral on a dry basis. For ericaceous plants, baled peat with a pH of 4.0 shall be used.

2.07 Landscape Weed Control Fabric

A. Weed barrier fabric shall consist of a geotextile fabric, spun-bonded polypropylene, non-woven fabric and a UV stabilizer.

Minimum Average Roll Values

Fabric Properties	Minimum Values	Test Method
Unit Weight	3.0 oz/yd2	ASTM D5261
Grab Tensile Strength	135 lbs.	ASTM D4632
Elongation at Break	70%	ASTM D4632
Puncture Strength	35 lbs.	ASTM D4833
Trapezoidal Tear	50 lbs.	ASTM D4533
Permittivity	1.2 sec.-1	ASTM D4491
Air Opening Size (equivalent Sieve)	60/70	ASTM D4751
Ultraviolet Stability	70% @ 500 hrs.	ASTM D4355

B. Fabric shall be Typar Professional Landscape Fabric 3301 or ENGINEER approved equal.

2.08 Steel Landscape Edging

A. Comply with ASTM A 569, hot-rolled, standard flexible carbon steel landscape edging, fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately thirty inches (30") apart to receive stakes. Steel landscape edging shall be double staked at overlap joints and designed to receive tapered steel stakes.

B. Steel Edge shall be 12ga (.10"-105") x 4" wide, by 10' length, with 4 stakes. Painted finish shall be Sherwin Williams H68GT85 powder coat paint electrostatically applied, and oven baked. Minimum thickness to be 1.5 mils. Color shall be green, brown, or black as determined by OWNER.

C. Steel stakes shall be Steel, tapered, 14" length and finished to match specified steel landscape edging. Stakes shall be designed specifically to anchor steel landscape edging in place, and made by the manufacturer of the steel landscape edging for which they will be used.

D. Furnish and install manufacturer's standard start/end sections, 90° corners, and splicers as required.

2.09 Stakes for Guying and Bracing

A. Stakes used for bracing or guying plants shall be sound wood of nominal 2" x 2" (50 mm x 50 mm) stock and shall be approximately 30 inches (750 mm) in length for guying or of the required length for bracing. The stakes shall be pointed on one end by beveling on two (2) sides.

B. Metal stakes for bracing trees shall be green metal T-section posts with no anchor plates. Posts shall be at least 8 feet (2.5 m) long. Posts shall only be used where specified on the plans.

2.10 Wire for Guying and Bracing

A. Wire shall be new and free from bends or kinks.

B. Wire used for guying trees four (4) inches (100 mm) or less in diameter shall be No. 11 steel wire.

C. Wire used for guying trees over four (4) inches (100 mm) in diameter shall be No. 9 galvanized steel wire.

2.11 Hose

A. Hose used with wire for guying trees shall be new 1/2-inch (10 mm) reinforced rubber garden hose or steam hose.

2.12 Plastic Guying and Bracing Material

A. High density polyethylene, chain-lock type material, 1-inch (25 mm) wide with a breaking strength of 100 lbs minimum.

B. Flat, woven, webbing type 3/4-inch (20 mm) wide tape constructed of polypropylene with a breaking strength of 900 lbs in either white or olive green.

2.13 Tree Balling Burlap

A. Balling material shall be untreated burlap or other material which will readily decompose. Synthetic materials such as nylon or plastic will not be permitted.

2.14 Planting Mixture

A. Planting mixture shall be a mixture of 1/3 topsoil, 1/3 sand, and 1/3 compost. Add fertilizer at the quantity as recommended by the manufacturer. Planting mixture shall be free from stick, stones, sod clods or other material which might leave pockets around the roots.

2.15 Acceptable Manufacturers

A. Plastic guying and bracing material shall be Adj-A-Tye heavy duty poly chain lock by A. M. Leonard Inc., ArborTape by Neptco Inc. or ENGINEER-approved equal.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall stake all plant locations and confirm the locations and type of plants to be placed with ENGINEER. Inspect trees, shrubs and ground cover for injury, insect infestation and improper pruning. Verify that all trees, shrubs, and ground cover are in healthy growing condition.

3.02 Preparation

A. CONTRACTOR shall not begin excavation until stake out of tree and/or shrub locations are acceptable to ENGINEER.

B. CONTRACTOR shall stake enough planting locations for two weeks work. CONTRACTOR shall arrange periodic site meetings with ENGINEER for the purpose of reviewing the work that has taken place in the prior two weeks and the staking for the next two weeks. CONTRACTOR shall notify ENGINEER at least three working days prior to the desired date for inspection of staking.

C. CONTRACTOR shall accurately stake plant material location according to the plans. Stakes for trees shall be 36” high above finished grade and painted a bright color to be clearly visible for inspection. Distinguish by color between types of material, i.e., evergreen trees, canopy trees, flowering trees. Staking for shrubs, perennials, and ground covers shall be staked 18” high above finished grade and painted white. Stakes shall be placed at the perimeter and at the bed line 30 feet on center. ENGINEER shall review the locations and make changes in locations as necessary.

3.03 Planting

A. Balled and burlapped plants shall be set plumb. Tree pits shall be excavated as shown on the plans. CONTRACTOR shall dispose of subsoil dug from pits, trenches and beds.

B. CONTRACTOR is responsible for planting to correct grades and alignment and all plants shall be set so that, when settled, they will bear the same relation to finish grade as they did before being transplanted. No filling will be permitted around trunks or stems.

C. At the start of the Work tree pits and beds are to be excavated and CONTRACTOR shall request inspection and approval by ENGINEER. Approval must be received before backfilling occurs.

D. Root ball shall be set on a compacted base as detailed. Burlap shall be cut away from top 1/3 of the root ball and all ropes, wires, etc. securing the ball shall be removed.

E. Plastic tape and/or plastic fabric shall be completely removed from the root ball during the planting operation. "Rot proof" or treated burlap shall also be totally removed.

F. Container-grown plants shall be planted as specified for balled and burlapped stock, except that when plants are furnished in nonplantable containers, the container shall be removed only at the time of planting. Plants furnished in plantable type containers shall have container sides severed in multiple places and the upper half of the container removed during the planting operation. Care shall be taken to protect tree roots during severing and removal operation.

G. When the plant has been properly set, the pit shall be backfilled with planting mixture, gradually filling, tamping and settling with water. No soil in a frozen or muddy condition shall be used for backfilling. Backfill shall be placed to an elevation flush with the ground elevation and the rootball, except that a saucer shall be created near the edge of the hole to capture water.

H. During fall planting, an ENGINEER-approved superphosphate fertilizer shall be applied over the planting mixture at a rate per the manufacturer's instructions.

I. Evergreen plant material shall be sprayed with an ENGINEER-approved anti-desiccant according to manufacturer's instructions and limitations immediately following planting and during final seasonal watering.

3.04 Mulching

A. After backfilling is completed, mulching material shall be placed over the plant hole area to a depth of five (5) to six (6) inches (125 - 150 mm) or as specified on the plans. Thoroughly soak mulched areas. After watering, mulched areas shall be raked and left in a complete and finished manner.

B. Perennial areas shall have 3 inches (75 mm) of mulch or as specified on the plans. Mulch these areas first and then plant ground cover through the mulch.

C. Planting beds shall be mulched with a 4-inch (100 mm) cover of mulch as shown on the drawings and details, unless otherwise indicated on the drawings. Mulch depths shall be 4 inches (100 mm) at time of inspection.

D. For plants located on slopes, an earth saucer or berm shall be constructed halfway around each plant on the down slope side. The saucer or berm shall have an inside diameter equal to that of the planting hole, and a maximum height of six (6) inches (150 mm). A trench shall be dug on the down slope side and filled with planting mixture to allow for drainage.

3.05 Bracing and Guying

A. Only evergreen trees equal to or larger than 5-feet (1.5 m) high and deciduous trees with a caliper equal to or larger than 2-inches (50 mm) need to be staked or guyed unless clay soil conditions exist, a tree is planted on a steep slope, or otherwise becomes apparent that a tree needs to be braced or guyed. Trees required to be braced, shall be braced or guyed immediately after planting.

B. Plants required to be braced shall be braced with a minimum of two (2) stakes.

C. Stakes shall be driven to avoid ball and shall be not closer than 1-foot (300 mm) from the trunk.

D. Stakes shall be driven to a depth which will firmly anchor the plant, but in no case less than 12 inches (300 mm) below the bottom of the planting hole.

E. The wide side of the stake shall face the trunk of the plant.

F. Stakes shall extend to within four (4) inches (100 mm) of the lowest plant's main branches.

G. Top of stake shall be firmly attached to the trunk with steel wire or plastic guying and bracing material.

H. When using steel wire, place wire so it forms a figure eight (8) around the stake and trunk. Portions of wire around trunk shall be encased in water hose of sufficient length to contain the wire loop around the trunk. Enclosed trunk loops shall not restrict normal trunk growth. Stakes shall be positioned on opposite sides of trunks and secured to the trunk at approximately 2/3 the height of plant. Warning tape or ribbon shall be tied to the wiring between the tree and the stake.

3.06 Pruning

A. Where determined by ENGINEER, pruning will be required.

B. Pruning of the new plants shall be done by workmen experienced in this type of Work. Pruning shall be completed prior to planting. Hedge shears shall not be permitted for pruning.

C. Pruning shall be done in accordance with the best standard practices.

D. Deciduous trees shall have branches pruned to balance the loss of roots in such a manner as to retain the natural form of the tree type. Evergreen trees shall be pruned only to the extent of removing broken or damaged branches. Cuts shall be made flush, leaving no stubs. Paint cuts over 3/4-inch (20 mm) in diameter with tree paint.

E. Notify ENGINEER at least one (1) week prior to pruning operations.

3.07 Watering, Fertilizing and Cultivating

A. Plants shall be thoroughly soaked after planting. After watering, beds shall be raked and left in a complete and finished manner.

B. Watering, Fertilizing and Cultivating is required during the Establishment Period. Watering, Fertilizing and Cultivating shall include measures necessary to establish and maintain plants in a vigorous and healthy growing condition for the entire Establishment Period.

C. CONTRACTOR shall manually water the plants a minimum of once a week or as necessary to keep the plant in a thriving condition from May 15 until October 15 or for the duration of the Establishment Period.

D. If the planted areas have an automatic irrigation system that CONTRACTOR is relying upon, it is the responsibility of CONTRACTOR to ensure that the irrigation system is running properly. If CONTRACTOR concludes that at any time the irrigation system is not working properly, then they shall notify ENGINEER or OWNER so that it may be fixed in a timely manner. However, CONTRACTOR will have to manually water the plants as necessary to keep them in a thriving condition at all times that the irrigation system is not working properly.

E. Keep planting beds and tree saucers free from weeds to the satisfaction of OWNER. Treat mulch with pre-emergent weed killer.

F. Keep trees erect. Raise trees that settle below grade to the established elevation. Keep tree wrap and wire in neat condition. Prune dead or broken branches from all trees and shrubs. Fill to the original grade level areas that have settled around trees and shrubs.

G. Winter protection shall include late fall spraying of evergreen trees and evergreen shrubs with anti-desiccant, emulsion type agent, at the manufacturer's recommended rate to prevent winter desiccation and late fall watering if required by a dry season.

H. At the seasons first watering, an ENGINEER-approved organic timed release, balanced fertilizer shall be applied to the ground around the tree at the rate instructed by the manufacturer. In lieu of organic fertilizer, pre-packaged, controlled release fertilizer packets may be used. Use one (1) 2-ounce packet of fertilizer per every inch (25 mm) caliper of tree, or one (1) 2-ounce packet for every shrub.

I. During the first and second watering of the growing seasons, the water used for each plant shall be a nitrogen-enriched solution containing available nitrogen at the rate of 8.3 pounds per 1,000 gallons (1 kg/kl) of water (42 pounds of 20-0-0, or 18 pounds of 45-0-0, fertilizer per 1,000 gallons of water). No fertilizer shall be applied after July 7.

J. During the establishment period(s) as called for in the Contract Documents, CONTRACTOR shall do all required watering, cultivating, pruning, fertilizing, weeding, and all other work necessary to keep the planted material vigorously growing sound and healthy. CONTRACTOR shall repair or replace any guying or bracing which is damaged, destroyed, or broken. CONTRACTOR shall spray any plant material which becomes diseased or infested with insects.

K. CONTRACTOR shall repair or replace any trees which are blown over, knocked down, uprooted or otherwise become impaired or defective. CONTRACTOR shall replace any plant material which is not in good physical condition, has more than 20% die back, shows defective growth, disease, signs of insect infestation, or any other signs of impairing defects during the Establishment Periods.

L. CONTRACTOR shall repair or replace any plant material damaged or impaired by wind, rain, snow, ice, sleet, sun, heat, drought, or any other weather-related occurrences. Costs for all labor, material, and equipment necessary to carry out the provisions of this Article shall be included in CONTRACTOR's bid price for the planting of trees unless otherwise indicated in the Proposal. CONTRACTOR shall notify ENGINEER prior to beginning any work called for under this Article.

M. At the end of the Establishment Period, unless otherwise determined by ENGINEER, the guying material, wrapping material, identification tags, and inspection tags shall be removed and disposed of off the project and the mulch around all the plants shall be replenished to the required depth of five to six inches (125 - 150 mm).

3.08 Establishment Period

A. The Establishment Period shall begin on the day of written acceptance of the installation of the trees, shrubs, bulbs, ground cover or other plant material. Each subsequent establishment period shall begin on the same day of the succeeding year(s). The Establishment Period shall be a minimum of one year unless otherwise indicated in the Contract Documents.

3.09 Schedules

A. General planting location, type and size of tree or shrub shall be as indicated on the Plans. Substitutions of plant material or alteration in plant sizes or specifications shall be approved by ENGINEER prior to ordering.

3.10 Steel Landscape Edging

A. Install steel landscape edging where indicated on Drawings, according to manufacturer's recommendations. Anchor with steel stakes spaced approximately 30 inches on-center, driven below top elevation of edging, or at every stake pocket location in landscape edging sections designed and manufactured to receive stakes. Stakes shall be located in solid undisturbed soil, or in soil compacted to 85% of its maximum density.

B. Install straight sections true to the alignments as indicated, free of waves or bends, using strings as guides. Install curved sections true to the alignments as indicated, free of waves or bends, following marked alignments approved in the field by ENGINEER. ENGINEER shall be given the opportunity to review the layouts. Set top of edging flush with finish grade. Set top of stake 1/2-inch below top of edging.

C. Replace edging sections damaged by construction operations.

End of Section

Section 32 9219
Seeding

Part 1 General

1.01 Scope of Work

A. This Section includes seeding complete with earth bed preparation, providing and placing topsoil, preparation and fertilizing topsoil, sowing of seed for lawns and other ground cover, protection of seeded areas, watering of seeded areas, mowing of seeded areas, protection and cleanup.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 01 8900: Site Construction Preparation Requirements
C. Section 31 2200: Grading

1.03 Requirements of Regulatory Agencies

A. Comply with the applicable requirements of the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, Michigan Seed Law, Act 329, PA of 1965, as amended.

B. Comply with the applicable requirements of the Proceedings of the Association of Official Seed Analysts, Rules for Testing Seeds.

C. Chemical fertilizer shall be supplied in suitable bags with the net weight of the contents and guaranteed analysis shown on the container. Bulk shipments shall be accompanied by an analysis and net weight certification of the shipment. Custom mixed fertilizers shall be accompanied by a certification of the weight of each commercial fertilizer used in the mixture and a guaranteed analysis of each shipment expressed in percentages of total Nitrogen (N), total available Phosphoric Acid (P_2O_5) and total available Potash (K_2O) included.

1.04 Source Quality Control

A. A seed mixture proposed for use in the Work shall have been tested for purity and germination by the Seed Producer within nine (9) months of sowing.

1.05 Reference Standards

A. ASTM - American Society for Testing and Materials

B. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.06 Submittals

A. Submit Seed Producers Certification that seed meets the requirements of these Specifications and conform to the State of Michigan Seed Act referenced above under Article 1.03 of this Section.

B. Where required, submit test reports for all seed proposed for use in the Work to ENGINEER, showing results of purity and germination tests, compliance with regulatory agencies, dates and location of tests.

1.07 Product Delivery, Storage, and Handling

A. Material shall be delivered to the Project site in their original, unopened containers. Containers shall be clearly marked showing, name of manufacturer, brand name, trade name or generic name of material, warranty of analysis, net weight of contents and date of packaging, where applicable.

B. Seed shall be delivered to the site in durable bags, tagged or labeled to show date of tests, warranty of purity and germination analysis, name, lot number and net weight of contents.

C. Commercial fertilizers shall be delivered to the site of the Work in the original unopened bags. Bags shall not exceed 100 pounds (45 kg) net weight each and shall be clearly marked with guaranteed analysis in a conspicuous location on each bag.

D. Material shall be stored at the Project site, under shelter, off the ground and shall be protected from damage by moisture, temperature, exposure to elements, vandalism or other action which might otherwise impair their use.

E. Materials proposed for use in the Work shall be handled in a manner that will protect the material and the personnel involved in the Work. Handle seed in a manner which will protect the mixture from contamination or deterioration.

1.08 Environmental Requirements

A. Seeding is limited to the periods between April 20 and June 1, August 10 to October 1 and after November 20 for as long as weather permits preparation of the seed bed without irrigation and/or mulch. With the use of irrigation and/or mulch, seeding can be done from April 20 thru October 1 inclusively.

B. Comply with the limitations placed on the use of certain soil protection materials because of prevailing temperatures as described in this Section.

C. Comply with the limitation placed on seeding applications because of wind velocity as described-in this Section.

1.09 Protection

A. Provide suitably approved warning signs and barricades for protection of seeded areas from pedestrian or vehicular traffic. Protect all newly seeded areas during the progress of the Work and until completion of the turf establishment period.

B. Protect all adjacent construction from topsoil spills and perform such cleanup of affected surfaces before it becomes compacted by traffic.

1.10 Final Acceptance

A. CONTRACTOR shall establish a dense cover of seeded grass on disturbed areas.

B. These areas shall be maintained until final acceptance of the Work by ENGINEER.

C. ENGINEER will inspect the turf to insure that the grass seed is well established, weed free, in a growing and vigorous condition.

D. Areas that do not meet the approval of ENGINEER shall be re-seeded at CONTRACTOR's expense.

Part 2 Products

2.01 Seed

A. Seed and seeding mixtures shall be certified, mature, clean, dry, new crop seed products suitable for the specified applications and having the percentages of purity, germination and proportions, by weight, indicated in Table 1.

Table 1 - Seeding Mixtures

	Seeds		Mixture Proportions (%)			
Kind	**Purity**	**Germination**	**TDS**	**TUF**	**TGM**	**THM**
Kentucky Blue Grass	98%	80%	5	10	10	30
Perennial Rye Grass	96%	85%	25	20	20	20
Hard Fescue	97%	85%	25	20	30	
Creeping Red Fescue	97%	85%	45	40	40	50
Fults Salt Grass	98%	85%*		10		

Table 2 – Soil Types and Location of Seeding

Symbol for Turf Seed Mixture	Soil Type	General Location	Rate of Seeding lbs/ac (kg/ha)
TDS	Dry Sandy to Sand Loam	Rural or Urban	250 (280)
TUF	All Types	Freeway, Blvds, Streets	250 (280)
TGM	Medium to Heavy	All	250 (280)
THM	Loamy to Heavy	Home and Business Turf	250 (280)

B. The specific mixture to be used shall be for the type of soil on the Project and the location of the seeding unless otherwise indicated on the Plans or as designated by ENGINEER.

C. Hydroseeding shall consist of a blend of seed, fertilizer and hydromulch.

2.02 Mulching Material

A. Straw:

1. Small grain straw or grass or marsh hay acceptable to ENGINEER.

B. Wood Excelsior:

1. Green wood fibers, baled or blanket of type and manufacture acceptable to ENGINEER.

2. Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.

3. Wood excelsior blankets shall be made of a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. The fabric net shall have a mesh size not exceeding 1-1/2" x 3" (40 mm x 75 mm) and shall be a woven of either cotton cord, twisted paper cord or a synthetic, biodegradable fiber. Blankets shall be produced in the form of a tightly compressed roll 36 inches ± 1-inch (900m m ± 25 mm) wide and approximately 120 feet (36 m) long. Blanket shall have a fiber net on the outside of the fiber mat. Blanket roll weight, when manufactured, shall average 85 pounds (38 kg) ± 10%. Each roll shall have separator sheets of 40 pound Kraft paper placed at the beginning and at the end of each roll to facilitate unrolling and handling at the job site. The Kraft paper sheet at the end of each roll shall also form a wrapper for the roll.

C. Netting:

1. Twisted Kraft paper or synthetic fiber, biodegradable woven mesh net material suitable for the application and acceptable to ENGINEER.

2. The net shall consist of a biodegradable mesh with openings not to exceed 1-1/2" x 3" (40 x 75 mm)

3. The net shall be furnished in widths of not less than 35 inches (900 mm).

D. Proprietary Mulch Material:

1. Biodegradable natural and/or synthetic materials suitably fabricated and acceptable to ENGINEER.

2.03 Mulch Anchoring Material

A. Emulsified Asphalt:

1. ASTM D977, Rapid Setting (R.S. 1 or 2), Medium Setting (M.S. 2 or 2h) or Slow Setting (S.S. 1).

B. Mulch Anchoring Tool:

1. Suitable unit having a series of flat, notched discs for punching and anchoring mulch in soil, or a regular farm disc weighted and set nearly straight as a substitute.

C. Latex Base Adhesive:

1. Latex base adhesive mixed with water at a ratio of 25 gallon of water to 1 gallon adhesive with 25 pounds of recycled newsprint as a tracer (14 L of adhesive with 0.35 kL of water with 28 kg of newsprint).

D. Recycled Newsprint:

1. Mix 7 pounds of newsprint with 7 gallons of water (60 kg of newsprint with 1000 L of water).

E. Guar Gum:

1. Mix 1 pound of dry adhesive with 26.5 gallons of water with 5 pounds of recycled newsprint as a tracer (55 kg adhesive / 12 200 L water / 280 kg newsprint).

2.04 Fertilizer

A. Fertilizer shall be a standard commercial grade fertilizer, conforming to state regulations, of the type recommended for grasses. The fertilizer shall contain slow release nitrogen amounting to 75% of the nitrogen available. Fertilizer shall be uniform in composition, free flowing and suitable for application with method selected. Fertilizer for hydraulic seeding shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the slurry.

2.05 Agricultural Liming Materials

A. Burnt lime (quick lime), hydrated lime, limestone (calcite and dolomite), marble shells and by-products shall conform to the requirements of ASTM C602.

2.06 Water

A. Free of matter harmful to plant growth.

2.07 Staples

A. Wire staples for holding mulching materials in place shall be not less than six (6) inches (150 mm) long No. 11 (U.S. Steel Gage) steel wire or longer.

2.08 Topsoil

A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than one (1) inch (25 mm) in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:

1.	Soil pH	5.0 to 7.5
2.	Soluble Salts	500 ppm max
3.	Organic Content	5 to 30 %
4.	Silt Content	35% to 50%
5.	Clay Content	5% to 10%
6.	Deleterious Material*	5% max

*rock, gravel, stone, sticks, roots, sod, etc.

B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8-inch (15 mm) maximum mesh screen prior to delivery to the Project site. ENGINEER shall review source and final screen results prior to release of topsoil. CONTRACTOR shall submit a certified analysis of the topsoil from each source to ENGINEER. Topsoil shall be placed in 3-inch (75 mm) minimum thickness throughout, or as specified in the plans or Specifications.

C. CONTRACTOR shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at his own expense.

2.09 Improved Topsoil

A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable as defined in P.A. 641 as amended and shall be in compliance with all federal and state law.

B. The improved topsoil mixture shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor. The mixture shall be free of glass, plastic, metal, and other contaminants, as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.

C. The manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.

D. The composition of the compost shall be within the following range of values:

	Quality Parameter	Range of Value
1.	Soil pH	6 to 7.5
2.	Soluble Salts	2 to 5 mmho/cm
3.	Carbon/Nitrogen Ratio	13 to 20 parts C to 1 part N
4.	Inerts	< 1%
5.	Organic Matter	35 to 55 %
6.	Nitrogen	1 to 2 %
7.	Phosphorus	0.2 to 0.8 %
8.	Potassium	0.5 to 1.5 %
9.	Unit Weight	535 to 775 Kg/m3
10.	Moisture Content	40 to 50 %
11.	Particle Size	< 20 mm maximum
12.	Water Holding Capacity	> 100%
13.	Heavy Metals	None

E. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

F. Temperature: The compost material must have undergone the procedure to significantly reduce the pathogen level as referenced in EPA 40 CFR, Part 257 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations. The temperature must be maintained at 40° C for 5 days with a temperature exceeding 55° C for at least 4 hours.

G. Pathogens and Trace Elements: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.

H. To comply with the annual filing requirements with the Michigan Department of Agriculture, Pesticide and Plant Management Division, the supplier of the compost shall certify that the compost meets Michigan P.A. 641 as amended and EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.

I. A data sheet shall accompany the certification.

J. The data sheet shall show the following:

1. Standard compost total nutrient test results, including N, P, K, Ca, Mg, Mn, Cu, Fe total carbon, pH, as provided by an acceptable testing laboratory
2. Organic content
3. Inert contamination
4. Soluble salts

5. Carbon/Nitrogen ratio

6. Proof of maturity/stability acceptable to the Michigan Department of Agriculture

K. The certification and data sheets shall be mailed annually to the Michigan Department of Agriculture, Agriculture Environment Coordinator. The date shall be included on which the compost test results were mailed to the Michigan Department of Agriculture.

Part 3 Execution

3.01 Preparation of Subgrade

A. Complete all fine grading within the areas to be covered with topsoil necessary to bring the surface of the proposed subgrade to the elevations indicated on the Plans and parallel to the proposed finished grade. The surface of the subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a minimum depth of two (2) inches (50 mm) to facilitate making a bond between the subsoil and the topsoil.

3.02 Preparation of Soil

A. After the areas to be seeded have been brought to the required grade and properly trimmed and cleaned up, the existing soil shall be brought to a friable condition by harrowing or otherwise loosening and mixing to a depth of at least four (4) inches (100 mm). Lumps and clods shall be thoroughly broken. When the area to be seeded has been prepared and covered with a layer of topsoil as specified under Article 3.01 of this section, this operation will not be required.

3.03 Preparation of Mulch Material

A. When seed is to be sown through mulch which has been in place for a period of more than two (2) weeks or which is being held in place by a surface-applied coating of asphalt emulsion or other adhesive, the mulched area shall be prepared for seeding by discing, a spike-toothed harrow, or by other means acceptable to ENGINEER.

3.04 Placing and Spreading Topsoil

A. Topsoil shall be placed and spread over the area designated on the Plans, or as determined by ENGINEER, to a depth of four (4) inches, ± 1-inch (100 mm ± 25 mm) or to such depth as specified on the plans.

B. In all cases, topsoil shall be placed to a depth sufficiently greater than that shown on the Plans or specified so that, after natural settlement or rolling, the completed Work will conform to the lines, grades and elevations shown on the Plans.

C. Spreading of topsoil shall be completed in such a manner that seeding as specified can proceed without additional moving of topsoil. Topsoil furnished and placed shall be considered incidental to seeding unless otherwise specified in the Proposal.

D. After topsoil is spread, all large earth lumps, rocks, roots, debris, or other foreign matter shall be raked and removed from the topsoiled area and legally disposed of by CONTRACTOR.

3.05 Fertilizing

A. Chemical fertilizer shall be applied on the prepared soil surfaces at a minimum rate of 1/3 ton per acre (666 lbs/ac.) (750 kg/ha) of 12-12-12 fertilizer, or such other rate of another fertilizer mixture that yield 240 lbs/acre (270 kg/ha) of nutrient. Dry fertilizers shall be thoroughly disced, harrowed or raked into the soil to a minimum depth of not less than 1-inch (25 mm). Where hydraulic seeders are used for sowing seed, one half the recommended rate of fertilizer may be spread in combination with such sowing with the balance incorporated into the soil prior to seeding. In all other cases, fertilizer shall be incorporated into the soil before any seeding is started.

3.06 Seeding

A. Seed of the kind required shall be sown at the rate as specified in Table 2. Seed shall be sown in the presence of an inspector by mechanical spreader, hydraulic seeder or broadcasting. The broadcasting method shall be used for sowing seed only in areas inaccessible to mechanical spreading equipment. Seeding during winds above 15 miles per hour (25 km/hr) shall not be permitted.

B. Prior to placing seed materials, water topsoil to a depth of four (4) inches (100 mm) at least 48 hours prior to seeding operations to obtain a loose friable seed bed. Time and depth of watering operations shall be varied at the direction of ENGINEER for varying conditions at the site of the Work.

C. Broadcasting methods for sowing seed materials shall be accomplished by spreading one-half of the specified amount of seed in one direction and then broadcasting the remaining one-half of the seed at right angles to the first seeding pattern using the same broadcast method. Rate of broadcast shall be as specified herein or per the written recommendations of the Producer of the seed material used. Roll seeded area with roller weighing a maximum of 150 pounds/foot (225 kg/m) of width.

D. Hydroseeding shall be performed using suitably acceptable hydraulic seeding equipment and a homogeneous slurry solution of water, seed, fertilizer and suitable mulch material as approved by ENGINEER. Seed slurry mixture shall be distributed uniformly at a rate approved by ENGINEER for the seed materials, fertilizer and/or mulch materials used to suit the seed application rate. Seed application rate shall be 300 lbs/acre (340 kg/ha).

3.07 Mulching

A. Mulching shall consist of placing a mulch material on areas that have been or are to be seeded. Mulch shall be placed in a loose enough condition so as to allow penetration of sunlight and circulation of air, but thick enough to shade the ground, reduce rate of water evaporation and prevent or reduce erosion by wind or water. Mulch shall be secured with suitably acceptable anchoring material.

B. For surfaces and slopes on which power equipment can be operated, satisfactory mulching materials include the following:

C. Small grain wheat straw or grass hay applied at 1-1/2 to two (2) tons per acre (3.5 to 4.5 metric ton/ha) with disc packer, asphalt or netting tie-down.

D. Wood chips applied at six (6) to nine (9) tons per acre (13.5 to 20.0 metric tons/ha).

E. Asphalt emulsion alone at 600 to 1,200 gallons per acre (5.5 to 11. kl/ha). (This application is suitable for limited periods of time and where trampling by either people or animals will not occur.)

F. For surfaces and slopes where power equipment cannot be operated, satisfactory mulching materials include the following:

G. Straw or grass hay applied at 1-1/2 to two (2) tons per acre (3.5 to 4.5 metric tons/ha), anchored with asphalt or netting tie-down.

H. Asphalt emulsion alone at 600 to 1,200 gallons per acre (5.5 to 11.0 kl/ha). (Limited to areas where tracking is not a problem.)

I. Commercially available erosion control netting of jute, paper or biodegradable synthetics.

J. Continuous filament fiberglass at 1,000 pounds per acre (1100 kg/ha) anchored with 150 gallons (1400 l/ha) of asphalt emulsion.

K. Anchor straw or hay mulch by the methods as specified herein.

L. Wood chips will not need anchoring when used on workable slopes.

M. Commercially manufactured netting and/or fiberglass materials shall be anchored in accordance with the manufacturer's printed instructions for the material used.

N. Punch and anchor mulch material into soil using mulch anchoring tool. Soil must be moist, free of stones and loose enough to permit disc penetration to a depth of three (3) inches (75 mm).

O. Blow on liquid or emulsified asphalt materials with the straw or hay mulch or spray or sprinkle asphalt tie-down materials immediately after mulch is spread.

P. Apply emulsified asphalt at 0.04 gallons per square yard 0.2 l/m^2). Do not apply emulsified asphalt during freezing weather since it contains approximately 50% water. Apply liquid (cut back) asphalt at approximately 0.10 gallons per square yard (0.45 l/m^2). Liquid asphalt may be applied during freezing weather since it is cut back with kerosene.

3.08 Conversion from Soil Protection to Permanent Vegetation

A. Following straw or hay mulching, grass seeding can be made in early spring by broadcasting seed directly into the mulch. Fertilizer or lime, where needed, should be incorporated into the soil before mulching.

B. Asphalt emulsion alone can be readily incorporated into the soil by ordinary tillage before seeding.

C. Wood chip mulch may be removed before seeding or incorporated deeply into the soil. If wood chips are incorporated into the soil, the addition of extra nitrogen fertilizer to the soil will be required to provide nitrogen in the new seeding.

D. Fiberglass mulch shall be removed before seeding because of its permanence. Care shall be taken to prevent fiberglass filaments left in place from becoming entwined or wound around shafts of power mowers or other power equipment.

E. Acceptable proprietary netting and erosion control materials shall be disposed of in accordance with the manufacturer's printed instructions for the material used prior to any seeding operations.

3.09 Turf Establishment

A. Seeded areas shall be watered whenever excessive drying is evident during the period set for establishment. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities and the watering equipment shall be of a type that will prevent damage to the cultivated surfaces. CONTRACTOR shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.

B. The seeded areas shall be mowed with mowing equipment acceptable to ENGINEER to a height of two (2) inches (50 mm) whenever the average height of grass establishment reaches four (4) inches (100 mm). When the amount of cut grass is heavy, cut grass shall be removed to prevent destruction of the underlying grass. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed, or in the case of rank growths, shall be uprooted, raked and legally disposed of from the area.

C. Reseed and mulch areas larger than four (4) square inches (25 cm^2) not having a dense, uniform, vigorous stand of grass acceptable to ENGINEER.

D. The establishment period shall extend for a period from the time of seeding until the seeded area has a uniform stand of grass acceptable to ENGINEER. The minimum period shall be 30 days.

E. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by CONTRACTOR, OWNER may reseed the defective areas and all costs will be deducted from CONTRACTOR’s payments.

End of Section

Division 33
Utilities

Section 33 0509.33
Thrust Restraints for Utility Piping

Part 1 General

1.01 Scope of Work

A. This Section includes harnessed or restrained joints and concrete thrust blocks.

1.02 Related Work Specified Elsewhere

A. Section 03 3000 Cast-in-Place Concrete
B. Section 31 2333: Trenching and Backfilling
C. Section 33 1100: Water Utility Distribution Piping
D. Section 40 0513: Process Piping and Valves

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. DIPRA - Ductile Iron Pipe Research Association

1.04 Submittals

A. Shop Drawings and Product Data:

1. Shop Drawings:

a. Submit shop drawings as required in Sections 01 3300, Submittal Procedures.

b. Submit descriptive details showing the size, length, type, and location of each fitting and adjacent pipe, and the details of all anchorage and harnessing proposed.

2. Product Data:

a. Submit catalog cuts on restrained joints to be furnished.

3. Manufacturer's Certificate:

a. Certify that the products furnished meet or exceed the specified requirements.

1.05 Qualifications

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 5-year documented experience.

1.06 Delivery, Storage, and Handling

A. Provisions for the delivery, storage, protection and handling products to and at site per Section 01 6000, Product Requirements.

B. Accept products at site. Inspect for damage and inventory

Part 2 Products

2.01 Restrained Joints

A. Manufacturers:

1. American Cast Iron Pipe Company - Lok-Ring or Flex Ring Joints.
2. U.S. Pipe Company - TR-Flex Joints.
3. Substitutions: Not Permitted.

2.02 Concrete Thrust Blocks

1. Concrete for thrust blocks shall be Class C as defined in Section 03 3000.

2. Thrust block dimensions: As shown on the Contract Drawings.

Part 3 Execution

3.01 Thrust Blocks

A. Blocking to prevent movement of lines under pressure at bends, blow-off drains, plugs, tees, caps, hydrants and auxiliary valves: Concrete.

1. Block Dimensions: Minimum of 12-inch-thick, unless otherwise shown on the Contract Drawings.

2. Place blocks between undisturbed ground and the fittings, and anchor so that pipe and fitting joints are accessible for repairs.

3. Extend concrete from 6 inch below the pipe or fitting to 12 inch above, unless shown otherwise on the Contract Drawings.

4. Horizontal and vertical bends between 0- and 10-degrees deflection angle will not require thrust blocks and harnessed or restrained joints.

B. Provide restrained joints and concrete thrust blocks for horizontal and vertical bends between 10- and 90-degrees deflection angle.

3.02 Harnessed and Restrained Joints

A. The required length of restrained pipe at all fittings, valves, plugs, etc.: Conform to the Table included in this section of the specifications and AWWA M41.

B. Install the total restrained length of pipe for elbows as shown in the Table on each side of each elbow.

1. The restrained lengths shown for vertical bends are for vertical down bends.
2. The restrained length for vertical up bends is the same as for horizontal bends.

C. Plugs require restrained pipe in only one direction.

D. The length of restrained pipe at valves: Same as for plugs or dead ends.

1. Install the restrained length of pipe as noted in the Tables below on both sides of each valve.

E. Base the length of restrained pipe for tees on the perpendicular branch, as shown in the Tables below, on the size of the run or branch of the tee whichever is the larger diameter.

1. Tees require only the perpendicular branch to be restrained.
2. Restrain both plugs and tees to the distances given in the Table.

F. The restrained pipe length for reducers shall be based on the larger diameter pipe.

G. The restrained pipe length for tees shall be based on the run diameter of the tee.

Restrained Length Tables

Fitting Type		4" Diameter		6" Diameter		8" Diameter		10" Diameter	
HORIZONTAL	Theta/2	**DIP**		**DIP**		**DIP**		**DIP**	
90 degree bend	0.79	32		45		59		72	
45 degree bend	0.39	13		19		25		30	
22.5 degree bend	0.20	7		9		12		15	
11.25 degree bend	0.10	4		5		6		8	
Tee		23		40		58		75	
Plug (dead end)		30		42		55		67	
VERTICAL	Theta/2	**DIP**		**DIP**		**DIP**		**DIP**	
90 degree bend	0.79	58		83		110		134	
45 de roe bend	0.39	24		35		46		56	
22.5 degree bend	0.20	12		17		22		27	
11.5 degree bend	0.10	6		9		11		14	

Fitting Type		12" Diameter		14" Diameter			16' Diameter		
HORIZONTAL	Theta/2	**DIP**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	0.79	86		99	114		112	128	
45 degree bend	0.39	36		41	62		47	70	
22.5 degree bend	0.20	17		20	32		23	36	
11.25 degree bend	0.10	9		10	16		1 1	18	
Tee		93		111	227		128	256	
Plug (dead end)		80		93	321		105	362	
VERTICAL	Theta/2	**DIP**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	0.79	159		185	114		210	128	
45 de roe bend	0.39	66		77	62		87	70	
22.5 degree bend	0.20	32		37	32		42	36	
11.5 degree bend	0.10	16		19	16		21	18	

Fitting Type	18" Diameter			20" Diameter			24" Diameter		
HORIZONTAL	**DIP**	**STEEL**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	125	142		138	155		164	181	
45 degree bend	52	77		57	84		68	98	
22.5 degree bend	25	39		28	43		33	50	
11.25 degree bend	13	20		14	22		17	25	
Tee	146	283		163	310		199	360	
Plug (dead end)	118	400		131	438		156	510	
VERTICAL	**DIP**	**STEEL**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	187	142		169	155		311	181	
45 de roe bend	78	77		70	84		129	98	
22.5 degree bend	38	39		34	43		62	50	
11.5 degree bend	19	20		17	22		31	25	

Fitting Type	30" Diameter			36" Diameter			42" Diameter		
HORIZONTAL	**DIP**	**STEEL**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	201	217		239	250		275	281	
45 degree bend	84	118		99	136		114	152	
22.5 degree bend	40	60		48	69		55	78	
11.25 degree bend	20	30		24	35		27	39	
Tee	251	434		303	500		355	561	
Plug (dead end)	193	612		231	707		269	792	
VERTICAL	**DIP**	**STEEL**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	386	217		462	250		537	281	
45 de roe bend	160	118		192	136		223	152	
22.5 degree bend	77	60		92	69		107	78	
11.5 degree bend	38	30		46	35		53	39	

Fitting Type	48' Diameter			54' Diameter			60' Diameter		
HORIZONTAL	**DIP**	**STEEL**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	311	309		335	337		371	363	
45 degree bend	129	167		145	182		154	195	
22.5 degree bend	62	86		70	93		74	102	
11.25 degree bend	31	43		35	47		37	51	
Tee	408	617		465	673		499	725	
Plug (dead end)	307	872		347	951		372	1025	
VERTICAL	**DIP**	**STEEL**		**DIP**	**STEEL**		**DIP**	**STEEL**	
90 degree bend	613	309		694	337		743	363	
45 de roe bend	254	167		288	182		308	195	
22.5 degree bend	122	86		138	93		148	102	
11.5 degree bend	61	43		69	47		74	51	

End of Section

Section 33 0513
Manholes and Structures

Part 1 General

1.01 Scope of Work

A. This Section includes Monolithic concrete manholes with lid frame, covers, anchorage and accessories, as well as modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage and accessories.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 04 0511: Mortaring and Grouting
C. Section 03 3000: Cast-in-Place Concrete
D. Section 31 2316: Structural Excavation and Backfill
E. Section 31 2319: Dewatering
F. Section 31 2333: Trenching and Backfilling

1.03 Requirements of Regulatory Agencies

A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ACI - American Concrete Institute
2. ASTM - ASTM International

1.05 Submittals

A. Shop Drawings: Indicate manhole and vault locations, elevations, piping, conduit, and sizes and elevations of penetrations.

B. Product Data: Provide manufacturer's data and installation instructions for precast manhole and vault sections, joint connections, water stops, gaskets, corrosion protection system, flexible pipe joints, chimney seals, manhole and vault castings, and other pertinent information for precast and cast-in-place manholes and vaults.

C. Manufacturers Certification: Certify that all products furnished meet or exceed the specified requirements, including worst case depth loadings for this project.

D. Calculations: Submit calculations for review sealed and signed by a registered Professional Structural Engineer in the State of Michigan. Include structural, depth of bury, buoyancy, and all other information necessary to determine adequacy of the item.

E. Results of manhole and vault leakage and vacuum tests

1.06 Closeout Submittals

A. The following shall be submitted in accordance with Section 01 7700, Closeout Procedures:

1. Manufacturer's field reports.

2. Project record documents:

a. Accurately record actual locations of manholes, connections, and invert elevations.
b. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.07 Design Requirements

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Structures: In accordance with ASTM C 890 "Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures." Provide lifting inserts designed for four times the anticipated lifting load. Grout inserts in place when complete.

C. Design of Joints for Precast Structures: Gaskets in accordance with ASTM C 923 "Standard Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals" with maximum leakage of 0.025 gallons per hour per foot of joint at 3 feet of head.

D. Use precast concrete manholes or vaults designed by the precast manufacturer's registered Professional Structural Engineer, licensed in the State of Michigan in accordance with the Contract Documents. Furnish precast concrete manholes, however, conforming to the following minimum design requirements in addition to the ASTM standards referenced in this Section:

E. The top slab of all manholes or vaults shall be designed for an H-20 truck loading.

F. Minimum manhole or vault base slab thickness shall be eight (8) inches up to twenty-five (25) feet depth and twelve (12) inches over twenty five (25) feet depth.

G. Manholes and vaults shall resist buoyancy due to flooding with a high ground water table elevation at the top of the precast concrete structure. The factor of safety against buoyancy shall be 1.20. Buoyancy calculations shall be provided with the submittal.

H. Walls backfilled with cohesive soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 135 pounds per square foot (psf) per foot of wall height for walls below the ground water table.

I. Walls backfilled with granular soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 125 psf per foot of wall height for walls below the ground water table.

J. Design walls for surcharge load from adjacent structures or minimum 300 psf surcharge, whichever is greater.

K. Loads associated with testing manholes and vaults for water-tightness by vacuum testing in accordance with this Section.

1.08 Delivery, Storage and Handling

A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes, vaults and drainage structures.

B. Store precast concrete manholes, vaults and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.

C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

1.09 Qualifications

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

Part 2 Products

2.01 Valve Vaults, Manholes, Frames, and Covers

A. Valve Vaults and Manhole Manufacturers:

1. Northern Concrete Pipe, Inc.
2. Mack Industries
3. ENGINEER-approved equal.

B. Manhole and Vault Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

C. Benching:

1. Provide full height and poured-in-place benching.
2. Use non-shrink grout as specified in Section 04 0511.
3. Appropriate granular filler may be used, subject to the approval of Engineer.

D. Watertight Cover and Frame Manufacturers:

1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
2. Neenah Foundry Co. - Model R-1916-F.
3. ENGINEER-approved equal.

E. Cover and Frame Product Description:

1. ASTM A48, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.02 Storm Sewer Manholes, Frames, and Covers

A. Storm Sewer Manhole Manufacturers:

1. Northern Concrete Pipe, Inc.
2. Mack Industries
3. ENGINEER-approved equal.

B. Cover and Frame Manufacturers:

1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
2. Neenah Foundry Co. - Model R-1916-F.
3. ENGINEER-approved equal.

C. Cover and Frame Product Description:

1. ASTM A48, Class 35B Cast iron construction, machined flat bearing surface, removable, watertight, and boltable lid, 304 stainless steel frame anchors with non-seizing 304 stainless steel nuts, 304 stainless steel bolts for cover, and a cover molded with name and logo per Contract Drawings.

2.03 Other Manhole and Vault Components

A. Steps: Per Contract Drawings.

B. Base Slab:

1. Per Contract Drawings, cast-in-place concrete of type specified in Section 03301 or integral, monolithically cast precast concrete or standard tee pipe base sections.

C. Pipe to Manhole/vault Connection:

1. Unless noted otherwise on the Contract Drawings, use a resilient type connector, in accordance with ASTM C-923, to connect pipes to the manhole. Use an A-Lock press wedge, Kor-n-Seal, or Res-Seal connector. No substitutions will be allowed. Non-shrink grout may only be used per the Contract Drawings or with written permission of the Engineer.

D. Manhole and Vault Chimney Seals:

1. As shown on the Contract Drawings, seal the outside of the manhole or vault cone or riser section to the grade rings and manhole and vault frame with a heat shrinkable wrap or a compressible rubber seal with 304 stainless steel compression bands.

2. Manufacturers:
   a. Canusa - WrapidSeal Manhole Encapsulation System.
   b. Cretex Specialty Products - External Manhole Seal.
   c. ENGINEER-approved equal.

2.04 Configuration

A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female gasketed joints; flexible rubber joint to receive pipe.

B. Shape: Cylindrical.

C. Clear Inside Dimensions: As indicated on Contract Drawings and as required for construction.

D. Design Depth: As indicated on Contract Drawings and as required for construction.

E. Clear Lid Opening: As indicated on Contract Drawings and as required for construction.

F. Pipe Entry: Provide openings as indicated on Contract Drawings and as required for construction.

G. Steps: As indicated on Contract Drawings and required by applicable safety code.

2.05 Bedding and Cover Materials

A. Structure and Pipe Bedding: Fill Type A1, A2 or A5 as specified in Section 31 2333 and on the Contract Drawings.

B. Topsoil Fill Type: S3 or S4 as specified in Section 31 2333 and on the Contract Drawings.

C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1 or S2, as specified in Section 31 2333 and on the Contract Drawings.

Part 3 Execution

3.01 Examination

A. Verify items provided by other sections of Work are properly sized and located.
B. Verify that built-in items are in proper location, and ready for roughing into Work.
C. Verify excavation for manholes or vault is correct.

3.02 Preparation

A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

B. Do not install structures where site conditions induce loads exceeding structural capacity of structures.

C. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

D. Prepare manhole or vault for installation of chimney seals per manufacturer's instructions.

3.03 Installation

A. Excavation and Backfill:

1. Excavate for manholes, vaults and drainage structures in accordance with Section 31 2316 in location and to depth shown. Provide clearance around sidewalls of structure for construction operations.

2. When groundwater is encountered, prevent accumulation of water in excavations. Place manholes, vaults or drainage structures in dry trench.

3. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation.

4. Placement and compaction of surrounding backfill material shall be accomplished to provide sufficient and equal side pressure on the manhole or vault.

B. Backfill excavations for manholes, vaults and drainage structures in accordance with Section 31 2316.

C. Form and place manhole cylinder or vault wall plumb and level, to correct dimensions and elevations.

D. Connect pipe with flexible rubber joints as shown on the Contract Drawings.

E. Set cover frames and covers level without tipping, to correct elevations.

F. Install chimney seals per manufacturer's instructions and Contract Drawings.

G. Coordinate with other sections of Work to provide correct size, shape, elevation, and location.

H. Use manufacturer's recommended method, procedure and equipment for handling, installing, and connecting the manholes or vaults.

3.04 Standard Precast Concrete Manhole, Vault and Drainage Structure Installation

A. Prepare granular bedding as shown on Drawings, to receive integral, monolithically cast base slab as specified.

B. Lift precast structures at lifting points designated by manufacturer. Grout all lifting holes when structure is in place.

C. When lowering manholes, vaults and drainage structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.

D. Set precast structures bearing firmly and fully on granular bedding, compacted in accordance with provisions of Section 02320 or on other support system shown on Contract Drawings.

E. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.

F. Remove foreign materials from joint surfaces and verify gaskets are installed properly.

G. Maintain alignment between sections by using guide devices affixed to lower section.

H. Verify manholes, vaults and drainage structures installed satisfy required alignment and grade.

I. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe. Connect pipe to manhole or vault with a flexible rubber joint as specified. Fill annular space with mortar.

J. Cut pipe to finish flush with interior of structure.

K. Shape inverts through manhole or vault as shown on Contract Drawings. Provide cast-in-place full height benching. Trowel smooth and slope to drain per Contract Drawings.

3.05 Castings Installation

A. Set frames using a precast concrete grade ring with butyl rope to seal joint. Use grade ring sizes per Contract Drawings

B. Unless Contract Drawings indicate otherwise, set frame and cover 6 inch above finished grade for manholes, vaults and other structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.

C. Set frame and cover flush with ground surface for manholes, vaults and other structures located within paved areas.

3.06 Leakage Testing For Manholes and Vaults

A. After completion of manhole or vault construction, inspect all manholes for leakage and repair all visible leaks.

B. After repairing all leaks, test manholes and vaults for water-tightness using vacuum testing procedure as follows:

1. Temporarily plug the influent and effluent lines with suitably sized pneumatic or mechanical plugs. Ensure plugs are properly rated for the pressure required for the test. Place plugs a minimum of 6 inches outside the manhole or vault walls. Brace inverts to prevent lines from being dislodged.

2. Install vacuum tester head assembly at the top access point of the manhole or vault and adjust for a proper seal. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure. Do not over-inflate.

3. Evacuate manhole or vault with vacuum pump to 10-inches of mercury (Hg). Disconnect the pump and monitor vacuum for the time period specified in the following table:

Vacuum Test Timetable

Depth (feet)	Test Duration (seconds)			
	48-inch Diameter Manhole**	60-inch Diameter Manhole**	72-inch Diameter Manhole**	96-inch Diameter Manhole**
4	30	30	30	30
8	30	30	32	38
12	30	39	48	57
16	40	52	64	76
20	50	65	80	95
24	60	78	96	114
Each 2' more	+5	+6.5	+8	+9.5

**Use equivalent volume for testing vaults

4. If the drop-in vacuum exceeds 1-inch of mercury (Hg) over the specified time period, locate the leaks and complete repairs necessary to seal the manhole or vault. Repeat the test until acceptable results are obtained.

3.07 Field Quality Control

A. Test concrete in accordance with Section 03 3000.

B. Vertical Adjustment of Existing Manhole and Drainage Structures:

1. Where required, adjust top elevation of existing manholes and drainage structures to finished grades shown on Drawings.

2. Reset existing frames, grates, and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated Drawings.

4. Clean and apply sand-cement-bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 3000.

End of Section

Section 33 0523.16
Utility Pipe Jacking and Boring

Part 1 General

1.01 Scope of Work

A. CONTRACTOR shall furnish and install bored or jacked steel casing, complete and in place, all in accordance with the requirements of the Contract Documents. Carrier pipe installation within the steel casing shall be in accordance with the requirements contained within this Section.

B. In the performance of the work, CONTRACTOR shall comply with the lawful requirements of the affected railway companies, public agencies, and owners of public utilities or other facilities respecting the safeguarding of traffic and improvements which might be endangered by the boring and jacking operations. The approach trenches in public streets will not be permitted to remain open for extended periods of time.

C. If CONTRACTOR is not ready to place the pipe in the casing at the time of completion of boring and jacking operations, the ends shall be bulkheaded, and the approach trenches in public streets shall be backfilled, temporary surfacing placed thereon, and the affected portion of the street reopened to traffic.

D. CONTRACTOR shall be responsible for maintaining the specified line and grade, and for preventing settlement of overlying structures, or other damage due to the boring and jacking operations.

1.02 Related Work Specified Elsewhere

A. Section 01 5713: Temporary Erosion & Sediment Control
B. Section 01 8900: Site Construction Performance Requirements
C. Section 31 2319: Dewatering
D. Section 31 2200: Grading
E. Section 31 2333: Trenching and Backfilling
F. Section 33 0130: Water Utility Leak Testing & Disinfection
G. Section 33 1100: Water Utility Distribution Piping

1.03 Reference Specifications, Codes, and Standards

A. AISC- American Institute of Steel Construction

B. ACI - American Concrete Institute

C. AREA - American Railroad Engineering Association

D. ASTM - ASTM International

E. MDOT - Michigan Department of Transportation, 2003 Standard Specifications for Construction

1.04 Submittals

A. CONTRACTOR shall submit shop drawings of pipe casing in accordance with the requirements of Section 01 3300:

1. CONTRACTOR, prior to beginning any trench or structure excavation five (5) feet deep or over, shall submit to ENGINEER and shall be in receipt of ENGINEER's written acceptance of CONTRACTOR's detailed plan showing design of shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation.

2. Casing installation schedules which include schedules of excavation, pipeline installation, and backfill operations.

3. Material list including diameter, thickness, and class of steel casing.

4. Detailed locations and sizes of all boring or jacking and receiving pits and the jacking head proposed to be used.

5. The method of transporting the pipe in the casing and the method of "tugging" the pipe into the joints.

6. Details of concrete support blocks and bracing to prevent the carrier pipe from shifting or floating during the installation of sand backfilling.

7. Permits associated with the boring or jacking operations.

B. Certifications: CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications and the following supplemental requirements:

1. Physical and chemical properties of all steel.

C. Expenses incurred in making samples for certification of tests shall be borne by CONTRACTOR.

1.05 Quality Assurance

A. Boring or jacking operations shall be done by a qualified CONTRACTOR with at least 5 years experience involving work of a similar nature.

B. CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notices of the start of an excavation or boring operations.

C. Work shall be performed in the presence of ENGINEER.

D. Welding Requirements: Welding procedures used to fabricate steel casings shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates and grout coupling connections.

E. Welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the casing or pipeline. Machines and electrodes similar to those used in the work shall be used in qualification tests. CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.06 Protection of Property, Utilities, and Structures

A. Take all steps necessary to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, drains, sewers, utilities, structures, and appurtenances from damage because of any tunneling operations. Responsibility and payment for correction of any damage shall be the sole responsibility of CONTRACTOR.

1.07 Soil Erosion and Sedimentation Control

A. CONTRACTOR, at his expense, shall provide, maintain and remove such temporary and for permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by ENGINEER.

1. Measures shall prevent surface runoff from carrying excavated materials into nearby rivers, creeks, catch basins or drains; to reduce erosion of the slopes; and to prevent silting in of drain downstream of the Work. The measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

B. Comply with requirements of Section 01 8900, Temporary Erosion and Sediment Control.

1.08 Safety

A. CONTRACTOR shall have sole responsibility for the safety of the jacking and boring operations and for persons engaged in the work.

B. CONTRACTOR shall conform to the requirements in accordance with Standard Specification Item No. 509, "Trench Safety System" of the Construction Industry Occupational Safety and Health Administration (OSHA) Standards (29 FR 1926/1920) as published in U.S. Department of Labor publication OSHA 2207, latest revision, and shall provide an appropriate Trench Safety Plan.

Part 2 Products

2.01 General

A. Steel casings shall be welded steel pipe of the diameters and plate thicknesses shown, and shall conform to ANSI/AWWA C200, subject to the following supplemental requirements.

1. Casing shall be of the diameter and thickness shown and shall be furnished complete with welded joint ends and pressure grout couplings as shown.

2. CONTRACTOR shall be fully responsible for the sufficiency of the casing provided and may select a greater diameter or thickness for the method of work, loading characteristics, site conditions, or possible interferences at no additional cost to OWNER.

2.02 Steel Casing Pipe

A. ASTM A252, Grade 2, welded and seamless steel pipe; ASTM A53, Type E or Type S, Grade B; or ASTM A139, Grade B, electric fusion (arc) welded type; of size and wall thickness shown on the Plans.

B. CONTRACTOR shall provide 2-inch grout connections regularly spaced at 5 feet on center alternating at 45 degrees from plumb each side of the vertical centerline.

C. Casing section joints shall be butt welded, lap welded, or welded using butt straps in the field. Each end of the casing for butt welding shall be prepared by providing .25-inch by 45-degree chamfer on the outside edges.

D. Provide smooth interior. Weld joints to form a leakproof continuous pipe. Provide cathodic protection or coating as indicated on the Plans.

2.03 Concrete

A. In accordance with MDOT Section 701, use Grade S3; 3,000 psi (21 MPa) strength; Type IA cement; 5.5 sacks cement per cubic yard (307 kg/m3); 6A coarse aggregate; 2NS fine aggregate; 6.5% + 1.5% air content; 3-inch (75 mm)maximum slump; no admixtures without ENGINEER approval.

2.04 Concrete Reinforcement

A. Use ASTM A615, Grade 60, for bars and ASTM A185 for welded wire fabric and meeting the requirements of MDOT Section 905.

2.05 Wales, Struts, Plates and Miscellaneous Steel

A. Carbon Steel: ASTM A36 except where otherwise noted on the Drawings or as approved by ENGINEER.

2.06 Fasteners

A. High-Strength Carbon Steel Bolts: ASTM A325, Type 1 or 2.
B. Alloy Steel Nuts: ASTM A563, Grade C, Heavy Hex Style.
C. Hardened Steel Washers: ASTM F436

2.07 Wood Lagging

A. Wood lagging: Sound southern pine or mixed hardwoods free from shakes, large knots, and other defects that might impair its strength.

B. Bending strength shall be as required for the design.

2.08 Blocks and Shims

A. Blocks and shims: Sound hardwood or southern pine with a rectangular cross section.

Part 3 Execution

3.01 Verification of Grades, Lines, and Levels

A. Prior to performing any tunneling or jacking and boring operations, verify the grades, lines and levels to which the new Work is to be installed. Any operations required to adjust grades, lines and levels after Work has started will be at the expense of CONTRACTOR.

3.02 Existing Structures and Utilities

A. Prior to beginning any tunneling or jacking and boring operations, verify in the field the location of existing structures and active utilities scheduled to remain and requiring protection from damage because of the Work. Notify ENGINEER where such conditions directly affect the progress of the Work.

3.03 Location of Work

A. ENGINEER will establish on the surface of the ground, control points both as to line and grade. CONTRACTOR shall insure that these control points are properly protected and adequately locate the Work from the reference points established by ENGINEER.

3.04 Layout of the Work

A. CONTRACTOR shall stake, mark and layout the work using suitable stakes and markers to facilitate verification of grades, lines and levels and location of the Work to be performed in a manner acceptable to ENGINEER. In laying out the Work, consideration should be made for the rights of adjacent property Owners.

B. Provide pedestrian and vehicular access to such properties. Should sidewalk encroachment be necessary, provide and maintain suitably safe, protected pedestrian walkways, at least four (4) feet (1.2 m) in width.

3.05 Sheeting, Shoring and Bracing

A. Provide and maintain all sheeting, shoring, and bracing required in tunnels, shafts, pits, trenches and open cut excavations to ensure protection and safety of personnel and to protect adjacent structures, property and Work in place.

B. Where indicated on the Plans and where necessary in the Work, install and leave in place, primary tunnel linings.

C. No extra compensation shall be paid to CONTRACTOR for sheeting, shoring, bracing left in place.

D. CONTRACTOR shall be responsible for the complete design of all sheeting, shoring, and bracing Work. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil.

E. Prior to installing the sheeting, shoring or bracing, CONTRACTOR shall submit plans for this Work to ENGINEER for informational purposes only.

F. Sheeting, shoring, and bracing shall conform to the current federal or state regulations for safety.

G. Furnishing, placing, bracing, maintaining, and removing of sheeting and shoring materials shall be at CONTRACTOR'S expense unless otherwise indicated.

H. CONTRACTOR shall not remove the sheeting, shoring and bracing unless the pipe has been properly bedded and backfilled to sufficiently support the external loads.

I. Sheeting, shoring, and bracing material shall not come in contact with the pipe but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

J. Bore pits within the 1 on 1 influence of the road or within railroad right-of-way shall be backfilled with flowable fill.

3.06 Work Under Existing Utilities

A. Where excavation or Work is conducted under existing utilities which may constitute a hazard to the new utility, excavation, or tunneling operations, CONTRACTOR shall perform such excavation or tunneling operations necessary to prevent damage or rupture to conduits or piping.

B. When Work is being conducted near a utility under conditions which may result in rupture of such utility, notify the utility of the conditions and do not proceed with the Work until an authorized representative of the utility has examined the conditions. Proceed only after the utility has been adequately protected.

3.07 Installation of Steel Casing

A. General:

1. Once the jack and bore operation has begun, CONTRACTOR shall work as necessary to prevent "freeze-up" of the pipe, until the entire pipeline is complete.

    a. Operations between 8:00 p.m., and 8:00 a.m., shall be approved by OWNER prior to beginning the work.

    b. CONTRACTOR shall endeavor, however, to limit the noise from this operation to the greatest extent possible between the hours of 8:00 p.m., to 8:00 a.m.

2. If necessary, use bentonite lubricant applied under pressure through fittings in the lead pipe to reduce pipe-soil friction.

3. Use no less than two (2) jacks of sufficient power to carefully and accurately install the pipe by pushing or jacking pressure.

4. Use a timber bearing pushing frame, built to fit and match the end of the pipe being jacked, to evenly distribute the jacking force over the end of the pipe.

5. Use reaction blocks or backstop supports, installed in the jacking pit, shaft or trench, of sufficient strength to handle the thrust of the jacks.

B. Jacking Head:

1. A steel jacking head shall be fitted to the lead section of the casing in such a manner that it extends around the entire outer surface of the steel casing and projects at least 18 inches beyond the driving end of the casing.

2. The jacking head shall not protrude more than 0.5 inches outside of the outer casing surface.

3. The head shall be securely anchored to prevent any wobble or alignment variation during the boring or jacking operations.

4. To minimize voids outside the casing, excavation shall be carried out entirely within the jacking head and not in advance of the head.

5. Excavated materials shall be removed from the casing as the boring or jacking operation progresses and no accumulation of excavated materials within the casing shall be permitted.

C. Jacking Pit:

1. Excavations for the boring or jacking operations shall be adequately shored to safeguard existing substructures and surface improvements and to ensure against ground movement in the vicinity of the jack supports.

2. Heavy guide timber, structural steel, or concrete cradles of sufficient length shall be provided to assure accurate control of boring or jacking alignment.

3. CONTRACTOR shall provide adequate space within the excavation to permit the insertion of the lengths of casing to be bored or jacked.

4. Timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing.

5. A bearing block, consisting of a timber or structural steel framework, shall be constructed between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.

D. Control of Alignment and Grade:

1. CONTRACTOR shall control the application of the jacking pressure and excavation of materials ahead of the casing as it advances to prevent the casing from becoming earthbound or deviating from the required line and grade.

2. CONTRACTOR shall restrict the excavation of the materials to the least clearance necessary to prevent binding in order to avoid loss of ground and consequent settlement or possible damage to overlying structures.

3. Allowable grade deviations in horizontal and vertical alignments shall be no greater than 0.2 feet per 100 feet in any direction over the length of the jacking or boring to a maximum deviation of 0.5 feet.

E. Installation:

1. Installation of the casing shall be in accordance with the Contract Documents and subject to the approval of the agency having jurisdiction over the area containing the boring or jacking operations.

3.08 Installation of Carrier Pipe

A. General:

1. Use the types and sizes of pipe shown on the Plans. Place pipe to the lines and grades indicated on the Plans.

2. Use care to not damage pipe, joints or joint material.

3. Use plywood or other protective joint spacer material to distribute pushing or pulling loads evenly around joints.

4. The carrier pipe shall be braced or filled as shown on the drawings to prevent shifting or flotation during backfilling operations.

5. Completely fill voids between outside pipe wall and soil as specified

B. Joints:

1. Joints of the carrier pipe within the casing shall be joined in accordance with the specification Sections for the type of pipe material installed.

C. Application of Mortar Lining and Coating to Joints:

1. Application of mortar to the interior and exterior joints shall be performed in accordance with the requirements of the specification Sections for the type of pipe materials installed and as provided for herein.

2. No exterior or interior joints of the carrier pipe shall have mortar grout applied over a seam until the seam has cooled.

D. Testing of the Carrier Pipe:

1. Hydrostatic testing of the carrier pipe shall be completed prior to the filling of the annular space between the casing and carrier pipe with sand.

2. Hydrostatic testing shall be performed in accordance with Section 33 0130.

E. Sand Backfill for Annular Space in Jacked Casing:

1. CONTRACTOR shall furnish the necessary sand, equipment, hoses, valves, and fittings for the operation.

2. Sand shall be conveyed by air through a hose and deposited by air pressure in its final position.

3. Sand shall be free of lumps to flow unimpeded and to completely fill all voids.

4. In general, sand backfill will be considered completed when no more sand can be forced into the annular space.

5. CONTRACTOR shall protect and preserve the interior surfaces of the steel casing from damage.

3.09 Backfilling Voids

A. Excavations beyond the neat lines of the pipe shall be backfilled with a sand-cement or grout mixture. Any voids judged by ENGINEER to exist behind such construction shall be grouted.

B. For tamped backfill, fill all voids with sand-cement mixture consisting of 1-part Portland cement to not more than ten (10) parts fine aggregate, by volume, tamped thoroughly in place.

C. For pressure grouted backfill, fill all voids with a grout mixture consisting of one (1) part Portland cement to three (3) parts fine aggregate, by volume, with sufficient water to flow through the grouting pipes. Install grout mixture under pressure from the pipe interior through threaded grout holes in pairs every 16 feet (5 m) piercing the pipe wall or from the ground surface through insertion pipes.

D. For all jacked pipe installations, use pressure grouted backfill.

3.10 Grouting Operations

A. Immediately after completion of the boring or jacking operations, CONTRACTOR shall inject grout through the grout connections in such a manner as to completely fills all voids outside the casing pipe resulting from the boring or jacking operations.

B. Grouting shall be done so as not to damage the pipe, adjacent structures or existing utilities. Two (2) grout holes shall be provided for each 10-foot (3 m) of tunnel run.

C. A grout pipe at least 1-l/2 inches (40 mm) in diameter shall be inserted and securely caulked into the grout hole. The grout pipe shall be fitted with a control valve to control the flow of grout into the voids.

D. Grout holes not less than 1-l/2 inches (40 mm) in diameter shall be drilled on radial lines the inner lining of the pipe. The grout holes shall be extended through the outer lining to permit complete grouting outside the primary lining as well as between the linings.

E. Grout shall consist of a mixture of Portland cement thoroughly mixed with mortar sand with sufficient water to permit ready flow through the grout pipes. In general, the mix shall be 1-part of cement to 1-part of sand, but the proportions may be varied at ENGINEER'S request to the extent of richening the mix to neat cement. If necessary to speed up the setting of the grout, approved admixtures or quick setting cement shall be used as approved by ENGINEER.

F. Grout shall be pumped through the grout pipe at the prescribed pressures to completely fill all voids between the inner and outer lining as well as the void spaces between the outer lining and the earth banks.

1. If there is no visible escape of grout between interior and exterior surfaces of the tunnel liners, at bulkheads or through outlets, grouting may be considered complete when grout can no longer be pumped through the inlet pipe at the prescribed pressures.

2. Care shall be taken during the grouting operation to prevent the pumped grout from escaping into basements, adjacent sewers, manholes or other structures.

3. If it becomes evident that more grout is being used then is effectively necessary for the Work, operations shall be halted and the source of waste investigated.

G. Following satisfactory grouting operations acceptable to ENGINEER and after initial set of the grout, remove the grout pipe from the grout hole and fill the space previously occupied by the pipe with stiff mortar and trowel smooth at the inner face of the sewer or conduit wall. The space from which the pipe was removed shall be at least three (3) inches (75 mm) deep before sealing. Chipping to that depth is required if necessary.

H. CONTRACTOR shall do all re-grouting required to close unfilled spaces or voids, repair cracks and/or breaks in the tunnel linings and to make the installation watertight.

3.11 Closing of Pits

A. After jacking equipment and excavated materials from the boring or jacking operations have been removed from the jacking pit, CONTRACTOR shall prepare the bottom of the jacking pit as a pipe foundation.

B. CONTRACTOR shall remove loose and disturbed materials below pipe grade to undisturbed earth and re-compact the material in accordance with Section 31 2333.

C. Should appreciable loss of ground occur during the jacking operation, the voids shall be backpacked promptly to the extent practical with soil cement consisting of a slightly moistened mixture of one-part cement to five parts granular material.

1. Where the soil is not suitable for this purpose, CONTRACTOR shall import, at CONTRACTOR'S expense, suitable material.

2. Soil cement shall be thoroughly mixed and rammed into place as soon as possible after the loss of ground.

3.12 Acceptance and Inspection

A. If unable to maintain line and grade or to maintain jacking operations due to pipe freeze-up, propose alternate methods of construction as specified under Article 1.10 of this Section to complete the Work.

B. Carrier and casing/camier pipe Work shall be inspected and accepted under the appropriate section of Related Work Specified Elsewhere.

C. Casing pipe shall be inspected for cracks, crushing, buckling or other structural damage.

D. Joints shall be inspected for structural damage and water-tightness. CONTRACTOR shall remove and replace any damaged or unacceptable Work. Repair Work shall be done to the satisfaction of ENGINEER.

E. If any excavation or installation Work done by CONTRACTOR is to be abandoned or not completed, CONTRACTOR shall fill all voids and spaces of the abandoned Work, as determined by ENGINEER.

3.13 Field Quality Control

A. Perform periodic tests of ventilation and compressed systems to ensure that all equipment is in proper working order and providing minimum required air for personnel safety and tunneling operations.

B. Perform periodic inspection and test of air lock equipment and operation in accordance with the requirements of the regulatory agencies referenced herein.

End of Section

Section 33 1100
Water Utility Distribution Piping

Part 1 General

1.01 Scope of Work

A. This Section includes water main Work complete with water main piping, valves, hydrants, thrust blocks, valve wells, structures, fittings, joints, joint materials, nuts, bolts, glands, gaskets, plugs and accessories as shown and required. This Section also includes bedding and laying of water main piping, hydrostatic testing of new water main piping systems, and flushing and chlorination of water main piping systems.

1.02 Related Work Specified Elsewhere

A. Section 01 2200: Unit Prices
B. Section 31 2316: Structural Excavation and Backfill
C. Section 31 2319: Dewatering
D. Section 31 2333: Trenching and Backfilling
E. Section 33 0513: Manholes and Structures

1.03 Requirements of Regulatory Agencies

A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 Reference Standards

A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute

2. ASTM - ASTM International

3. AWWA - American Water Works Association

4. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

5. NSF - National Sanitation Foundation

1.05 Submittals

A. Tabulated Laying Schedule:

1. Tabulated Laying Schedule, showing stationing, deflection, elevation, slope and description of pieces (i.e., pipe size and material; fitting type, size and material; valve type and size, etc.) shall be submitted to ENGINEER. Pipe manufacture shall not be started until the laying schedule has been reviewed by ENGINEER.

B. Product Data:

1. Submit catalog data showing pipe sizes, and manufacturing standards, as well as design calculations for internal pressure, vacuum and external load conditions, for both non-restrained and restrained joints.

C. Schedule of Corporation Stops (Tapping Outlets):

1. A complete schedule of tapping outlets installed in water main piping shall be kept by CONTRACTOR and submitted to ENGINEER at the end of each water main piping section of the Project or on the last day of each week, whichever occurs first.

D. Quality Assurance Materials:

1. Quality assurance test procedures, test reports for pipes, specials and fittings shall be submitted to ENGINEER.

E. Affidavits:

1. Affidavits of compliance with the Contract Documents shall be submitted to ENGINEER and shall include the following, where applicable:

a. Pipes, specials and fittings (AWWA C200).

b. Cement-mortar protective lining (AWWA C205 and AWWA C602).

c. Tape coating for the exterior (AWWA C214 and AWWA C209).

d. Shrink wrap for exterior (AWWA C216).

e. Paint system for the exterior (AWWA C210, C218 or C222).

f. Manufacturer's standard repair procedures.

g. Manufacturer's written quality control procedures.

h. Manufacturer's Installation Instructions: Indicate special installation requirements.

i. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

2. Affidavits for items a through e shall be signed by an authorized professional.

1.06 Closeout Submittals

A. The following shall be submitted in accordance with Section 01 7700, Closeout Procedures:

1. Manufacturer's field reports.

2. Project record documents:

a. Accurately record actual locations of piping mains, valves, connections, and invert elevations.

b. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

3. Provide a final record laying schedule.

4. Submit certified copies of hydrostatic test results of completed force main sections as specified in Article 3.15.

1.07 Storage of Materials

A. Pipe shall be stored in a manner to minimize infiltration of dirt, debris and other extraneous materials.

B. Piping materials shall not be stacked higher than four (4) feet (1.2 m). Suitable racks, chairs and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.

C. Store hydrants, valves, wells and prefabricated structures off the ground, drained and kept free of water to protect against damage from freezing. Hydrants, valves, wells, their accessories and appurtenances shall be kept in their original containers until ready for installation.

D. Gaskets, glands, joint and sealing materials subject to ultra-violet or ozone attack shall be protected from the sunlight, atmosphere and weather; and stored in suitable enclosures until ready for installation.

1.08 Handling of Materials

A. Load and unload piping using suitably approved hoists and skidding. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping shall be rejected by CONTRACTOR.

B. Lifting devices shall be suited to the Work and shall protect surfaces from damage.

Part 2 Products

2.01 Scope

A. It is the intent of the Articles in Part 2 of this specification section is to specify in detail the various types of pipe, joints, and fittings which have been indicated throughout the Plans and Specifications.

B. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 Flanged Tapping Sleeves for Prestressed Concrete Cylinder Pipe

A. Material:

1. Saddle Plate shall be manufactured from ASTM A285 Grade C Steel or equal.

2. Straps shall be manufactured from ASTM A36 steel or equal.

3. Gasket shall have a broad, flat sealing surface and shall be manufactured of a material suitable for the intended conveyed fluid.

4. Flange to be connected to valve shall be manufactured in accordance with AWWA C207 Class D. Flanges larger than 12" diameter shall have an alignment recess suitable for accepting the alignment lip of the tapping valve.

5. Waterway shall be lined with fusion-bonded epoxy to a minimum thickness of l5 mils in accordance with AWWA C2l3.

6. All other steel shall be coated with a shop coat primer coating.

7. Bolts, studs and nuts shall be high strength, low alloy, ANSI A21.11.

B. Features:

1. Sleeve shall be designed for an operating pressure of 150 psi.

2. The sleeve shall have a separate gland, which allows the sleeve to be installed, and the annular space between the pipe and the sleeve to be grouted, prior to cutting the prestressed wires.

3. Foam or rubber grout gaskets and hard rubber spacers shall be used to provide an annular space between the pipe and the sleeve. Grout horns shall be furnished to facilitate grouting of the annular space.

4. The annular space shall be grouted with a suitable Portland Cement grout. The grout shall be allowed to set prior to cutting any prestressing wires. Any accelerant used in the grout shall not be deleterious to prestressing wire.

5. The pressure plate shall be adequately braced to eliminate vibration & flexing of the plate while the tapping machine is operating.

6. The machined gasket groove on the pressure plate must be consistently positioned about throat of tapping gland waterway. However, ID of the gasket groove must be set back a minimum of 1" from the waterway to allow dispersal of forces generated by gasket compression. Gasket grooves machined in a circle and then rolled to an elliptical shape will not be allowed.

7. All waterway welds shall be dye-penetrant inspected or hydrostatically shop tested for water tightness.

8. The gland shall be equipped with load bearing set screws to transfer thrust loads from the branch piping to the sleeve.

9. A three-flange configuration shall be used on all outlets above twelve-inch to allow for valve bypass.

10. Welding the gland to the steel cylinder of the pipe to provide a watertight seal shall not be permitted.

12. The sleeve shall be encased in a minimum of one inch of Portland cement mortar or concrete for corrosion protection after the tap.

13. The sleeve shall be Thompson Pipe Group or ENGINEER-approved equal.

2.03 Strap-Type Tapping Saddles for Prestressed Concrete Cylinder Pipe

A. Tap saddles with threaded outlets for prestressed concrete steel cylinder pipe shall have a separate gland, which permits installation of the saddle prior to removal of the prestressing wire.

B. Saddle shall be constructed to allow grouting of the outlet after the service of the tap.

C. Tap saddle shall be provided with a cloth diaper so that the straps can be encased in grout after installation.

D. Saddle shall be Thompson Pipe Group strap-type tap or ENGINEER-approved equal.

2.04 Ductile Iron Pipe System

A. Ductile Iron Pipe shall be ANSI/AWWA C151/A21.51, with cement mortar lining inside per ANSI/AWWA C104/A21.4, and an exterior zinc coating per ISO 8179-1, Ductile Iron Pipes-External Zinc-based Coating-Part 1: Metallic Zinc with Finishing Layer (ISO 2004).

B. Pipe shall be Pressure Class 250 and have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans or specified in the Proposal.

C. Mechanical joints for ductile iron pipe shall be compression gasket type, conforming to ANSI/AWWA C111/A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.

D. Push-on, compression gasket type joints shall conform to ANSI/AWWA C111/A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.

E. Fittings and plugs shall be ductile iron compact fittings, mechanical joint, pressure rating of 350 psi (2.4 MPa), conforming to ANSI/AWWA C153/A21.53, and rubber gasket joints conforming to ANSI/AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

F. Cement mortar linings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C104/A21.4 of the thickness specified and shall be permanently set prior to the application of any additional pipe coating.

G. Pipe and fittings shall be completely encased in polyethylene film.

2.05 Restrained Joints

A. Where the Plans or Specifications call for restrained joints they shall be per the following.

1. Restrained joints for ductile iron pipe and fittings shall be designed for a working pressure of 350 psi (2.4 MPa). Joints shall be capable of being deflected after assembly. Restraints shall be by one of the following methods:

a. A positive axial lock between the bell interior surface and a retainer welded on the spigot end of the pipe.

b. A thrust restraint wedge which embeds in the pipe with twist off nuts to control wedge setting.

2. Restrained joints for PVC water main pipe shall be designed for a working pressure of 200 psi (1.4 MPa). Where the restrained portion of the pipe is connected to fittings, restraint shall be provided across the joint by a clamping ring and anchored to the fitting with T-head bolts or stainless steel rods.

3. Restraining devices for PVC water main pipe shall incorporate clamping rings with serrations on the inside surface to provide positive restraint on the outside surface of the pipe and shall provide full support around the circumference of the pipe to maintain roundness.

2.06 Polyethylene Encasement

A. Polyethylene material for encasement shall be either 4 mil high density, cross-laminated polyethylene film or 8 mil linear low-density polyethylene film per AWWA C105.

2.07 Hydrants

A. Fire hydrants shall equal or exceed AWWA C502 Specifications and shall be in compliance with OWNER's standards.

B. Hydrants shall have a main valve opening of 5-1/4" and a 6" inlet connection. Each hydrant shall have two (2) 2-1/2" national standard hose connections and one (1) 4 1/2" national standard pumper connection.

C. Each hydrant shall be furnished complete with one 6" auxiliary gate valve and box.

D. The hydrant inlet joints and auxiliary valve joints shall be push-on type or mechanical joint for standard hydrants and mechanical type for Type P hydrants.

E. Standard hydrant leads shall consist of pipe material as used for water main construction:

1. Type P hydrant leads shall consist of anchoring couplings (F-1215) and anchoring pipe with one end solid gland and the other Roto-Right gland (F-1218) by Clow, and standard mechanical fittings where applicable.

2. TCIW-MJ hydrant tee with fittings, clamps and rods, or equal may be substituted.

2.08 Valves

A. General:

1. Valves, operation, accessories, and specific notes are specified on the drawings. Valve materials and workmanship shall conform to applicable ANSI, ASTM, and AWWA standards. Valve bodies shall have an arrow to indicate direction of turning to open.

C. Swing Check Valve (2-1/2 inch and larger):

1. General:

a. Swing check valves shall be the rubber flapper type with a heavily constructed cast iron body and cover in accordance with ASTM A296.

b. The body shall be long pattern design (not wafer), with integrally cast-on end flanges.

c. Check valves to have full pipe size flow area.

d. Seating surface to be on a 45° angle requiring the flapper to travel only 35° from closed to full open position, for minimum head loss and non-slam closure.

e. The valve shall be designed to also function in the vertical position.

2. Flapper:

a. The flapper shall be Buna-N having an "O" ring seating edge and be internally reinforced with steel.

b. Flapper to be captured between the body and the body cover in a manner to permit the flapper to flex from closed to full open position during flow through the valve.

c. Flapper shall be easily removed without need to remove valve from line.

d. Flapper shall have an elastic spring, molded internally, to assist the flapper to close against a slight head to prevent slamming.

3. Exterior Paint: Phenolic Primer Red Oxide (NSF Approved)

4. Manufacturer: Valve shall be Crispin, Val-Matic, Clow, or equal.

D. Wafer Style Check Valves:

1. General:

a. Silent or double door spring loaded check valves shall be compact wafer style, designed to fit between ANSI flanges.

b. Valves shall be sized as shown on Drawing for low pressure air, with a working pressure of 150 psi

c. Check valve shall be spring loaded, normally closed by means of one or more heavy duty stainless steel torsion springs.

d. Flow from the blowers shall cause the valve to open and upon blower shut down, the torsion spring will shut the valve before reverse flow starts and at a point of zero velocity of non-slam closure.

2. Materials:

a. The sealing element shall be BUNA-N molded to body.

b. Valve body shall be fabricated of cast iron.

c. Torsion spring, hinge shaft and stop pin shall be constructed of stainless steel.

d. Silent plug or doors shall be bronze, ASTM B584.

3. Manufacturer: Valves shall be Val-Matic, Mission, or equal.

E. Ball Check Valves:

1. Provide PVC Ball Check Valve with socket union connections, true union design, ball check type, Viton O-rings and seat, rated for 150 psi at 73°F.

2. Manufacturer: Valves shall be NIBCO, Inc., Hayward Industrial Products, Inc, or approved equal.

F. Ball Valves:

1. Manufacturer: Valves shall be Apollo Conbroco, Jamesbury Series 500 Chemtrol, Howard, or equal.

2. Ball valves have a working pressure of 200 psig, except PVC which is 150 psig, drop tight shut off, full port material bronze body, hard chrome plated ball teflon or viton seats and/or 316 stainless steel body and ball, teflon seats and/or PVC body and ball teflon seats depending on the service, with stops at full open and full closed.

G. Plug Valves:

1. General:

a. Plug valves shall be of the non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connection as shown on the plans. Flanged valve shall be faced and drilled to the ANSI125/150 lb. standard.

2. Bodies:

a. Valve bodies shall be of ASTM A126 Class B cast iron. Bodied in 4" (100mm) and larger valves shall be furnished with a 1/8" welded overlay seat of not less than 90% pure nickel. Seat areas shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Screwed in seats are not acceptable.

3. Plugs:

a. Plugs shall be of ASTM A126 Class B cast iron. The plugs shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interface between the plug face and body seat, with the plug in the closed position, shall be externally adjusted in the field with the valve in line under pressure. Plug valves shall be chloroprene (CR) or resilient facing suitable for application.

4. Bearings:

a. Bearings shall have sleeves type metal bearings and shall be of sintered, oil impregnated permanently lubricated type 316 ASTM A743 Grade CFB 1/2" – 36" sizes. Non-metallic bearings shall not be acceptable.

5. Shaft seals:

a. Shaft seals shall be of the multiple V-ring type and shall be externally adjustable and re-packable without removing the actuator or bonnet from the valve under pressure. Valves utilizing O-rings or non-adjustable packing shall not be acceptable.

6. Pressure Rating:

a. Pressure rating shall be 175 psi on sizes ½" – 12" and 150 psi for 14" – 72". Every valve shall be given a hydrostatic and seat test, with test results being certified.

b. Manual valves shall have lever or gear actuators and tee wrenches, extension stems, floor stand, etc., as indicated on the plans. All 6" valve and larger shall be equipped with gear actuators.

c. Gearing shall be enclosed in a cast iron housing and be suitable for running in a lubricant with seals provided on all shaft to prevent entry of dirt and water into the actuator.

d. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and adjustable stop shall be provided to set closing torque and to provide adjustment to compensate for change in pressure differential or flow direction change.

e. Exposed nuts, bolts and washers shall be zinc plated.

f. Power actuated valves shall be furnished with electric motor actuators as indicated on the plans.

7. Manufacturers: Valves shall be the product of DeZurik or engineer approved equal.

H. Butterfly Valves:

1. Butterfly valves shall be Class 150, rubber-seated tight closing and shall conform to AWWA Standard C504 latest revision.

2. Valves shall be of the flangeless wafer body style and suitable for use with ANSI 150 pound flanges. Bodies shall be cast iron. Valves shall be rated at 175 psi, minimum. Bodies of all flangeless wafer valves shall have bolt guides to center the body in the pipeline.

3. Valves shall be furnished with self-lubricated bearings of TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

4. Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets. Seats shall be of Buna-N or EPDM suitable for use with potable water. Shafts shall be one piece and shall be 316 stainless steel. Shaft diameter shall be suitable for the service conditions specified.

5. Shafts shall be finish ground to minimize bearing and shaft seal wear. Shafts of 12-inch and larger shall have a non-adjustable thrust collar. Shaft seals shall have a stuffing box and pull down packing gland. Packing shall be furnished with self-adjusting "V" type packing.

6. Discs shall be aluminum bronze. The disc-to-shaft connections shall be Type 316 stainless steel.

7. Pins, shaft, and disc of all valves shall be individually machined and completely interchangeable.

8. Valves shall be available with field interchangeable manual or powered actuators as required. The actuator-to-shaft connection shall be designed to shear and prevent internal valve damage if the disc closes on foreign material in the pipeline.

9. Factory Testing: Test shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.

10. Butterfly valves shall be marked with the valve size, manufacturer's mark, year of manufacture, and class.

11. Manufacturer: Valves shall be DeZurik, Val-Matic, Henry Pratt, Clow or ENGINEER-approved equal.

I. Gate Valves:

1. Gate valves shall be iron-body, bronze mounted, inside-screw, hand-operated resilient seat, and shall be equipped with rubber O-Ring Seals at the top of the stems unless otherwise shown on the plans. Valves shall conform to the requirements of AWWA C509 for valves reated for 150 psi service and AWWA C515 for valves rated for 250 psi service.

2. Wedge shall be of cast iron completely encapsulated with rubber. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D-249.

3. Valves shall be supplied with o-ring seals at all pressure retaining joints. No flat gaskets allowed.

4. Valve shall be equipped with a fully self-supporting yoke structure shall be capable of being able to withstand the thrust generated from packing drag as well as loads induces from flows through the valve. Yoke should be designed with no less than a 25% safety factor.

6. Drive bushing (stem nut) shall be sully machined to smoothly accept drive stem with proper clearance for lubrication. Drive bushing shall be fixed to the gate of the valve in a manner that it can be easily removed or replaced. Drive bushing shall be made of brass.

7. Drive stem shall be 304 Stainless steel as a minimum. The threads shall be rolled, left-handed ACME threads either single or double lead. The stem shall be "free floating" at the gate drive bushing end and shall have a thrust collar at the actuator drive end. The thrust collar shall be designed to ensure long life and smooth operation of the valve.

8. Gate valves shall be furnished with a bevel gear manual operator:

    a. External cast housing and drive sleeve shall be class 65-45-12 or better.

    b. Top entry replaceable drive bushing shall be high-strength aluminum bronze.

    c. Self-aligning radial and thrust spherical roller bearings.

    d. Bevel gear made from fully machined 1045 steel.

    e. Pinion gear made from fully machined and head treated 4140 steel.

    f. Sealed to meet IP67 submergence class.

9. Gate valves shall be designed to turn left or counter-clockwise, unless otherwise specified, to open with 2-inch square operating nut or handwheel with the word "Open" and an arrow cast in the metal to indicate direction of opening.

10. Suitable extension stems or operating keys shall be furnished to properly operate all valves installed with valve boxes, and all necessary guides and supports for valve stems shall be furnished and installed where required.

11. Gate valves installed underground shall be equipped with standard cast iron valve boxes unless otherwise shown on the plans. Where valves are shown to be of smaller diameter than the connecting piping the two reducers required shall be included as fittings.

12. CONTRACTOR shall submit to ENGINEER complete catalog information showing principal dimensions, weights, and specifications and operating data for all valves he proposes to finish.

13. Body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C-550 and be NSF 14 and NSF 61 approved.

14. Each valve shall have maker's name, pressure rating, and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement for both AWWA requirements. Bolting shall either be regular plated or stainless steel type 304/316, as required.

15. Valves shall be as manufactured by American Flow Control, US Pipe and Foundry, Kennedy, Waterous, Clow Valve Company, or ENGINEER-approved equal. Valves shall be backed by manufacturer's five-year limited warranty.

J. Double Acting Level Control Valves (Altitude Valves):

1. General:

a. Double acting level control valves shall automatically close to prevent tank overflow when the high water level is reached, and open to permit flow from the tank to distribution when the distribution pressure becomes less than full tank head (or when tank level drops through some other means).

b. Non-throttling action is required for operation (valves will assume either a fully open or fully closed position).

c. Double-acting level control valves shall be globe (inline) or angle (90 degree) body with flanged end connections, be fully mounted, external pilot operated, with free floating piston (operated without springs, diaphragm or levers).

d. Valves shall contain a single full-ported seat, with seat bore equal to size of valve.

e. Minimum travel of the piston shall be equal to 25% of the diameter of the seat. For true alignment (to correct lateral thrust and stem binding), the piston shall be guided above and below the seat a distance equal to no less than 75% of the diameter of the seat. The piston shall be cushioned and so designed as to ensure positive closure.

f. Main valve shall be packed with leather (or other soft material) to ensure tight closure and prevent metal-to-metal friction and seating.

g. Valves shall be furnished with an indicator rod to show position of piston opening, and pet-cocks for attachment to valve body for receiving gauges for testing purposes. The design shall be such that repairs and dismantling internally of main valve may be made without its removal from the line.

h. The pilot valve, controlling operation of the main valve, shall have a range of adjustment, be easily accessible, and arranged to allow for easy removal from the main valve while the main valve is under pressure. The pilot valve, external strainer with blow-off, isolation valves, and all associated rigid brass piping and fittings (with the exception of a separate static pressure sensing line, if required) shall be factory assembled and furnished with the valve.

2. Construction:

a. Valve body and cap(s) shall be constructed of gray iron castings that conform to ASTM Specification A 126 Class B.

b. Internal bronze components shall conform to ASTM Specification B-584.

c. Internal stainless steel components shall conform to ASTM Specification A-743 Grade CF-8 or CF-8M.

d. Control piping shall be rigid red brass, no less than 0.5-inches in diameter.

e. Flanged assemblies shall conform to ANSI standards for wall thickness of body and caps, and flange thickness and drilling, subject to other specified standards.

3. Finish:

a. Ferrous surfaces of the valves shall be coated with NSF Certified Epoxy (Tnemec Series FC20) in accordance with ANSI/NSF Std. 61 and conforming to AWWA D102 Inside System No. 1.

4. Testing:

a. Completely assembled valves shall be tested prior to shipment, including a hydrostatic test of up to two (2) times the working pressure (maximum 500 psi testing pressure), a tight seating test, and a performance test for simulated field conditions. Results of the tests, either in digital format (PDF) or hard copy shall be delivered to OWNER for his/her records.

5. Valves shall be equal in all respects to the Model 40DAWR as manufactured by Ross Valve Mfg. Co., Inc, 6 Oakwood Ave, Troy, NY 12180, or an ENGINEER-approved equal.

K. Air Release Valves:

1. Air Release valves shall have an ASTM A126 Class B cast iron body and cover with a threaded inlet connection of the size shown on the plans or listed in the schedule and a 1/2-inch NPT outlet connection. Valve body shall have a 2-inch NPT plugged port near the base to facilitate cleanout of large solids as well as a ½-inch NPT connection near the top and 1-inch NPT port near the bottom to permit the installation of flushing attachments.

2. Valves shall have an 18-8 stainless steel float and a replaceable seat of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel, plastic or bronze is not acceptable. The linkage mechanism shall be capable of being removed from the cover without disassembly of the mechanism. Valves shall have 3/16-inch diameter stainless steel orifice for working pressures up to 150 psi. Valve shall close drop tight.

3. The valve shall automatically exhaust accumulated air from a fluid system while the system is pressurized and operational.

4. For valves installed below grade, each valve shall be equipped with a flood safe kit to prevent inflow into the valve during submerged conditions.

a. Cover, and upper/lower chamber shall be constructed of ductile iron and conform to ASTM A536, Grade 65-45-12 with internal and external FBE coating.

b. Upper and lower seats shall be resilient in accordance with ASTM D2000.

c. Float checks shall be constructed of Type 316 stainless steel in accordance with ASTM A240.

d. Nuts and bolts shall be constructed of Type 316 stainless steel in accordance with ASTM F593.

e. Basket retainer shall be Type 304 stainless steel in accordance with ASTM F879; basket shall be Type 304 stainless steel in accordance with ASTM A240.

5. Air release valves shall be Golden Anderson, Val-Matic or equal.

2.09 Tapping Sleeves

A. Tapping Sleeves shall be cast iron or ductile iron, pressure rating of 250 psi (1.7 MPa), mechanical joint sleeves conforming to AWWA C153, furnished complete with valve, stops, caps, plugs and joint accessories as indicated on the Plan. The sleeve shall be of a 2-section type.

2.10 Valve Boxes

A. Valve boxes shall be 3-piece, 5-1/4-inch (135 mm) diameter, screw type, gray iron castings consisting of base section, bottom section, and top section with lid, conforming to ASTM A48, Class 20. Overall length shall be adjustable to meet grade.

2.11 Corporation Stops

A. Corporation stops, couplings and plugs shall be water service bronze of type and size detailed on the Plans.

2.12 Service Saddles

A. Water service saddles shall be compatible with the main and service lead, with straps of a ductile material to avoid crushing the main out-of-round. A molded gasket of rubber or neoprene shall completely encircle the tapped opening to insure a watertight connection. The use of lead gaskets is not allowed. Water service saddles shall be bronze with AWWA tapped threads.

B. Service saddles used with PVC water main shall be double strap, full circular and provide uniform bearing around the circumference. U-bolt type straps are not allowed.

2.13 Curb Stops

A. Water service bronze of types and sizes detailed on the Plans. Curb stops shall include an extension type, 3-piece curb box with extension type base, foot piece, one piece lid and a 3-foot stationary rod, unless otherwise specified.

2.14 Threaded Fittings

A. Where indicated on the Plans, threads for water main service fittings shall conform to the requirements of AWWA C800 and AWWA C800 "Appendix for Materials."

2.15 Water Service Pipe

A. Soft Copper shall be Type "K" conforming to ASTM B-88, with flared fittings.
B. Polyvinyl Chloride shall conform to ASTM D2241 or D1785 Schedule 40.

2.16 Restraints, Clamps, Rods, and Ties

A. High strength low alloy steel or stainless steel conforming to ANSI/AWWA C111/A21.11. Balls and fittings shall be bronze alloy or corrosion protected steel.

2.17 Structures

A. Material for water main structures shall conform to the details on the plans and the requirements specified in Section 33 0513, Manholes and Structures.

2.18 Bolts, Studs, and Nuts

A. Bolts, studs, and nuts shall be as specified on the Plans and shall conform to the requirements of ANSI/AWWA C111/A21.11 and the ASTM standards listed below:

1. Bronze: ASTM B98
2. Steel: ASTM A307, Grade B
3. Cadmium Plating: ASTM B766, Grade NS
4. Zinc Coating: ASTM A153 or B633, Type GS

B. Tee head bolts and nuts shall be high strength, low alloy steel conforming to ANSI/AWWA C111/A 21.11.

2.19 Flowable Fill

A. Materials:

1. Cement: Cement shall conform to ASTM C150 or ASTM C595

2. Fly Ash: Fly ash shall have a maximum loss on ignition of 12 percent and meeting the other requirements of ASTM C618 (Class F)

3. Water: The water shall meet the requirements of ASTM C94

B. Mixture (Strength 50-100 psi) (345 to 690 kPa):

1. Fly Ash: 2,000 lbs/cyd (1190 kg/m^3) (min)

2. Cement: 100 lbs/cyd (60 kg/m^3)(minimum)

3. Water: Sufficient water to produce the desired flowability (approximately 700 lbs/cyd)(415 kg/m^3)

C. Temperature of the flowable fill mixture as manufactured and delivered shall be at least 50 degrees Fahrenheit (10 degrees Celsius).

D. Flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method for filling abandoned Water Mains.

E. CONTRACTOR shall submit a history of the mix design for 7 day and 28 day strengths, together with any other technical information. The design mix shall also be included as part of CONTRACTOR's submittals for project.

2.20 Tracer Wire

A. Copper clad steel wire with 30 mil High Density Polyethylene insulation. Concentric copper cladding metallurgically bonded to a steel core through a continuous solid cladding process.

B. Copper cladding to measure 3% minimum of the overall wire diameter. Wire to be 12 AWG, 0.0808 inches in diameter, 0.00242-inch nominal copper thickness, 9.5270 ohms nominal resistance per 1,000 feet, 675 pounds breaking strength. Wire to be Copperweld ® or equal.

2.21 Acceptable Manufacturers

A. Flexible Joint Pipe: Acceptable manufacturers include Clow, Usiflex, U.S. Pipe, or ENGINEER-approved equal.

B. Restrained Joints: Acceptable manufacturers for restrained joints for ductile iron pipe include Griffin Pipe Products Company, “Snap-Lok” or “Bolt-Lok”; American Cast Iron Pipe Company, “Lok-Ring” or “Lok-Fast”; United States Pipe and Foundry Company, “TR Flex”; EBBA Iron “Megalug” or ENGINEER-approved equal.

1. Manufactured in accordance with ANSI/AWWA C111.

2. A tightly adherent, corrosion resistant coating shall be used on all exposed metal components of the restrained joint system.

a. Wedges, actuating hardware or other exposed threaded components shall be coated with a minimum of two (2) coats of fluoropolymer epoxy coating that has been heat cured.

b. Primary restraint castings shall be coated with a polyester coating, electrostatically applied and fusion bonded.

c. Bolts, nuts, and washers shall be manufactured of low-allow steel conforming with the material characteristics listed in ANSI/AWWA C11 and shall have a minimum of two (2) coats of fluoropolymer epoxy coating that has been heat cured.

C. Valve Boxes: Acceptable manufacturers include: "A-295 Three Piece Screw Type," Traverse City Iron Works; "F2450," Clow, "Series 6860, Tyler," or equal.

D. Corporation Stops: Acceptable manufacturers include: Hays; Crane; Mueller; Ford; or equal.

E. Service Saddles: Acceptable manufacturers include: "Twin Seal," Clow, "Hays Seal," Hays, "Service Saddles," Mueller, or equal.

F. Curb Stops: Acceptable manufacturers include: Hays, Ford, Mueller, or equal.

Part 3 Execution

3.01 Contractor's Verification

A. Prior to the installation of any water main piping or materials, examine all trenches and other excavations for the proper grades, lines, levels and clearances required to receive the new Work.

B. Ascertain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive water main materials to be installed. Correct defects and deficiencies before proceeding with the work.

C. Expose the existing water main piping and structures to which the new Work is to be connected and notify ENGINEER of the same. ENGINEER will verify the vertical and horizontal locations of the existing system and shall inform CONTRACTOR as to the necessary adjustments required to align the new water main work with the existing system.

3.02 Preparation

A. Remove lumps, blisters and excess coatings from the socket and plain ends of pipe. Wire brush and wipe clean the outside surfaces of plain ends and the inside surfaces of socket ends before installation. Any pipe or fitting which has acquired a coating of mud or other foreign material shall be scrubbed clean with heavily chlorinated water.

B. Pipe fittings, valves, hydrants, accessories and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged materials shall be rejected and removed from the Project by CONTRACTOR.

3.03 Installation - General

A. Foreign matter shall be prevented from entering the pipe while it is being placed in the trench. During and after laying operations, no debris, clothing or other materials shall be placed in the pipe.

B. During the progress of water main Work, watertight plugs shall be carried along and inserted in the end of each pipe as it is laid to prevent foreign matter or rodents from entering the pipe. This watertight plug shall be fastened in the end of the water main in such a manner as to prevent it from floating or being otherwise displaced whenever construction operations are temporarily halted, such as at noon or at the end of the day's Work.

C. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes.

D. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles, shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer for the type of pipe materials being cut and according to the best trade practices.

E. When cutting pipe or fittings, care shall be taken to prevent damage to linings and coatings. Damage to linings shall be cause for rejection of the complete Section. Damage to exterior coatings shall be corrected to original Specifications.

F. Where pipe using a resilient gasket to affect the seal is cut, the cut pipe end shall be tapered at a 30-degree angle with the centerline of the pipe, and ground smooth, on the outside end to remove any sharp edges or burrs which might damage the gasket.

G. Unless otherwise specified, pipe shall be laid with bell ends facing in the direction of laying. After a length of pipe is placed in the trench, the spigot shall be centered in the bell end of the adjacent pipe section, the pipe shoved into position and brought to true alignment and secured with sand tamped under and on both sides of the pipe except at bell holes. Adequate support shall be provided for all water main pipe.

H. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 2333, Trenching and Backfilling. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 2333, Trenching and Backfilling. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.

I. A continuous and uniform bedding as specified in Section 31 2333, Trenching and Backfilling, shall be provided in the trench for all buried pipe.

J. Backfill shall be as indicated on the Plans and as specified in Section 31 2333, Trenching and Backfilling.

K. Install bolts, studs, and nuts of the type specified per the manufacturer's installation and torquing requirements. All steel bolts, studs, and nuts shall be painted with bituminous paint after installation.

3.04 Installation of Ductile Iron Pipe

A. Push-on-joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be prelubricated before installation using a lubricant recommended by the pipe manufacturer. The seated joint shall be identified by the visible mark on the spigot of the installed pipe section.

B. Mechanical joints shall be made with bolts, molded resilient gasket and cast iron follower gland. Nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall be brought up evenly at all points around the bell flange and then torqued per the manufacturer's recommendations.

C. Exposed portions of bolts shall be covered with mastic.

D. Flexible joint pipe shall be assembled, handled and installed in accordance with the printed recommendations which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to ENGINEER.

3.05 Installation of Polyvinyl Chloride Pipe

A. Polyvinyl chloride pipe shall be laid with gasketed joints in complete accordance with AWWA C605 and the pipe manufacturers published instructions. Joints shall be sufficiently lubricated using the pipe manufacturers recommended lubricant.

B. Gaskets for pipe joints shall be inserted with the painted edge facing the end of the bell. Each length of pipe shall be pushed home individually. Pipe shall be positioned so that the reference mark on the spigot end is in line with the bell end.

C. Tracer wire is to be installed along with PVC water mains. Tracer wire is to be continuous from end to end and terminate at each structure in such a way and with a sufficient length of wire to allow for easy connection to utility tracing equipment. Wire shall be continuity tested after installation. Any wire which fails the continuity test shall be replaced.

3.06 Installation of Restrained Joints

A. Restrained joints shall be provided where indicated on the plans. Joints shall be assembled in strict accordance with manufacturer's directions. Joints shall be fully extended after assembly.

3.07 Fittings, Strapping, and Lugged Pipe

A. Install all fittings to the lines, levels and locations indicated on the Plans. Fittings shall be provided with restraints as specified herein, as indicated on the Plans, or as required for a functional installation.

B. Where indicated on the Plans or as determined by ENGINEER, bends in water main piping and piping runs subject to impact reaction shall be secured by means of metal strapping. Install all necessary bands, tie rods, nuts, and washers required. No metal strapping shall be used in direct contact with polyvinyl chloride pipe.

C. Where lugged pipe and special fittings are indicated on the Plans, furnish and install all necessary tie rods, nuts, and washers.

3.08 Polyethylene Encasement

A. Where called for on the plans, ductile iron water main, fittings and hydrants shall be encased in a polyethylene film tube.

1. Service taps, bends, tees and other connections shall be made to polyethylene encased pipe in accordance with section 4.4.6 of AWWA C105.

B. Polyethylene film tube shall be installed in accordance with ANSI/AWWA C105/A21.5, Method A.

1. Method A consists of cutting the polyethylene tube two feet longer than the pipe to provide an overlap at the joints.

C. The cost of the polyethylene encasement shall be incidental to the water main.

3.09 Valves

A. Valves shall be installed to the grade, lines, levels and locations indicated on the Plans.

B. Valve connections shall be as specified for the piping materials used. Valves shall be set with the stem plumb on permanent, firm foundations as indicated on the Plans.

C. Where required, valves shall be supported with special supports as indicated on the Plans and as approved by ENGINEER. Valves shall be installed so as not to receive support from the connecting pipe. In no case shall valve installation be used to bring misaligned pipe into alignment.

3.10 Line Tapping

A. Traditional line tapping methods shall be used for the installation of all insertion valves to allow removal of a single coupon for system evaluation. Reaming the pipe, complete removal of a section of pipe (top and bottom) or milling a slot in the pipe shall be prohibited.

B. Insertion valves must be installed by companies trained and authorized by the approved valve manufacturer. This will ensure high quality installation and guarantee the warranty of the product.

C. Tapping shall be accomplished without interruption of service.

3.11 Water Main Structures

A. Construct water main valve wells and structures to the grades, lines and levels indicated on the Plans and as specified. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment rings, etc. as shown and as required for a complete installation.

B. Construction of water main structures shall conform to the type of construction and dimensions indicated on the Plans and as described below.

C. Block Structures:

1. Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar.

2. Mortar joints shall be full and close in courses. Courses shall be level throughout. Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable.

3. Joints shall be uniform in thickness throughout the structures. Strike joints and properly point to provide true, smooth surfaces.

D. Precast Concrete Structures:

1. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide 2 to 4 courses of 8-inch (200 mm) brick at top of structure for future adjustment.

E. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick or block gate wells and other water main structures indicated on the Plans. Plaster coat shall be 1/2 inch (10 mm) thick and shall be applied to the outer surfaces of the structures.

F. Provide and install to the elevations shown cast iron covers, frames, adjusting rings, anchors, etc., indicated on the Plans and as required. Castings shall be set in a full bed of cement mortar 1/2 inch (10 mm) thick minimum. Mortar joints shall be struck smooth.

G. Install steps for structures of types and in locations indicated on the Plans. Steps shall be installed on 16-inch (400 mm) centers minimum, unless shown otherwise on the plans.

H. Pipe placed in structures for inlet or outlet connections shall extend through the walls and beyond the outside wall surfaces a sufficient distance to allow for complete connections. Openings between pipes and walls shall be sealed with a full bed of cement mortar. Pipe shall be supported by concrete supports.

3.12 Valve Boxes

A. Install valve boxes to the grade, lines, levels and locations indicated on the Plans. Valve boxes shall not transmit shock or stress to the valve and shall be set plumb with covers centered over operating nuts and flush with the indicated surface elevations. Valve boxes that shift or fill during backfilling shall be uncovered and reset.

3.13 Hydrants

A. Hydrants shall be installed plumb to the lines, levels, grades and locations indicated on the Plans. Hydrants shall be set to the established grade, shall have their nozzles parallel to or at right angles to and facing the grade or curb.

B. Where necessary to adjust for proper hydrant location, CONTRACTOR shall install additional pipe between the water main and road box. Hydrant extensions shall be installed to adjust hydrant to proper grade.

C. CONTRACTOR shall plumb hydrants at the time they are set with a plumb line or other means acceptable to ENGINEER.

D. Upon substantial completion of cleanup, CONTRACTOR shall recheck hydrants for plumb and grade and shall make adjustments as necessary at this time.

E. The Work of constructing fire hydrants shall not be considered complete until these final adjustments for plumb and grade have been made.

3.14 Fire Hydrant Approaches

A. Where specified, fire hydrant approaches shall consist of culvert pipe with end protection and a gravel approach.

B. Culvert pipe shall be of the size and type shown on the Plans. Pipe shall be installed to the existing or proposed grade of the drain or ditch with pipe bedding and backfill from a point 4 inches (100 mm) below the pipe to a point 12 inches (300 mm) above the top of the pipe, consisting of bank run sand meeting the requirements of MDOT Class II granular material and compacted to 95% of maximum unit weight. Each end of the culvert pipe shall be protected against erosion, as shown on the Plans.

C. Gravel approach shall extend from the edge of the traveled portion of the road to the fire hydrant and shall be a minimum of 10 feet (3 m) wide. Approach shall consist of a minimum of 6 inches (150 mm) of compacted 22A or 23A aggregate, with calcium chloride applied at a rate of 6 pounds per Ton (3 kg per metric ton) of aggregate.

3.15 Air Release Assembly

A. Provide materials and construct air release assemblies where indicated on the Plans. Install valves, fittings, caps, plugs and piping as required. Fittings and joint materials used for air release assemblies shall be as specified herein for the water main piping materials used.

3.16 Blow-off Assembly

A. Provide materials and construct blow-off assemblies where indicated on the Plans.

B. Blow-off assemblies and pipe shall be installed to the lines, levels and elevations shown. Install valves, fittings, reducers, piping, plugs, joints, etc., as detailed.

C. Blow-off assemblies shall be installed on stable, undisturbed earth materials with changes in directions and returns provided with bedding and restraints as indicated on the Plans, as specified herein and as required for a complete installation.

D. Blow-off assemblies shall include valve boxes as detailed.

3.17 Anchors, Encasements, and Restraints

A. Plugs, tees, sleeves, bends, caps, straps and lug piping shall be provided with suitable anchors, encasements and restraints as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. Bearings shall be as shown.

B. Anchors, encasements and restraints shall rest on firm, stable, compacted subgrade and shall be provided for all standard and special fittings.

3.18 Water Service Lines

A. When so indicated in the Proposal, or on the Plans, CONTRACTOR shall provide water service lines in accordance with this Section. Otherwise, water service lines are not required.

B. Water service lines shall be installed after the water main has been successfully tested and put into service, including the installation of fire hydrants.

C. Service lines shall be of the type indicated on the Plans and shall be ¾-inch (20mm) diameter unless otherwise indicated on the Plans or Proposal.

D. Water service lines shall be provided for all lots or parcels at the locations indicated on the Plans, within these Contract Documents or as designated by ENGINEER. Service lines shall extend from the water main to within 1-foot (300 mm) of the limits of a right-of-way or easement at a minimum 5-foot (1.5 m) depth terminating with a curb stop and curb box as specified herein.

E. Water service lines under concrete or asphalt pavements shall be installed by boring or tunneling, unless otherwise indicated on the Plans or approved by ENGINEER.

F. Backfilling of open cut construction for water services shall be in accordance with Section 31 2333, Trenching and Backfilling, after the service line, including curb stop, has been laid and approved by ENGINEER. Prior to backfilling the service line CONTRACTOR shall request an inspection by ENGINEER and obtain approval of the service line.

G. Alternative methods such as hydraulic jacking; air jetting; piston mole; etc, may be used to install water service lines if approved by ENGINEER.

1. Proposed method must be approved by the governmental agency having jurisdiction over the work area and CONTRACTOR must demonstrate that, in the opinion of ENGINEER, the method is suitable for local soil and ground conditions.

2. To be found suitable for local conditions, the method must be demonstrated to perform within acceptable horizontal and vertical accuracy limits, must not compress soil beyond acceptable limits, and must not leave voids in the soil. Water jetting shall not be permitted.

3. Final installation of the service pipe must be in accordance with manufacturer's recommendations and no joints or fittings shall be allowed under roadway surfaces.

H. Existing water mains shall be kept in service until all water services have been connected to the new mains. CONTRACTOR shall repair all water services damaged during the installation of the new water mains. Only after the new mains have been accepted and put into service, will service connections be made to the new mains.

I. Reconnection of Water Services:

1. Connection of existing service lines to the new mains shall be made within the street rights-of-way or within the easements, utilizing the existing curb stops.

2. Existing lead water service lines shall be abandoned and new water service lines installed from the new water main to the existing curb stops.

J. Backfill, method of construction under pavements, and new water service lines shall be as specified in this Section.

3.19 Corporation Stops

A. Corporation stops shall be located on water main piping where indicated on the Plans, or as determined by ENGINEER.

B. Corporation stops on PVC water mains shall be made with service saddles.

C. Install a minimum of two (2) corporation stops in each valve well.

D. One-inch (25 mm) tapping outlets shall be installed at approximately 20-foot (6 m) intervals along the entire length of the concrete water main. Tapping outlets shall be constructed as detailed on the plans and shall be positioned 45 degrees off vertical. Location of the tapping outlets shall be marked by means of No. 4 (No. 13M) reinforcing rod. The rod shall be placed in a vertical position immediately adjacent to, but not touching, the water main and the top, 6 inches (150 mm) below finished grade.

3.20 Service Saddles

A. Where service saddles are to be installed, the entire circumference of the main shall be free of loose material. Installation of the saddle and tapping of the main shall be in accordance with manufacturer's recommendations.

3.21 Curb Stops

A. Install curb stops of the types and sizes indicated on the Plans. Curb stops shall include furnishing and installing a curb box.

3.22 Abandoning Water Main

A. Install cap with a minimum 2-inch (50 mm) diameter threaded opening at one end of water main to be abandoned and solid cap at opposite end.

B. Install a minimum 2-inch (50 mm) diameter stand pipe no farther than 1-foot (0.3 m) from the end with the solid cap in the top of the water main to be abandoned. The stand pipe should be installed such that it can be removed after use and the hole sealed.

C. Install a minimum 2-inch (50 mm) diameter drain pipe in threaded opening. Pipe shall be installed in the opposite end of the water main from the stand pipe. Pipe should bend up to a 90 degree angle with the end of the pipe being a minimum of 6 inches (150 mm) above the top of the water main.

D. Using the stand pipe, fill the water main to be abandoned with flowable fill material. Material shall be placed in the water main until free water flows from the drain pipe at the opposite end. Continue filling water main until the material released at the drain pipe is representative of the flowable fill being introduced at the fill end of the water main, at which time the drain pipe will be sealed with a threaded cap and the filling terminated.

E. Remove the stand pipe and cap the filling hole.

3.23 Relocate Water Main

A. Relocate water main shall consist of removing and relaying and existing water main to go under or over a proposed utility. Existing pipe shall be removed and disposed of. Bends and vertical anchors shall be installed as shown on the plans. Verticals anchors and thrust blocks shall be sufficient to resist thrust forces.

3.24 Abandon Existing Gate Valve and Well

A. Gate valve and well, and other water main structures on the existing water main, shall be abandoned and the structures shall be abandoned in accordance with the following:

1. Abandonment of existing structures shall consist of removing and salvaging the existing frame and cover.

2. The valve shall be opened.

3. Masonry shall be broken down to an elevation at least 3-feet (1 m) below the subgrade.

4. Abandoned structure shall be backfilled with flowable fill to 1-foot (300 mm) above the pipes and the remainder of the structure with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1-foot (300 mm) below finished grade.

3.25 Remove Gate Valve and Well

A. Gate valve and well, and other water main structures on the existing water main, shall be removed in accordance with the following:

1. Removal of existing structures shall consist of removing and salvaging the existing frame and cover, and valve.

2. Ends of the existing water main shall be plugged and braced.

3. Complete structure shall be removed entirely and disposed of.

4. Excavation shall be backfilled with sand and compacted to 95 percent of its maximum unit weight.

3.26 Remove Existing Fire Hydrants

A. Fire hydrants on the existing water main shall be removed by excavating and removing the existing fire hydrant, gate valve, and valve box.

1. Existing hydrant lead shall be capped and blocked.

2. Fire hydrant, valve, and box shall be salvaged and delivered to a location as designated by OWNER.

3. Excavation shall be backfilled with sand and compacted to 95 percent of its maximum unit weight.

3.27 Relocation of Fire Hydrants

A. Relocation of hydrants shall include the provision of new hydrant shoes, frost jacket and restraints.

B. Provide new materials required for hydrant relocation.

C. Reinstall hydrants at the new locations to the lines and levels shown.

D. Make joint connections to new or existing water mains, joints, couplings, etc., as shown and as required.

E. Provide anchorage and restraint for a complete installation.

3.28 Hydrostatic Testing

A. General:

1. After the pipe has been laid and backfilled, the pipe shall be hydrostatically tested for leakage. CONTRACTOR shall furnish the pump, pipe connection, hydrants, valves and any other necessary apparatus including gages and meters and all personnel necessary for conducting the test. Before applying the test pressure, all air shall be expelled from the pipe. If necessary to accomplish this, taps shall be made at points of higher elevation and afterwards plugged.

2. Test sections shall not exceed 1 mile (1.6 km) and in the event more than 1 mile (1.6 km) of water main is tested, the permissible leakage will remain at the amount determined for 1 mile (1.6 km) of pipe.

3. Hydrostatic testing shall conform to AWWA C600.

B. Testing Ductile Iron Water Main:

1. The test shall be made at a pressure of 150 pounds per square inch (1 MPa) gage minimum. Full pressure shall be held for at least 2 hours.

2. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by CONTRACTOR with sound material and the test shall be repeated until specified requirements are met.

3. Maximum permissible leakage measured by water meter from the section of main tested under pressure, shall not exceed a rate of 10 U.S. gallons, per inch diameter of main, per mile of pipe, in 24 hours for each section tested.

   a. No pipe installation will be accepted if the leakage is greater than the allowable leakage calculated in accordance with the following formula:

$$L = \frac{S * D * (P)^{½}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

C. Testing PVC Water Main:

1. The test shall be made at a pressure of 150 pounds per square inch (1 MPa) gage minimum. Full pressure shall be held for at least two (2) hours.

2. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by CONTRACTOR with sound material and the test shall be repeated until specified requirements are met.

3. The maximum permissible leakage measured by water meter from the section of main tested under pressure, shall not exceed a rate of 10 U.S. gallons, per inch diameter of main, per mile of pipe, in 24 hours for each section tested.

   a. No pipe installation will be accepted if the leakage is greater than the allowable leakage calculated in accordance with the following formula:

$$L = \frac{S * D * (P)^{½}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

3.29 Flushing

A. After completion of water main installation, flush the new mains, valves, hydrants and appurtenances completely and as acceptable to ENGINEER.

B. Heavily chlorinated water discharged from a disinfected system shall be controlled adequately to protect any surface water resource or adjacent property from potential environmental damage, or from creation of a hazard to traffic.

C. Remove and dispose of all temporary installations at completion of the flushing operation.

D. After flushing, and prior to final approval of the system, CONTRACTOR shall pump down all fire hydrants and verify that the hydrant valve is properly seated to prevent the hydrant standpipe from filling with water.

3.30 Disinfection

A. General:

1. Potable water pipelines, except those appurtenant to hydraulic structures, shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein.

B. Chlorination:

1. The liquid mixture shall be applied by means of a solution-feed chlorinating device.

2. CONTRACTOR shall install corporation stop and feed chlorine solution through the corporation stop at the beginning of the main or valved section.

3. A slow flow of water shall be let into the main approximately at the point of injection of the chlorine solution, at a rate such that the chlorine dosage of the entering water shall be at least 50 mg/l; free chlorine concentration at initial chlorination shall be a minimum of 25 mg/l.

4. An open discharge shall be maintained at the far end of the section of main being chlorinated, and the introduction of chlorine solution and water shall continue until the water discharging at the far end shall carry the required dosage of chlorine.

5. As the main is filled with chlorinated water, each outlet from the main shall be opened and sufficient water drawn off to assure that the full dosage of chlorine reaches each outlet.

6. Back pressure causing a reversal of flow in the main being chlorinated shall be prevented, and pressure in the main shall be held down to a point which will make it impossible for chlorinated water to be forced into other sections of the main or water system.

7. If the chlorine residual shall be less than 10 mg/l at the end of 24 hours, further application of chlorine shall be made, and the retention period repeated until the required 10 mg/l residual is obtained.

C. Repetition of Test:

1. The disinfection testing procedure shall be repeated if the initial tests fail to produce satisfactory results.

2. Two consecutive satisfactory test results shall be required after any unsatisfactory test.

3. The tablet method shall not be used for repeated disinfection.

3.31 Water for Cleaning, Testing and Disinfection

A. Water for cleaning, testing and disinfection shall be obtained from a potable water supply. CONTRACTOR shall provide all water required at his own expense and shall make all necessary arrangements with the authority which controls the source of water system and shall be governed in his use of water by all rules and regulations imposed thereon by said authority.

B. CONTRACTOR shall provide and remove temporary connections between the source water system and the mains constructed under this contract. All temporary connections shall meet the approval of the ENGINEER, the authority controlling the source water system, and Public Health authorities having jurisdiction.

C. CONTRACTOR shall be responsible for the safe disposal of chlorinated water flushed from water mains following disinfection procedures. CONTRACTOR shall be responsible for disposing of disinfecting solution in a manner in accordance one of the following approved manners:

1. Discharge chlorinated water directly into a nearby sanitary sewer provided that the water will receive subsequent treatment and disposal by a properly permitted wastewater treatment plant.

2. Dechlorination may be required by the wastewater treatment plant prior to receiving the discharge water.

    a. CONTRACTOR must obtain written permission from the wastewater treatment plant prior to discharge and shall verify whether or not dechlorination is necessary prior to disposal.

    b. CONTRACTOR shall submit a copy of the written authorization from the wastewater treatment plant to ENGINEER and the OWNER prior to disposal.

3. Discharge chlorinated water to a surface water body, either directly or indirectly (i.e., through a storm sewer).

    a. Prior to discharging, CONTRACTOR shall obtain a National Pollutant Discharge Elimination System (NPDES) general discharge permit, and shall comply with the associated monitoring and reporting requirements of the issuing agency, including dechlorination.

    b. CONTRACTOR shall submit a copy of the NPDES permit to the ENGINEER and the OWNER prior to disposal.

4. Discharge chlorinated water to the ground under Act 451 of the Part 31 Rules.

    a. Prior to discharging, CONTRACTOR shall dechlorinate the water to below 4 milligrams per liter (mg/L).

    b. Following dechlorination, CONTRACTOR shall discharge to an area large enough, and with suitable soils, to prevent site runoff.

5. CONTRACTOR must obtain written permission from the landowner where the discharge is to take place and written verification that dechlorination is or is not necessary prior to disposal and that a value of less than 4 mg/L of chlorine is present within the water.

    a. CONTRACTOR shall submit a written copy both the ENGINEER and the OWNER prior to disposal.

3.32 Bacteriological Analysis

A. General:

1. Prior to placing a water main in service, not less than two (2) consecutive water samples taken 24 hours apart for bacteriological analysis shall be collected and each analysis shall show results meeting state and local drinking water standards.

2. Samples will be taken at locations indicated in ANSI/AWWA C651 and will be tested for coliform organisms and heterotrophic plate count according to the latest edition of the *Standard Methods for the Examination of Water and Wastewater*.

3. CONTRACTOR shall collect water samples and cause analyses to be made at his own expense. Samples shall be collected in accordance with AWWA C651. Testing laboratory and sample collection shall meet the approval of public agency having jurisdiction.

4. If disinfection fails to produce satisfactory bacteriological counts, the pipe shall be reflushed and will be resampled and retested.

    a. If counts from analysis of the second samples exceed the criteria in Standard methods, the pipe shall be re-disinfected and will be resampled and retested until satisfactory results are obtained.

    b. CONTRACTOR shall be responsible for all repeat bacteriological testing costs.

B. Sampling:

1. Per AWWA Standards, no sampling stations shall be at a distance greater than 1,200 feet.

2. Mains shall be flushed at an adequate velocity prior to sampling to remove any debris remaining in the pipe.

3. Sampling must be accomplished by a certified treatment/distribution operator or an employee of a certified laboratory. This certification will be evidenced in the approved plan.

4. At OWNER's discretion, source water will be sampled or the nearest water quality sample station's most recent results will be used to determine the baseline water quality.

5. Samples must be collected from extreme ends, all branches of the new main and at a minimum 300-foot interval. The sample points will also be part of the approved plan.

6. The temperature and total chlorine residual will be measured with a field test kit and recorded by the sampler on the "chain of custody" form.

7. After another 24-hour period, a second set of samples will be collected from the same sample points.

8. Both sets will be analyzed for total and fecal coliform presence/absence and heterotrophic plate count.

9. OWNER reserves the right to sample for bacteria at its own discretion with notice.

C. Laboratory Report:

1. General:

a. Lab results will be reported on a chain of custody, lab work sheet, or summary letter imprinted with the laboratory's name, address, and phone number.

(1) The report will include the field tests and laboratory analysis.
(2) The report will be signed by the laboratory director.

b. It will be OWNER's right and responsibility to reject the report if any data is missing or suspect due to conflicting indications.

3.33 Cleaning (Pigging)

A. When required in the plans or specifications, water main shall be mechanically cleaned. Cleaning shall be with a metal bodied, mandrel type solid plug (pig) with scrapers. The pig shall be pulled or otherwise propelled through the entire line prior to testing or connecting to any existing water main.

End of Section

Division 40
Process Integration

Section 40 0513
Process Piping and Valves

Part 1 General

1.01 Scope of Work

A. This Section includes process piping systems complete with pipe, fittings, valves, connections, and accessories such as hangers, supports and operators as indicated on the Plans or as required for a complete and functioning installation inside buildings and vaults. Refer to Sections 33 0523.16 and 33 1100 for buried piping.

1.02 Related Work Specified Elsewhere

A. Section 01 7700: Closeout Procedures
B. Section 03 3000: Cast-in-Place Concrete
C. Section 09 9600: Industrial Paintings and Coatings
D. Section 23 0500: Common Work Results for Mechanical
E. Section 26 0500: Common Work Results for Electrical
F. Section 26 0510: Basic Materials and Methods
G. Section 31 2333: Trenching, Backfilling
H. Section 40 9000: Process Instrumentation, Controls and Monitoring Equipment

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute
2. ASME - American Society of Mechanical Engineers
3. ASTM - American Society for Testing and Materials
4. AWS - American Welding Society
5. AWWA - American Water Works Association
6. NCPWB - National Certified Pipe Welding Bureau
7. NEMA - National Electrical Manufacturers' Association
8. UL - Underwriters Laboratories

1.04 Quality Assurance

A. Manufacturer's Qualifications:

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five years documented experience.

2. Insofar as possible all valves of the same specific type shall be the product of one manufacturer.

B. Manufacturer's Certifications:

1. Submit manufacturer's certificates: Certify that valves furnished meet or exceed the specified requirements.

C. Welder Qualifications:

1. Welders and/or welding processes shall be qualified by the NCPWB or similar ASME Boiler and Pressure Vessel Code.

D. Other:

1. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, and acid solder are NOT PERMITTED.

2. Provide certificate of independent testing laboratory that piping meets the test requirements.

1.05 Submittals

A. Shop Drawings and Product Data:

1. Shop Drawings:

a. Submit shop drawings as required in Sections 01 3300, Submittal Procedures and 40 0500, Process Equipment General Requirements, showing the layout of the piping systems complete with piping, supports, and structural dimensions.

b. Shop drawings shall identify all joints, valves, fittings, component parts, pipe material, insulation where required, and valve identification codes. Supports and anchors shall be shown in the layout and detailed.

c. CONTRACTOR shall verify in the field, the location, position, and size of all existing piping (including buried pipes), as indicated on the Contract Drawings and Specification to be reused, forming a part of the new process piping layout.

d. Process piping Shop Drawings submitted to the ENGINEER for review shall clearly indicate the location, position (elevation), and size of all existing piping to be reused.

B. Product Data:

1. Submit product data as required in Section 01 3300, Submittal Procedures. Include manufacturer's recommendations for installation, connection to automatic operators, and instructions for proper operation and maintenance. Valve operator data shall also include information necessary for any external controls, wiring or hydraulics to be furnished, installed or connected by other Work.

C. Welders Certification:

1. Submit certification of welders and/or welding process for fabrication and/or field assembly.

D. Operation and Maintenance Data:

1. Submit operation and maintenance data as required in Sections 01 3300 Submittal Procedures, and 40 0500, Mechanical General Requirements.

E. Record Drawings:

1. Submit record drawings as required in Section 40 0500, Process Equipment General Requirements

1.06 Delivery, Storage, and Handling

A. Handling:

1. Pipe and special castings shall be handled in such a manner as to avoid any damage to pipe or specials.

a. In the event pipe coating is damaged, especially on the inside of the pipe, the damaged area shall be cleaned by wire brushing and then recoated with an approved coating similar to that specified for the pipe.

B. Storage:

1. Store materials in enclosures or under protective coverings. Keep inside of pipe fittings and valves free of dirt and debris. Store in a manner for easy identification of all materials.

1.07 System Description

A. General:

1. Drawings show general arrangement, direction, and sizes of pipes. Drawings are not intended to show every offset and fitting or every structural difficulty that may be encountered. Install the piping and appurtenances to suit, and to avoid interference with installation, operation, and maintenance of fixtures, equipment, or other piping. Verify all measurements at job site.

2. Provide piping with necessary hangers, anchors, and supports as specified herein and as indicated. Piping supported by equipment to which it is connected is not acceptable.

Part 2 Products

2.01 Pipe System

A. General:

1. Pipe systems shall conform to the materials or component performance as specified herein and the pipe schedule as shown on the drawings.

B. Ductile Iron Pipe Systems:

1. Pipe:

a. AWWA C151 with AWWA C104 cement mortar lined, minimum Pressure Class 300. Provide primer coat for above ground inside facilities pipe in accordance with AWWA C115.

b. Pipe sizes indicated in the Contract Drawings are inside diameter (I.D.).

c. Pipe with grooved end joints to be per AWWA C606.

d. Shouldered joints per AWWA C606 Type D.

e. Restrained joints shall be used in accordance with Section 33 0509.33, Thrust Restraints.

f. Fittings shall be either cast iron or ductile iron, full body per AWWA/ANSI C110 or compact per AWWA C153, with the type of joint(s) shown on the Contract Drawings.

g. Tap any required openings on top of the piping after pipe installation (Example: high points for air release valves).

h. Flanged Piping:

(1) Flanges, Gaskets, Bolts, and Nuts: AWWA C115.
(2) Bolts and Nuts: ASTM A307, Grade B.
(3) Gaskets: Full face.
(4) Flanges: Ductile iron plain-faced.

i. Mechanical and Push-On Joint Piping: Conform to AWWA C111.

(1) Bolts and nuts low carbon steel.

C. Polyvinyl Chloride Pipe (PVC) Systems:

1. Polyvinyl Chloride Pipe (PVC) and fittings shall be in accordance with ASTM D-1784, D-1785, D-2464, and D-2467, Schedule 80 as indicated in the pipe schedules with socket welded or flanged joints. Provide unions or flanges at all valves and equipment. All pipe connections shall be made in conformance with the manufacturer's recommendations including supply of gaskets, where necessary.

2. Polyvinyl Chloride pipe and fittings shall be "Chamorro" as manufactured by Celanese Piping Systems, Plastiline, Inc., R & G Sloane; or equal.

D. Copper Water Tubing:

1. Pipe: Conform to ASTM B88. Type L.

2. Connections: ½-inch and larger shall be copper sweat; 3/8-inch and smaller shall be compression.

3. Soldered Fittings: Wrought copper or cast bronze, Conform to ASA B16.22.

4. Compression Fittings: Brass

2.02 Sleeves and Wall Fittings

A. Wall Castings:

1. Wall castings for metal pipe through exterior walls below grade or for walls with liquid on one or both sides: Grey or ductile iron with intermediate waterstops.

2. Provide castings with mechanical joints, flanged, flare, restrained or other ends as indicated on the Contract Drawings. Mega-lugs shall be used with mechanical joints.

3. Where type of end is not shown, provide restrained joints.

4. Wall Fittings for Non-Metallic Pipelines: As shown on the Contract Drawings.

B. Wall Sleeves and Seals:

1. Wall Sleeves: Ductile iron or 1/4-inch-thick nickel-copper steel alloy pipe.

   a. Extend sleeves from face to face of wall.

   b. Provide intermediate waterstops where installed in "wet" or exterior walls.

2. Seals for Pipe Sleeves: Bolt-up type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the sleeves.

   a. Rubber Links: Suitable for the pipe size and type indicated on the Contract Drawings. When bolts are tightened the rubber sealing elements shall expand to results in a watertight seal.

   b. Bolts and Pressure Plate Nuts: ASTM A193, Class 1 Type 316 stainless steel in below grade or "wet" locations, and of carbon steel at other installations.

   c. Rubber Links: Suitable for use in water, moist environments, normal atmospheric conditions, and minus 40 to plus 250 degrees F temperatures for standard service.

3. Sleeves through Interior Partitions: 14 gage, unpainted galvanized steel.

4. Sleeves for Pipe Passing through Floor Slabs: Plain end ductile iron or 1/4-inch-thick nickel-copper steel alloy pipe anchored to the concrete.

   a. Size sleeves, with smooth and level ends to accommodate the pipelines and extend 3-inches above the finished floor.

5. Prime coat sleeves in accordance with Section 09 9600 before installation.

2.03 Link-Type Seals

A. Link-type seals shall be interlocking expandable type of molded synthetic rubber segments with 304 stainless steel bolts and nuts and pressure plate.

B. Seals shall be as manufactured by Link-Seal or ENGINEER-approved equal.

2.04 Sleeve-Type Couplings

A. Pressure rating at least equal to that of related pipeline.

B. Manufactured by Dresser Mfg. Div., Bradford, PA – Style 38; Smith Blair, Inc., Texarkana, TX – Style 411; R.H. Baker & Co., Inc., Los Angeles, CA – Series 200; or ENGINEER-approved equal.

C. Bolts and Nuts: Galvanized steel. Gaskets: Composition suitable for the pressure, fluid and temperature in the pipeline.

D. Sleeve Type Couplings: AWWA C219; designed for the same size, pressure, class and temperature as the pipeline in which it will be installed, with minimum ½-inch diameter tie rods, 1/2-inch bridles and pipe clamps or sized as required by the manufacturer; number of tie-rods to be as required by manufacturer.

2.05 Flange Adapters

A. Cast iron adapters for transitioning from plain end ductile iron to flanged fittings, 125 lb bolt pattern. (ANSI B16.1). Flange adapters shall have ductile iron set screws to securely grip the pipe end. Flange adapters shall be as manufactured by EBAA Iron, inc. or ENGINEER approved equal.

2.06 Valves

A. General:

1. Valves, operation, accessories, and specific notes are specified on the drawings. Valve materials and workmanship shall conform to applicable ANSI, ASTM, and AWWA standards.

2. Valves shall be suitable for installation in the position in which they are installed in the pipeline.

3. Valve bodies shall have an arrow to indicate direction of turning to open.

4. Marking and Identification of Valves: Conform to the standard specifications referred to, or to the manufacturer's standard.

5. End Connections of Valves: As shown, but in general valves 3-inches and smaller shall be threaded. Valves larger than 3-inch shall be flanged (plain faced), unless otherwise specified.

6. Valves for Non-Metallic Pipelines: Same material as the pipeline in which installed, or lined with, or fabricated from a material satisfactory for the service intended.

7. Prime coat exterior surfaces of metal valves installed where visible in accordance with Section 09 9600.

B. Gate Valves:

1. Valves shall be resilient wedge, non-rising stem type and conform to AWWA C509.

2. Valves shall be furnished with the type of connection indicated on the Contract Drawings, or flanged ends for non-buried valves and mechanical joint ends for buried valves.

3. Bonnet Bolts, Studs, and Nuts shall be manufactured from Series 300 stainless steel.

4. Body, bonnet and gate shall be manufactured from gray or ductile iron.

5. Stem seals shall be o-rings.

6. Valve shall close counterclockwise, unless otherwise indicated.

7. Where specified, gate valve shall be furnished with an electric motor operator as specified in Section 40 0557, Actuators for Process Valves and Gates.

8. Acceptable manufacturers include:

   a. American Flow Control
   b. Waterous
   c. Kennedy
   d. U.S. Pipe and Foundry
   e. M&H

C. Swing Check Valve:

1. Swing check valves 3-inches and smaller shall have a bronze body and cap. Seats shall be integral with the valve body and shall provide leakproof closing with the disc. The disc shall be bronze with composition face and bronze hinge. Valves shall be rated for a working pressure of 125 psi, unless as otherwise indicated in the valve schedule.

2. Swing check valves 6-inches and larger regardless of system operating pressure shall be air cushioned side mount lever and weight check valves. Materials of construction shall be as follows:

   a. Valve body, cover and disc shall be cast iron per ASTM A126, Grade B.
   b. Disc arm shall be ductile iron per ASTM A536.
   c. Seat shall be aluminum bronze per ASTM 8148 or stainless steel per ASTM A276.
   d. Disc seat shall be Buna-N.
   e. Cylinder shall be of corrosion resistant material.

3. Swing check valve body shall be cast iron per AWW C508 having integral ANSI 125 lb flanges. The seat shall be centrifugally cast with an o-ring seal, locked in place with stainless steel lock-screws and be field replaceable.

4. The shaft shall be single and continuous stainless steel extending one side of the body with a lever and weight, using an air cushion cylinder side mounted. The totally enclosed external air cushion cylinder shall be adjustable with a flow control valve.

5. Valves shall be manufactured by APCO (Valve and Primer Co.), Val Matic, Christman, M&H or ENGINEER-approved equal.

D. Butterfly Valves:

1. Butterfly valves shall be Class 150, rubber-seated tight closing and shall conform to AWWA Standard C504 latest revision.

2. Valve bodies shall be cast iron ASTM A126 Class B. They shall have integral hubs for housing shaft bearings and seals. Body ends shall be flanged with facing and drilling in accordance with ANSI B16.1, Class 125.

3. Valves shall be of the flangeless wafer body style. All valves shall be suitable for use with ANSI 150-pound flanges. Bodies shall be cast iron. Valves shall be rated at 175 psi. Bodies of all flangeless wafer valves shall have bolt guides to center the body in the pipeline.

4. Valves shall be furnished with self-lubricated bearings of TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

5. Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets. Seats shall be of Buna-N or EPDM suitable for use with potable water. Shafts shall be one piece and shall be 316 stainless steel. Shaft diameter shall be suitable for the service conditions specified.

6. Shafts shall be finish ground to minimize bearing and shaft seal wear. Shafts of 12-inch and larger shall have a non-adjustable thrust collar. Shaft seals shall have a stuffing box and pull-down packing gland. Packing shall be furnished with self-adjusting "V" type packing.

7. Discs shall be aluminum bronze. The disc-to-shaft connections shall be Type 316 stainless steel.

8. Pins, shaft, and disc of all valves shall be individually machined and completely interchangeable.

9. Valves shall be furnished with worm gear or travelling nut actuators with operating nut operator.

10. Valves shall be available with field interchangeable manual or powered actuators as required. Actuator-to-shaft connection shall be designed to shear and prevent internal valve damage if the disc closes on foreign material in the pipeline.

11. Factory Testing: Test shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.

12. Butterfly valves shall be marked with the valve size, manufacturer's mark, year of manufacture, and class.

13. Acceptable manufacturers including DeZurik, M&H, Clow or ENGINEER-approved equal.

E. Pressure Sustaining Valves:

1. General:

a. Valve manufacture to confirm supplied valve will meet head and flow requirements without cavitation. Provide cavitation trim as necessary.

b. Valve shall be hydraulically operated electronic control valve. Electronic controls will consist of pressure transmitter on the inlet side of the valve; solenoid valves as required for positioning of the valve; and position transmitters as required by the instrumentation and control system.

c. Valve shall be a solenoid operated diaphragm valve designed to permit flow when upstream pressure is above the adjustable setpoint, and throttle toward closed when upstream pressure falls below the adjustable setpoint. Control shall be by intermittent operation of the solenoids via a remote signal by others or from the control panel provided by the valve manufacturer.

d. Main valve shall be a hydraulically operated, single diaphragm actuated, globe valve. Y-pattern and angle pattern valves shall not be permitted.

2. Construction:

a. Valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. Siaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. There shall be no pistons operating the main valve or pilot controls.

b. Main valve body and cover shall be cast ductile iron ASTM A536, and all internal cast components shall be ductile iron or 316 Stainless Steel. Ductile iron components, including the body and cover, shall be lined and coated with an NSF 61 Certified Epoxy Coating applied by the electrostatic heat fusion process. Valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No o-ring type discs (circular, square, or quad type) shall be permitted as the seating surface.

c. Disc retainer shall be of a sturdy one-piece design, capable of withstanding opening and closing shocks, with straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc

retainers shall be permitted. Exposed portion of the rubber disc shall contact the valve seat and shall seal drip-tight. Disc and diaphragm assembly must be guided by two separate bearings, one installed in the valve cover and one concentrically located within the valve seat, to avoid deflection and assure positive disc-to-seat contact. Seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. Center guided valves shall not be permitted.

d. Diaphragm shall be constructed of nylon fabric bonded with synthetic rubber compatible with the operating fluid, shall not seal directly against the valve seat and shall be fully supported by the valve body and cover. Rolling diaphragm construction shall not be allowed and there shall be no pistons operating the main valve or any pilot controls.

e. Diaphragm assembly shall contain a non-magnetic 303 stainless steel stem of sufficient diameter to withstand high hydraulic pressures. No center guides shall be permitted. The stem shall be extended through the cover to provide visual indication of the valve position and a place to affix the position switches required and such accessories as may be deemed necessary.

f. Diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and covered by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position

g. Main valve throttling components (valve seat and disc guide) shall be Stainless Steel. Valve body and cover must be machined with a 360-degree locating lip to assure proper alignment. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat shall be retained by flat head machine screws for ease of maintenance. Lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. Repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted. Disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. No V-type or slotted type disc guides shall be used.

h. The pilot system shall consist of two solenoid valves, one to open the pressure sustaining valve by reducing the cover pressure and the other to close it by increasing the cover pressure. Solenoid valves shall be direct-acting, 2-way valves.

(1) On being called to open the pressure sustaining valve, the system shall energize the relevant solenoid valve which relieves valve cover pressure to the outlet side of the pressure sustaining valve. Once the pressure is correct, the controller shall de-energize the solenoid valve.

(2) On being called to close the pressure sustaining valve, the system shall energize the relevant solenoid valve which increases valve cover pressure. Once the pressure is correct, the controller shall de-energize the solenoid valve.

3. Controls:

a. NEMA 4X control panel shall be provided with 120 VAC, 60 Hz and be designed for outside installation. A programmable solid-state controller shall be able to function with an external temperature range of -40 to 185 degrees Fahrenheit. Controller shall be able to receive a 4-20 mA signal from the local pressure transmitter or from the water treatment plant SCADA system, and compare it to a local manual set-control point or a 4-20 mA set-control point from SCADA. If the pressure is below the set point the control panel shall close the valve. If the pressure exceeds the set point the control shall allow the valve to open and control the position of the valve so the pressure does not fall below the set point. Valve shall automatically adjust to and maintain the fully closed position and resume automatic operation in response to external inputs.

b. Control shall be able to retransmit up to 3 input 4-20 mA signals. Control system shall be designed to close valve on loss of power."Valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of three years from date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty. Valve manufacture shall provide any field service required to ensure valve and control system functions as required.

c. Valve manufacturer shall provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.

4. Acceptable Manufacturers: Singer Valve

5. Valve Schedule:

a.	Diameter (inches):	20
b.	Flow Range (gpm):	35 - 9,030
c.	Maximum Upstream Pressure (psi):	60
d.	Minimum Downstream Pressure (psi):	40

2.07 Valve Lever/Handwheel Operators

A. On valves 6-inches and smaller, latch lock levers shall provide automatic, positive latching in the open, closed, or eight intermediate positions. These valves shall allow locking in any position with a standard padlock. Infinite position levers shall allow manual throttling and locking in any position from open to close.

B. Manually actuated valves 8-inches and larger shall be operated using a cast iron housed handwheel actuator with crank or optional chainwheel, unless specified otherwise. Units to have adjustable open and closed position stops with provision to prevent accidental adjustment changes. Operating shaft shall be supported axially and radically at input end by permanently lubricated bronze thrust and sleeve bearings.

2.08 Corporation Stops and Valves

A. Corporation stops shall be brass per ASTM B62 and provided with outlets suitable for copper connections. Corporation stops shall be of ground key design and meet all requirements of AWWA C800. Inlet threads to be tapered. Corporation stops shall be suitable for direct tap with the pipe.

B. Corporation valves shall be balanced pressure plug type valve with a full open unobstructed flow way and o-ring seal. Valve bodies shall be one-piece, bronze body per ASTM B62, with integral wrench flats. Inlet and outlet threads for corporation valves shall be the same material specified for the corporation stops.

2.09 Valve Identification

A. Shut-off and Control Valves: 1-1/2-inch minimum diameter brass tag.

B. Indicate valve number and identify service line by letter and number symbols. The letters and numbers:

1. Black type with 1/2-inch-high numbers and 1/4-inch-high letters stamped on the tags and filled with black enamel.

C. Attach tags by split-key ring soldered, closed so that ring and tag cannot be removed.

2.10 Magnetic Flow Meters

A. Refer to Section 26 9100.

2.11 Venturi Flow Meters

A. Refer to Section 40 7123.13.

2.12 Water Meter

A. General:

1. Meter shall meter meet or exceed the most recent revision of AWWA Standard C701 class II standards. Each meter shall be performance tested to ensure compliance and shall be NSF/ ANSI Standard 61, Annex F and G approved.

B. Performance:

1. Meter shall have no restrictions within its specified continuous operating range and shall utilize floating ball measurement technology to allow for flows up to its rated maximum capacity without affecting undue wear or accuracy degradation when installed.

C. Construction:

1. Measuring chamber assembly shall include a "floating ball" impeller with a coated titanium shaft, hybrid axial bearings, integral flow straightener and an electronic programmable register with protective bonnet.

2. Main case shall be made from ductile iron with an approved NSF epoxy coating. Main case shall also have a removable measuring chamber, chamber seal to the main case using a high-pressure o-ring, testing port and an integral strainer.

3. Meter registration shall be achieved by utilizing a fully magnetic pickup system.

4. Impeller shall be constructed of thermoplastic and hydro dynamically balanced between the bearings.

5. Meter shall be equipped with a "V" shaped integral strainer using a stainless steel. Strainer shall have a removable strainer cover to permit access to the screen for routine maintenance.

D. Acceptable Manufacturer:

1. Water meter shall be a Model OMNI T^2 manufactured by Sensus, Raleigh, NC 27615 or ENGINEER-approved equal.

E. Meter Schedule:

1. GCDC-WWS Meter Vault:

a.	Inlet Diameter (inches):	6
b.	Overall Length Allowed (inches):	27
c.	Average Flow Range (gallons per minute):	35

2.13 Fabrication

A. Fabricated sections of pipe systems shall have provisions for possible field adjustments to avoid interferences and/or to compensate for final installation of equipment or connecting lines.

2.14 Hose Bibbs

A. Hose bibbs shall be 125-pound, bronze body with garden hose thread and vacuum breaker.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall field measure all dimensions and check possible interferences for the pipe system and accessories.

3.02 Preparation

A. Pipe fittings and accessories shall be free of all foreign matter. Accumulations of dirt, rust, scale, etc., shall be removed prior to installation. Pipe ends shall be reamed and deburred to prevent loose particles from getting into the pipe.

3.03 Installation

A. General:

1. Pipe systems shall be installed to line and grade indicated on the Plans. Valves shall be located as indicated on the Plans.

2. Piping connections to equipment shall be aligned and supported in such manner that no load or thrust will be exerted upon the equipment by the piping at installation or in operating conditions.

3. Cutting of the pipe shall be done in a neat workmanlike manner with the least amount of waste and without damage to existing or new lines. A fine tooth saw, tubing, or pipe cutter, or similar tool shall be used to cut the pipe. Cuts must be square and ragged edges removed with a burring tool and/or file.

4. After cutting bell and spigot or socket pipe a stop mark shall be made with a pencil or crayon using dimensions as shown by the manufacturer's instructions or by using another pipe in the field as a guideline.

5. Install piping through walls and floors in pipe sleeves or connect to wall castings accurately located before concrete is poured or when masonry walls are constructed. Where pipe must pass through existing floors, install sleeves.

6. Where 6-inch outside diameter or smaller pipes pass through floors, walls, or ceilings with finished surfaces, they shall be fitted with chromium plated steel plates held in place on the pipe by springs. Floor plates shall completely cover the sleeve extension.

7. Cutting of concrete walls, floors or ceilings shall be avoided and requires written approval from the ENGINEER. If approved, holes shall be core drilled and patched. Reinforcement steel shall not be cut or disturbed.

8. At the termination of pipe installation any open ends of pipelines shall be closed off by a suitable cover until installation operations are resumed.

9. Provide plugged wyes, tees, or crosses with threaded joints at all changes in direction to facilitate cleaning of chemical lines.

10. PIPE-RUNS DIRECTLY OVER OR IN FRONT OF ELECTRICAL SWITCHBOARDS, POWER PANELS, OR SIMILAR EQUIPMENT ARE NOT ALLOWED.

B. Pipe Supports:

1. Pipe supports, pedestals, base elbows and tees and pipe hangers shall be provided and installed as required by ENGINEER in accordance with the following:

Pipe Size (inches)	Maximum Distance Between Supports (feet)	Minimum Diameter of Hanger Rod (inches)
1/2 thru 2	6	3/8
2-1/4 thru 4	8	3/8
4-1/4 thru 12	8	7/8
14 thru 30	8	1

2. Polyvinyl chloride pipe, fiber glass reinforced pipe, rubber hose, tubing, etc., shall be supported along the entire length by means of a steel channel or angle iron or approved tray anchored to the floor, wall, or ceiling with supports per above. Where shown, chemical feed lines are installed in containment piping.

3. Piping 8-inch and larger located close to the floor shall be supported in concrete saddles. Welding to structural steel members shall not be permitted without written approval of ENGINEER.

4. Valves shall be supported to keep undue strain off of piping and adjacent equipment.

5. Equipment requiring periodic maintenance shall be supported to allow easy removal with a minimum of temporary supporting.

6. Hanger rods shall be connected to beam clamps or concrete inserts. Clamps or inserts shall be Underwriters' Laboratories approved. "C" clamps will not be permitted. Expansion anchors may be used upon written approval by ENGINEER. Holes for expansion anchors shall be made by rotary drilling only, hammering devices will not be permitted. Explosive studs may be used provided they are driven under safe conditions.

7. Anchors, guides and sway braces shall be provided to allow for forces on the piping system. Sleeves shall be provided on all pipe subject to movement. Sleeves shall be no less than four inches wide or have a width equal to 1/3 the diameter of the pipe, whichever is larger.

8. Vertical piping shall be supported at each floor or grating level with approved riser clamps except where prohibited by piping flexibility requirements. Lateral movement of exposed vertical piping at building walls shall be restrained by anchor devices attached to walls except where prohibited by piping flexibility requirements. Provide retaining straps when clamps are used.

C. Pipe Connections:

1. Joint connections shall be as indicated on the Plans and specified herein. Excluding connections for valves, fittings, equipment, etc., joints in the pipe line shall be minimal yet provide easy access as required for maintenance.

2. A joint compound of oil and graphite, Teflon tape or other ENGINEER approved material shall be applied to the male threaded end only. Care shall be used to prevent the joint compound from entering the pipe interior.

3. Use dielectric bushings or unions when ferrous pipes join nonferrous pipes carrying liquid either underground or elsewhere.

D. Electrical Conductivity:

1. When indicated on the Plans or specified, ductile iron piping joints shall be bonded to provide electrical conductivity across the joints of both bell and mechanical joint pipe and fittings.

2. The cable conductor shall be flexible to simplify assembly and to withstand ground and pipe movement after installation. The installation shall provide a positive lasting connection.

3. Where required, bonds shall be made between cast and/or ductile iron pipe and steel pipe to ensure electrical conductivity across the joints.

4. Use dielectric bushings or unions when ferrous pipes join nonferrous pipes carrying liquid either underground or elsewhere.

E. Expansion Joints:

1. Expansion joints shall be installed where indicated on the Plans and in accordance with the manufacturer's recommendations.

2. Pipe systems shall be properly supported so expansion joints do not carry any loads.

3. Piping on equipment adjacent to expansion joints shall be anchored to prevent excessive elongation of the pipe system when subject to pressure.

4. Restrained expansion joints shall be used when adequate anchoring is not available.

5. Misalignment of installation shall not exceed 1/8" to allow full movement of expansion joints when necessary. Do not cover expansion joints with insulation.

6. Straight, concentric or eccentric tapered joints shall be used as indicated on the Plans.

F. Miscellaneous System Connections:

1. Connection to large size pipe or headers for gages, sampler lines or other small inlets or outlets shall be made as indicated on the Plans and specified herein.

2. Connections to large steel pipe shall be by welding on the threaded saddle. The small line shall be socket or nipple type for either threaded or welded connection.

3. Tapping saddles shall be used on large PVC or fiberglass pipe. The small line connection shall be threaded.

4. Connections shall have gate valve installed adjacent to pipe.

5. Install valves and specialties in accordance with manufacturer's recommendations and instructions to permit intended performance.

6. Valves and specialties shall be painted in accordance with applicable AWWA standard specified and with Section 09 9600.

3.04 Field Quality Control

A. General:

1. Installed pipe systems shall be tested by hydrostatic or pneumatic means as specified in Section 40 0500, Mechanical General Requirement, and herein.

2. Hydrostatic testing shall be for any fluid type material to be handled with pneumatic testing for any gas or air pressurized lines.

3. Testing shall be made with the temperatures of surrounding air and test water or air are approximately constant within operating temperature ranges.

4. Pipe ends shall be valved or blanked off. Exterior surfaces of pipes, fittings, or valves shall show no cracks or other forms of leakage.

B. Testing – Piping:

1. Unless otherwise specified, all piping systems, including small pipe, tubing, nipples, connectors, and other appurtenances which are a part of the systems, shall be field tested as specified herein.

2. Instruments, controls, and appurtenances with pressure ratings less than the test pressure of the piping system shall be removed or blocked off before testing starts.

3. Process piping shall be tested with water.

4. Unburied lines which will transmit liquids under pressure from a pump shall be tested to a pressure of 150 percent of the maximum possible discharge pressure of the pump, or as directed by ENGINEER.

5. Unless otherwise specified, tests shall be maintained for 2 hours. Leaks or defective pipe shall be repaired or replaced, and the tests repeated until piping shows tight. Furnish and dispose of material for tests. Piping shall not be insulated or concealed until it has been tested. Test results shall be certified by a registered professional engineer from a testing company or by CONTRACTOR's representative when approved by ENGINEER.

C. Testing – Valves:

1. Test all valves with hydrostatic shop pressure test in accordance with applicable AWWA standard specified.

2. Valves and specialties to be tested in place by CONTRACTOR, and any defects in valves, specialties or connections corrected to the satisfaction of ENGINEER.

3.05 Adjusting

A. Requirements for starting and adjusting work per Section 01 7700.
B. Adjust piping, valves and ancillary appurtenances to achieve specified requirements.

3.06 Cleaning

A. Before placing piping in use, the interior shall be cleaned of foreign substances. Any stoppage, discoloration, or other damage to buildings and their finish or furnishings because of failure to properly clean piping systems shall be repaired without cost to OWNER.

3.07 Disinfection

A. Potable water system piping shall be disinfected. After flushing the system, chlorine or chlorine compound shall be introduced at a dosage which will give a residual chlorine content of 25 mg/1 at the end of a 24-hour contact period. Collect samples from taps and fixtures throughout the system while the chlorine is being introduced to assure uniform distribution. After the contact period, take additional samples from taps and fixtures to determine the residual chlorine content. If satisfactory, flush all traces of the chlorinated water from the system. Chlorination shall be in accordance with AWWA C651.

B. Flushing and dispose of chlorine sterilization water to prevent damage to the surrounding area. Flushed chlorination water shall be dechlorinated in accordance all federal, state and local requirements.

C. After flushing, collect at least 4 bacteriological samples from different locations in the system and have the samples tested by a laboratory. If samples test safe, the system shall be considered to have been sterilized. If unsafe, repeat the chlorination process until the bacteriological samples test safe.

3.08 Piping Protection

A. Protect piping, equipment, and materials from damage during construction until final acceptance. Close pipe openings with plugs or caps during installation. Cover and protect equipment against dirt, water, chemicals, or mechanical injury. Before final acceptance, clean equipment and deliver to OWNER in perfect condition.

End of Section

Section 40 0557
Actuators for Process Valves and Gates

Part 1 General

1.01 Scope of Work

A. This section includes electric motor operated actuators for 90° and multi-turn/rising stem applications. Actuators shall be used for open/shut and modulating/throttling service.

1.02 Related Work Specified Elsewhere

A. Division 26: Electrical

1.03 Quality Assurance

A. Actuators specified under this section shall be furnished by one manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment furnished.

B. Actuators and all related equipment shall be designed, constructed, and installed with the best practices and methods.

1.04 Submittals

A. General:

1. Submit to ENGINEER, in accordance with the requirements of Section 01 3300 complete shop drawings and schematics which shall show details of installations and connections to work of other sections.

2. Furnish catalogue data and parts schedule in sufficient detail to serve as a guide in assembly, disassembly of the actuator and in ordering repair parts.

B. Certificates: The manufacturer shall provide an affidavit of compliance with all applicable provisions of this specification.

C. Operation and Maintenance Data: Submit operating instructions, repair parts listing and recommended maintenance schedule of inspection, cleaning and lubrication.

1. Include manufacturers recommended lubricants.

D. Shop Drawings and Product Data: Submit manufacturer's drawings showing the principal dimensions and general construction of and materials used in all parts of the actuator. All actuators shall be manufactured and furnished in accordance with these drawings and specifications.

1. Furnish illustrated catalog data and parts schedule in sufficient detail to serve as a guide in assembly and disassembly of the valve actuator and in ordering repair parts.

E. Test Reports: Submit copies of tests and inspection data to ENGINEER for review and record in accordance with the requirements of these Contract Documents.

F. Actuator: Actuator shall be submitted with the equipment it will operate and will not be accepted as a stand-alone submittal. Actuator sizing and selection shall be as recommended by the gate or valve supplier. CONTRACTOR shall coordinate with the valve or gate supplier to obtain operators of the proper size and type.

1.05 Product Delivery, Storage, and Handling

A. Storage of Materials and Equipment:

1. CONTRACTOR shall store material and each piece of equipment in accordance with the manufacturer's recommendation for protection from weather, temperature, and moisture contamination.

B. Handling Materials and Equipment:

1. Material shall be handled in a manner such as to eliminate the possibility of damage, breakage, or chipping in transit or otherwise.

1.06 Startup

A. Each actuator shall be supplied with a startup kit comprising installation instruction, electrical wiring diagram, and sufficient spare cover screws and seals to make good any site losses during the commissioning period.

1.07 Performance Test Certificate

A. Each actuator must be performance tested and individual test certificates shall be furnished to OWNER. The test equipment should simulate a typical valve load and the following parameters should be recorded:

1. Current at maximum torque setting
2. Torque at maximum torque setting
3. Flash Test Voltage
4. Actuator Output Speed or Operating Time

B. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.

1.08 Warranty

A. Each actuator shall be warranted for a minimum of 24 months of operation up to a maximum of 36 months from shipment.

1.09 Experience

A. Technologies and devices used in the actuator must have a minimum of five years' of commercial operating experience for that specific manufacturer, including torque and position sensing, lubrication, and electrical compartment design.

Part 2 Products

2.01 General

A. Actuators shall operate on a 480 volt, three-phase, 60 Hertz power supply and are to incorporate motor, solid state integral reversing starter, local control facilities, and terminals for remote control and indication connections.

B. It shall be possible to carry out the setting of the torque, turns, and configuration of the indication contacts without the necessity to remove any electrical compartment covers.

2.02 Actuator Sizing

A. Actuator shall be sized to guarantee valve closure at the specified differential pressure.

B. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal.

C. Operating speed shall be such as to give valve closing and opening at approximately 60 seconds, unless otherwise stated in the job specification.

D. Actuator shall be capable of functioning in an ambient temperature ranging from -22 degrees to +158 degrees Fahrenheit.

2.03 Motor

A. The electric motor shall be Class F insulated with a time rating of at least 15 minutes at 104 Fahrenheit (40 degrees Celsius) or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of maximum valve torque.

B. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case. Plugs and sockets are not acceptable as a means of electrical connection for the motor.

2.04 Motor Protection

A. Protection shall be provided for the motor as follows:

1. Motor shall be de-energized in the event of stall when attempting to unseat a jammed valve.

2. Motor temperature shall be sensed by a thermostat to protect against overheating.

2.05 Gearing

A. Actuator gearing shall be totally enclosed in an oil- filled gear case suitable for operation at any angle. Where the actuator operates gate valves or large diameter ball or plug valves, the drive shall incorporate a lost-motion hammer blow feature.

B. For rising spindle valves, the output shaft shall be hollow to accept a rising stem and incorporate thrust bearings of the ball or roller type at the base of the actuator, and the design should be such as to permit the gear case to be opened for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

C. Standard SAE80EP or Dextron II gear oil shall be used to lubricate the gear case. Special or exotic lubricants shall not be used.

2.06 Hand Operation

A. A handwheel shall be provided for emergency operation engaged when the motor is declutched by a lever or similar means; the drive being restored to power automatically by starting the motor.

B. Hand/Auto selection lever should be padlockable in both "Hand" and "Auto" positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in "Hand" without damage to the drive train.

C. Handwheel drive must be mechanically independent of the motor drive, and any gearing should be such as to permit emergency manual operation in a reasonable time.

D. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in the job specification.

2.07 Drive Bushing

A. Actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft.

B. Thrust bearings, when housed in a separate thrust base, should be of the sealed-for-life type.

2.08 Torque and Turns Limitations

A. Torque and turns limitation to be adjustable.

B. Torque setting: 40% to 100% rated torque.

C. Torque sensing must be affected directly electrically or electronically. Extrapolating torque from mechanically measured motor speed is not acceptable due to response time.

D. Torque measurement shall be independent of variations in frequency, voltage or temperature.

E. “Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads.

F. The electric circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

G. A setting tool is required for non-intrusive calibration and interrogation of the actuator.

1. Setting tool will provide quick interrogation capabilities as well as security in a non-intrusive intrinsically safe watertight casing.

2.09 Remote Valve/Actuator Control, Status and Alarm Indication

A. Four contacts shall be provided which can be selected to indicate any position of the valve with each contact externally selectable as normally open or normally closed.

1. Contacts shall be rated at 5A, 250V AC, 30V DC.

B. As an alternative to providing valve position, any of the four contacts shall be selectable to signal one of the following:

1. Valve Opening or Closing
2. Valve Moving (Continuous or Pulsing)
3. Local Stop Selected
4. Local Selected
5. Remote Selected
6. Open or Close Interlock Active
7. ESD Active
8. Motor Tripped on Torque in Mid-Travel
9. Motor Tripped on Torque Going Open
10. Motor Tripped on Torque Going Closed
11. Pre-Set Torque Exceeded
12. Valve Jammed
13. Actuator Being Operated by Handwheel
14. Lost Main Power Phase
15. Customer 24V DC or 120V AC Supply Lost
16. Battery Low
17. Internal Failure Detected
18. Thermostat Tripped

C. In the event of a (main) power (supply) loss or failure, the four position contacts must be self latching to maintain interlock capabilities.

D. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 2.0 kV.

E. Operators for valves or gates listed in the valve or gate schedule as throttling service shall have 4-20 mA analog signal setpoint control module.

2.10 Local Valve/Actuator Control, Status and Alarm Indication

A. The following Control, Status and Alarm indication shall be available locally at the actuator:

1. Control:

a. Open/Stop/Close
b. Desired Valve Position Control
c. Positioning Units shall have a 4-20 mA input setpoint control module.

2. Status:

a. Motor Running Open Direction
b. Motor Running Closed Direction
c. Fully Open
d. Fully Closed

e. Percentage Open
f. Percentage Torque

3. Alarms:

a. Communications Failure
b. Actuator Alarm
c. Valve Alarm
d. Battery Low Alarm

B. Actuator must provide a local display of the position of the valve, even when the power supply is not present. The display shall be able to be rotated in 90 degree increments so as to provide easy viewing regardless of mounting position.

C. Actuator shall include a digital position indicator with a display from fully open to fully closed in 1% increments with +/-1/2 percent accuracy. Red, green, and yellow lights corresponding to Open, Closed, and Intermediate positions shall be included on the actuator. The digital display shall be maintained even when the power to the actuator is isolated.

D. Local display should be large enough to be viewed from a distance of six (6) feet when the actuator is powered up.

2.11 Integral Starter and Transformer

A. Reversing starter, control transformer, and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup.

1. For Open-Shut service, the starter shall be an electromechanical type suitable for 60 starts per hour and of rating appropriate to motor size.

2. For positioning or throttling service, the starter shall be solid state suitable for excess of 2000 starts per hour.

B. The controls supply transformer shall be fed from two of the incoming supply voltage and shall have the necessary tapings and be adequately rated to provide power for the following functions:

1. 120V AC energization of the contactor coils
2. 24V DC output where required for remote controls
3. Supply for all the internal electrical circuits

C. The primary and secondary windings shall be protected by easily replaceable fuses.

2.12 Integral Push Buttons and Selector

A. Integral to the actuator shall be local controls for Open, Close, and Stop, and a local/remote selector

B. Switch, pad-lockable in any one of the following three positions:

1. Local Control Only
2. Off (No Electrical Operation)
3. Remote Control plus Local Stop Only.

C. It shall be possible to select maintained or non-maintained local control.

D. Selection of maintained or push-to-run control for (A) above shall be provided. It shall be possible to reverse valve travel without the necessity of stopping the actuator. Starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of approximately 300 ms.

2.13 Wiring and Terminals

A. Internal wiring shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and three- phase power. Each wire shall be clearly identified at each end.

B. Terminals shall be embedded in a terminal block of high tracking resistance compound.

C. Terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal.

D. Terminal compartment of the actuator shall be provided with a minimum of three threaded cable entries. When required, a fourth cable entry shall be provided.

E. Wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

F. Control logic circuit boards and relay boards must be mounted on plastic mounts to comply with double insulated standards. No more than a single primary size fuse shall be provided to minimize the need to remove single covers for replacement.

G. A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

1. Serial Number
2. External Voltage Values
3. Wiring Diagram Number
4. Terminal Layout

H. This must be suitable for CONTRACTOR to inscribe cable core identification beside terminal numbers.

2.14 Enclosure

A. Actuators shall be “O” ring sealed, watertight to NEMA 6, and shall at the same time have an inner watertight and dustproof “O” ring seal between the terminal compartment and the internal electrical elements of the actuator fully protecting the motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.

B. Enclosure must allow for temporary site storage without the need for electrical supply connection.

C. External fasteners should be of stainless steel.

2.15 Acceptable Manufacturers

A. Rotork Controls
B. ENGINEER-approved equal.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall field measure all dimensions and check possible interferences for the valve actuator system and accessories.

3.02 Preparation

A. Valve actuators and accessories shall be free of all foreign matter.
B. Accumulations of dirt, rust, scale, etc., shall be removed prior to installation.
C. Connections and terminals shall checked to ensure integrity.

3.03 Installation

A. Install all items in accordance with printed instructions of manufacturers, as indicated and specified. Make adjustments necessary to place equipment in satisfactory working order.

B. Valve actuators shall be aligned and supported in such manner that no load or thrust will be exerted upon the equipment or the piping at installation or in operating conditions.

C. Joint connections shall be as indicated on the Plans and specified herein. Excluding connections for valves, fittings, equipment, etc., joints in the pipe line shall be minimal yet provide easy access as required for maintenance.

3.04 Acceptance Test

A. Complete installation.

B. Furnish labor, equipment, and materials necessary to conduct tests.

C. Give each actuator a running test fully opening and closing the valve or gate in the presence of ENGINEER to demonstrate satisfactory operation.

D. Correct all defects and replace any defective equipment. Make necessary adjustments at no additional cost to OWNER.

E. Repeat tests, if necessary, at no additional cost to OWNER to obtain results acceptable to ENGINEER.

3.05 Field Quality Control

A. Installed actuators shall be tested over their whole range of service and operating conditions.

B. Valve and actuator shall function as an integral whole in modulating service as intended, and shall operate without “hunting”, widely fluctuating or excessive cycling.

C. Testing shall be made with the temperatures of surrounding air and test water approximately constant within operating temperature ranges.

End of Section

Section 40 7123.13
Venturi Flow Meters

Part 1 General

1.01 Scope of Work

A. This Section includes venturi flow meters as indicated on the Plans or as required for a complete and functioning installation.

1.02 Related Work Specified Elsewhere

A. Division 26: Electrical
B. Section 40 7329: Differential Pressure Transmitters
C. Section 40 0513: Process Piping and Valves

1.03 Reference Standards

A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:

1. ANSI - American National Standards Institute
2. ISA - Instrument Society of America
3. NFPA - National Fire Protection Association
4. UL - Underwriters Laboratories

1.04 Submittals

A. Submittals shall be made as required in Section 01 3300.

B. Shop Drawings:

1. Complete and detailed system schematic drawings showing all components and the pneumatic and electrical point to point connections of each system together with a description of the operation of the system and equipment.

2. Instrumentation equipment specifications, outlined dimension drawings, and wiring and piping diagrams for each item of equipment. Duplicate equipment may be covered by 1 set of literature.

3. Submittal shall be organized in a logical manner and have a schematic diagram for each system.

C. Product Data: Provide data for all insert flow tubes. Include manufacturer's catalog information showing dimensions and configurations.

D. Test Reports: The manufacturer of differential producing equipment shall furnish for approval certified data substantiating dimensions, calculations, and performance. The data must substantiate that the accuracy of the venturi meter is based on calibration of the device being submitted and not taken from other sources. Data shall include:

1. Calculation sheets.
2. Coefficient values and tolerances.
3. Effect of upstream piping configurations.
4. Non-recoverable head loss
5. Flow vs. differential curve.
6. Uncalibrated accuracy.

7. Dimension prints.

E. Manufacturer's Installation Instructions

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.

2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.

F. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements. Venturi meter shall have a 25-year warranty against defects in workmanship and materials.

1.05 Closeout Submittals

A. Submittals shall be made as required in Sections 01 3300 and 01 7700.

B. Manufacturer's field reports.

C. Project Record Documents: Accurately record actual installed equipment.

D. Operation Data: Include description of system operation, adjusting and testing required.

E. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources. Include instructions for testing and cleaning cable and accessories.

F. Instruction Manuals

1. Complete descriptive literature for each piece of equipment, including a list and description of all parts of each piece of equipment.

2. Data sheets containing information relative to metering range, indicator or chart range, electrical requirements, system function, and shop drawing data.

3. Process flow diagrams showing location of instrumentation equipment, function of each piece, and description of use of equipment as applied to this Project.

1.06 Delivery, Storage, And Handling

A. Handling: Meters shall be handled in such a manner as to avoid any damage.
B. Storage: Store meters in enclosures or under protective coverings.

1.07 Field Measurements

A. Verify that field measurements are as indicated on shop drawings.

1.08 Project Conditions

A. Verify that field measurements are as shown on Contract Drawings.

B. Verify pipe size, material and compatibility with the fluid prior to rough-in.

C. Meter locations shown on Contract Drawings are approximate locations unless dimensioned. Install meters as required to complete piped system.

1.10 Extra Materials

A. Provide 1 complete set of special tools and equipment per meter that are required for calibration and maintenance including digital calibrators for reading and generating 4-10 mA signals.

Part 2 Products

2.01 Venturi Flow Meters

A. General:

1. Flow meter shall be a short form Venturi design utilizing pure static pressure sensing taps in the inlet and throat sections and shall produce a differential pressure, which shall be measured and transmitted by the specified differential pressure transmitter.

2. Meter supplier shall submit a complete manufacturing plan to include calculations for proper material thicknesses which will be used for this meter(s). In addition, a full quality assurance procedure will be provided to include welders qualifications, material and welding testing procedures and proof of welders current certification for all procedures that will be used in the manufacturing of the meter(s).

B. Performance:

1. Venturi flow meter(s) shall have an accuracy of +/-0.5% of actual flow above a pipe Reynolds number of 75,000 with a discharge coefficient of 0.9900.

2. Temperature: Suitable for an operating temperature up to 165 degrees Fahrenheit, with operating pressure limited only by line pressure rating.

3. Losses: Non-recoverable head loss not to exceed 4 percent of maximum differential.

C. Tube Design:

1. Venturi meter shall have a cylindrical inlet section of the same inner diameter as the inlet piping and shall contain two high pressure taps and a single vent and drain tap. Cylindrical throat section shall contain two low-pressure taps.

2. Length of the cylindrical throat section shall be equal to one-half its diameter.

3. Converging section shall be comprised of a single angle of 30 degrees; sections using a radius or multiple inlet angles will not be acceptable.

4. Recovery section shall be comprised of a single angle of 10 degrees and shall be truncated at approximately 90 percent of the downstream pipe inner diameter.

5. Devices such as flow tubes that do not sense true static inlet and throat pressure will not be accepted.

D. Construction:

1. Meters shall consist of reducing cone inlet sections, straight cylindrical throats, and expanding cone outlets. The cones shall be constructed of fiberglass.

2. Body material shall be carbon steel, epoxy coated.

3. Throat section shall be 304 stainless steel.

4. Mounting flanges shall hold the flow elements between pipe flanges of the line in which installed and be constructed of carbon steel and epoxy coated. Flanges shall be ANSI B16.1 125 1b.

5. High- and low-pressure taps shall be installed through the mounting flanges and be 1/4-inch NPT and located 180 degrees apart in the horizontal plane.

E. Testing:

1. Each meter shall be flow calibrated by an independent flow lab and provided with certified copies of the test results to substantiate the flow meter's accuracy, discharge coefficient and permanent pressure loss.

2. In lieu of lab flow calibration, the manufacturer may provide prior independent lab test data substantiating the flow meter's accuracy, Reynolds number performance, installation effects, discharge coefficient, and head loss. Prior test data shall cover at least 36 lab calibrations in sizes from 2.0 to 48.0 inches. Since the validity of prior test data is based on the quality and tolerance adherence of the fabricator, if laboratory calibration data from prior meter calibrations is presented for consideration, the venturi meters used for those calibrations must have been built by the same fabricator as will be used to fabricate the meter on this contract.

3. The supplier of the venturi meter shall provide a certified statement that all test data has been derived on meters made by the manufacturer of this meter.

4. In the event that the fabricator did not provide the prior calibrated meters, this meter shall be flow calibrated at Utah Water Research Labs. Calibration shall be a 20-point calibration for the minimum to maximum stated flow rate. Headloss shall also be calibrated.

F. Meter Schedule:

1. GCDC-WWS Meter Vault:

a.	Type:	HVT-PIF
b.	Number of Meters:	1
c.	Inlet Diameter (inches):	20
d.	Throat Diameter (inches):	12.6
e.	Overall Length Allowed (inches):	50.7
f.	Flow Range (gallons per minute):	700 – 9,000

2. Control Station No. 2:

a.	Type:	HVT-FVF
b.	Number of Meters:	2
c.	Inlet Diameter (inches):	36
d.	Throat Diameter (inches):	12
e.	Overall Length Allowed (inches):	96
f.	Average Flow Range (gallons per minute):	6,250 – 17,360

H. Acceptable Manufacturer:

1. Venturi meter shall be a Model HVT-FVF manufactured by Primary Flow Signal, Inc., Cranston, RI or ENGINEER-approved equal.

Part 3 Execution

3.01 Contractor's Verification

A. CONTRACTOR shall field measure all dimensions and check possible interferences for the pipe system and accessories.

3.02 Installation

A. Install meter(s) in accordance with manufacturer's instructions.

B. Install the transmitter(s) in an orientation where the sensing diaphragms are in a vertical plane.

C. Allow sufficient clearance overhead for cover removal and around the transmitter(s) to provide an access for necessaryadjustments.

D. Provide connections for drain and vent ports on the transmitter(s) as per manufacturer's recommendations.

E. Locate transmitter(s) as close to the process pipe and pressure tap as practicable with the lengths of meter lead piping/tubing kept to a minimum. Do not exceed 10 feet lead length. Locate the transmitter to minimize exposure to shock and vibration, or with proper vibration protection hardware and rugged frame. Select location to avoid any thermal shocks.

F. Slope horizontal leads a minimum of one inch per foot downward from the pressure taps.

G. Assemble screwed fittings with teflon tape wrapped on the external threads.

H. Do not run horizontal meter leads in excess of 10 feet without supports.

3.03 Field Quality Control

A. Conduct field inspection, testing and adjusting per Section 01 6000, Product Requirements, and Section 01 7700, Closeout Procedures.

B. Field Tests: Verify specification performance criteria and perform tests as recommended by manufacturer.

3.04 Adjusting

A. Requirements for starting and adjusting work per Section 01 7700.
B. Adjust and calibrate flowmeters.

3.05 Manufacturer's Field Services

A. Quality Requirements: Provisions for manufacturer's field services per Section 01 4500, Quality Control.

B. Include services of a factory authorized service technician for up to 2 man-days per meter to supervise adjustments, final connections, and system testing.

3.06 Protection

A. Protect finished installation under provisions of Section 01 6000, Product Requirements.

End of Section

Section 40 9000
Process Instrumentation, Controls and Monitoring Equipment - General Requirements

Part 1 General

1.01 Scope of Work

A. This Section encompasses general provisions relating to instrumentation work. Work included in this Section pertains to all instrumentation work contained in Division 22, Division 23, Division 26, or Division 40, unless modified therein, as though this Section was repeated in its entirety in each Section.

B. Furnish labor, materials, equipment and accessories required to provide complete operating instrumentation at the facility as described in the specifications, listed on the schedules and shown on the Drawings.

C. Install and/or connect furnished equipment, including equipment furnished by others, as detailed herein and as shown on the Drawings.

D. It is the intent of these Contract Documents that the instrumentation shall be suitable in every way for the service required. Material and all work that may be reasonably implied as being required for a complete fully functioning, automated and manually controlled facility shall be furnished at no extra cost.

E. Make field connections to process instruments and other equipment furnished under this Contract; to equipment furnished by OWNER under separate contract, if any; and to reworked or relocated existing equipment as in the Contract Documents.

F. Provide mounting, mount, and wire process instruments furnished under Contract. Furnish wire, and interconnections between process instrumentation primary elements, transmitters, local indicators, and receivers. Mount and wire surge protection equipment where indicated on the Drawings.

G. Provide mounting, mount, and make field connections to "packaged" instruments furnished under this Contract. Electrically or pneumatically connect "package" control systems to other related panels or instrumentation defined by the Contract Documents.

H. Process Instrumentation equipment and materials furnished under this Contract, shall be installed under Division 40. This installation Work shall include mounting and making of process and signal connections to the equipment. This Work, with the exception of factory-mounting of certain instruments, shall be performed under the supervision of a qualified representative of the vendor of the system or equipment. This installation Work and the completed installation shall be in compliance with instructions of the above-mentioned vendor's representative and in accordance with the Drawings and documentation prepared by the vendor of the system or equipment and approved by ENGINEER.

1.02 Related Work Specified Elsewhere

A. Section 22 1000: Plumbing Materials and Methods
B. Section 26 0500: Electrical General Requirements
C. Section 26 0510: Basic Materials and Methods
D. Section 40 0500: Process Equipment General Requirements

E. Section 40 9100: Instrumentation and Control for Process System

1.03 Responsibilities

A. CONTRACTOR shall assume responsibility to take field measurements of related and connecting work, and to determine the entire scope of the work required for a finished and completed project, in accordance with the Contract Documents and as approved by ENGINEER.

B. Drawings upon which this Contract is based show the arrangement, general design and extent of the systems and components. Systems are suitably outlined on the Drawings with regard to size, locations, general arrangements and installation details. Connections are shown in diagram form, except where in certain cases the drawings may include details giving the exact locations and arrangements. Drawings shall not be scaled to determine location. Work shall be installed in such a manner to avoid interferences.

C. Where any parts of the systems or piece of equipment are located by dimensions on the Drawings, said dimensions shall be checked and verified in the field. Should discrepancies or interferences occur which will necessitate major revisions in the work, ENGINEER shall be notified immediately and his authority secured in writing for such revisions before proceeding with the Work.

D. Drawings are intended to convey the desired method of control and operation of the instrumentation and control system. CONTRACTOR shall retain the services of the Control System Supplier to be responsible for the system analysis, design and functional adequacy of equipment necessary to achieve required systems performance and to satisfy the intent of these Contract Documents.

E. Instrumentation and controls shall be installed under the supervision of the Control System Supplier. Insofar as possible, instrumentation and control equipment shall be furnished from a single supplier. CONTRACTOR shall retain the services of the Control System Supplier to supply the complete control and instrumentation system and prepare wiring diagrams, installation drawings and changes for existing equipment.

F. Modifications or additions to the electrical conduit and wiring installation for the instrumentation and control system required by the instrumentation and control system and not shown on the Contract Drawings shall be furnished and installed by CONTRACTOR, as approved by the equipment manufacturers. Other devices or wiring including energy sources and/or converters necessary to obtain proper operation of the instrumentation and control system, shall be provided and installed by CONTRACTOR. Special interface equipment required shall be provided and installed by CONTRACTOR at no additional cost to OWNER.

1.04 Reference Standards

A. Equipment, materials, and systems provided shall be designed, manufactured, finished, painted, tested, inspected, packaged, shipped, stored, installed, connected, and tested in accordance with the General Industry Standards of OSHA, MIOSHA, and local, county, state, and federal laws; and in accordance with the published codes, standards, and specifications of the following organizations:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing and Materials
3. AWWA - American Water Works Association

4. IEEE - Institute of Electrical and Electronics Engineers
5. ISA - Instrument Society of America
6. MIOSHA - Michigan Occupational Safety and Health Administration
7. NEC - National Electric Code
8. NEMA - National Electrical Manufacturers Association
9. NFPA - National Fire Protection Association
10. OSHA - Occupational Safety and Health Administration (U.S. Depart. of Labor)

B. Equipment, materials, and systems shall be U.L. labeled or listed except for classes of materials and equipment not available with such listing.

1.05 Guarantee and Warranties

A. Guarantee work in accordance with the requirements of the Conditions of the Contract. With respect to instruments and equipment, guarantee shall cover:

1. Faulty or inadequate design
2. Improper assembly or erection
3. Defective workmanship or materials
4. Leakage, breakage, or other failure not caused by OWNER misuse.

B. For equipment bearing a manufacturer's warranty in excess of one year, furnish a copy of the warranty with OWNER named as beneficiary.

1.06 Improvements

A. Manufacturer's improvements involving specified systems or equipment needed to fulfill the intent of these specifications, and required to fulfill functionally the operational requirements, shall be provided at no additional cost to OWNER.

1.07 Submittals

A. Shop Drawings and Product Data:

1. Certified drawings and diagrams for all instrumentation and control work shall be furnished by CONTRACTOR and delivered to ENGINEER in accordance with Section 01 3300, Submittal Procedures. Information to be submitted for approval shall include:

   a. Schematic Wiring Diagrams

2. CONTRACTOR shall submit wiring diagrams of each piece of equipment, termination cabinet, starter, switch, relay, indicator, controller, recorder, annunciator, telemetering equipment, etc.

3. Drawings shall be 24" x 36" mylar with border, title block, symbols, etc., as used on the Contract Drawings and approved by ENGINEER. Ladder diagrams and wiring diagrams shall conform to JIC format and include line numbers, item numbers, source of power, terminal numbers, wire numbers, etc. Wire numbers and item numbers shall be assigned using the line numbers on the ladder diagrams.

4. Where applicable, and if CONTRACTOR desires, he may purchase mylars, vellums or electronic files (when approved by ENGINEER) of the process control drawings from ENGINEER, modify these drawings as required, and utilize them as shop drawings.

5. Bond copies will be acceptable for the approval issue only.

6. Manufacturer's specifications complete with descriptive information indicating design data underscored to assist in verification that equipment proposed is equal to or exceeds the technical requirements and intent of these specifications. Design data shall cover exact equipment furnished.

7. Dimensional outline drawings of all control and instrument enclosures including designated conduit or wireway entrances, internal equipment layouts and structural details.

8. Internal wiring diagrams of control enclosures identifying terminals and showing external and interconnecting terminals and field mounted devices.

9. Details necessary for fabrication of equipment specific to these control systems.

10. Working and/or construction drawings, showing conduit layout, locations, details, size, wire size and type and cables therein.

11. Technical information for all devices furnished.

12. Cable schedule detailing each cable, routing and all connections, as described in a format approved by ENGINEER.

13. A riser diagram shall be provided showing all cables, wires and conduits.

14. A complete list of all recommended spare parts and test equipment required for the upkeep of all instruments and controls devices installed under this Contract.

15. Complete parts lists of all materials and components incorporated in the system.

16. Individual manufacturer's instruction manuals for all devices.

17. CONTRACTOR shall submit as-built drawings, instruction manual material and assistance as required by Sections 01 7700, Closeout Procedures.

1.08 Shipping Precautions

A. After completion of shop assembly and tests, all control cabinets, panels and consoles, etc., shall be enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from dust and moisture.

B. Dehumidifiers or desiccant materials shall be placed inside the polyethylene coverings prior to sealing. Equipment shall then be skid mounted and braced for final transport.

C. Lifting rings shall be provided for moving without removing protective coverings on all sections weighing more than 150 lbs. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling.

D. Equipment provided under this Contract shall not be delivered to the job site until scheduled for installation.

E. Special instructions for proper field handling and installation required by the manufacturer for proper protection shall be securely attached to each piece of equipment prior to shipment.

F. Each package shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on outside of package.

G. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, shall be provided on each piece of equipment supplied under the Contract.

1.09 Storage

A. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters and shall be adequately protected against mechanical injury or damages by water.

1.10 Instrument Identification

A. Major instrumentation and equipment items or system specified shall be identified by system and tag numbers. This same number appears in the tag number designations on the drawings and on the schedule.

B. Instrumentation and equipment shall be identified by nameplates or tags.

C. Nameplates for panels and panel mounted equipment shall be as specified in the respective Section.

D. Field equipment shall be tagged with assigned instrumentation tag number and function.

1. Tags shall be white lamacoid with engraved black characters of 3/16 inch minimum height.

2. Tags shall be attached to equipment with a commercial tag holder using a stainless steel band with a worm screw clamping device or by a holder fabricated with standard hose clamps and meeting the same description. In cases where this would be impractical, use 20 gage stainless steel screws installed in an unobtrusive manner.

E. In addition to tags, field mounted control stations, recorders or indicators shall have a nameplate indicating their function and the variable controlled or displayed.

1. Nameplate shall be attached by one of the above methods.

1.11 Signal Isolators, Converters, and Conditioners

A. Ensure that input-output signals of all instruments and control devices are compatible.

B. Unless otherwise specified, signals between field and panels shall be 4 to 20 mA DC unless specifically approved otherwise.

C. Granting such approval does not relieve the compatibility requirement above.

D. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices inside or behind control panels, or in the field at point of application.

1.12 Process Connections

A. Provide instrument piping, tubing, and capillary tubing to meet the intended process service and ambient environmental condition for corrosion resistance.

B. Slope lines according to service to promote a self draining or venting back to the process.

C. Terminate connection to process lines or vessels in a service rated block valve that will permit closing off the sense line or removal of the element without requiring shutdown of the process.

D. Include drip legs and blow-down valves for terminations of sensing lines at the instruments when mounted in such a way that condensation can accumulate.

E. Process vessels, line penetrations, connecting fittings, and block valves shall be furnished by CONTRACTOR.

1.13 Manufacturer's Service

A. General:

1. CONTRACTOR shall furnish the services of a factory representative of the instrumentation equipment manufacturer to provide field supervision during installation, to direct the installation of the equipment, and to conduct initial equipment checkout and system start-up.

2. CONTRACTOR shall furnish the services of a factory trained and qualified serviceman of the manufacturers of the instrumentation equipment and accessories supplied under this Contract to perform the following:

B. Supervision:

1. Supervisory service of a trained serviceman, specifically trained on the type of equipment herein specified, shall be provided during construction to assist in, location of sleeves, methods of installing conduit and special cable, mounting piping and wiring for each type of device, and the methods of protecting all of the equipment prior to placing it in service.

C. Power Check-Out:

1. Checking the installation of all components before power is applied.

2. No form of energy shall be applied to any part of the instrumentation system prior to receipt by ENGINEER of a certified statement of approval of the installation from CONTRACTOR, containing his Control System Supplier’s authorization for turning on energy to the system.

D. Check-Out:

1. Placing the equipment into operation and making necessary adjustments including tests and loop checks.

2. CONTRACTOR shall provide the Control System Supplier's services to maintain all control system equipment in good operating condition and furnish-on-call maintenance as required to minimize equipment down time, until the project has attained Substantial Completion.

   a. Control System Supplier shall provide scheduled preventative maintenance based on ENGINEER approved listing specifying the time required for preventative maintenance on the various types of equipment and shall provide remedial maintenance services as required.

   b. Additional service time shall be provided during the one-year warranty period for at least three 8-hour day service visits to the site to check and readjust the equipment supplied under this Section.

1.14 Tools and Spare Parts

A. One complete sets of any specialty instrument required to adjust and calibrate the instrumentation equipment shall be furnished with the equipment.

1. They shall include hand tools for maintenance and calibration such as: unique screwdrivers and wrenches plus other tools as required.
2. They shall be supplied in a durable case.

3. Calibration tools for instrumentation equipment such as magmeters, flowmeters, and pneumatic instruments shall also be provided.

B. A universal, portable input-output calibrator shall be provided.

1. The unit shall be suitable for use as a current or voltage source, current or voltage measuring device and as a power supply for two wire transmitters.

2. Output section shall contain 6 current and 5 voltage ranges.

3. Internal power supply shall contain 3 ranges.

4. A self contained portable potentiometer shall also be provided.

5. Tester shall be Fluke model 789 or ENGINEER approved equal.

1.15 Spare Parts

A. Spares consumed during installation and testing shall be replaced by CONTRACTOR prior to final acceptance of the system.

B. Control System Supplier shall supply a complete list of all suggested spare parts and supplies he considers required for the continuous operation of the system.

1. List shall include catalog and serial numbers of the hardware devices, spare parts part numbers, commercial part numbers and price in effect when the list is prepared.

2. Spare parts shall be 100% of the manufacturer's recommended spare parts for each device.

C. Spare parts for specific equipment, if necessary to be furnished by CONTRACTOR, shall be specified in the Sections for the specific equipment.

1.16 Source Quality Control

A. Instruments and controls shall be installed under the supervision of Control System Supplier.

1. In order to ensure a coordinated instrumentation and control system, CONTRACTOR shall require the Control System Supplier to certify coordination of the overall control and instrumentation system so that all devices provided under this Contract are compatible and provide a complete and operable system.

2. Control System Supplier shall inspect each component piece of equipment supplied for each system to assure that it is new, in good working order and complies with the intent of Contract Documents.

3. Components not fulfilling these criteria shall be rejected.

Part 2 Products

2.01 Instrumentation General

A. Electronic instrumentation shall be of the solid-state type, of manufacturer's latest design; preferably designed and packaged for miniature, high density mounting configuration.

1. Where available, the instruments will be supplied with self-supporting, draw-out feature when in extended position.

2. Transmitted analog signals shall be 4-20 mAdc; however, signals between instruments within the same panel/cabinet may be 1-5V.

3. Zero base transmission signals will not be allowed, only "live zero" signals. An exception would include outputs of sensing devices specified hereafter, however, converted to compatible high-level signals for remote transmission.

B. Field mounted equipment shall be in NEMA 4X enclosures and, if required, shall include suitable strip heaters to prevent accumulation of moisture.

C. Equipment installed in hazardous areas, shall meet Class I, Group D, Division I to comply with the National Electrical Code.

D. Indicators and recorder readouts will be linear in process units.

E. Transmitters shall be provided with either integral indicators or separately mounted indicators reading in process units. Special features listed in the individual instrument specifications are required and all information listed therein shall be considered as minimum requirements.

F. Equipment furnished shall be approved for specific application by Underwriter's Laboratories, Inc., or Factory Mutual if applicable.

2.02 Electrical

A. Refer to Division 26.

B. Equipment shall be designed to operate on a 60 Hertz alternating current power source at 105 to 135 volts, except as noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

C. Switches shall have single-pole double-throw contacts rated at 600 VA.

D. Contacts for low voltage signals shall be gold flashed.

2.03 Power Failure

A. Equipment shall be designed and constructed so that in the event of a power interruption the equipment shall resume normal operation without manual resetting when power is restored.

2.04 Control System Suppliers

A. Available Control System Suppliers: Subject to compliance with requirements, provide a Control System Supplier of the following:

1. Aggressive Systems, Inc.
2. Commerce Controls, Inc.

Control System Supplier. Equipment specified and shown on Drawings shall be designed as a system, fabricated or purchased, shipped to job site, and started up by a qualified and approved Control System Supplier listed under this heading. Intent is for unit responsibility.

B. Control System Supplier shall not assign any of his rights or delegate any of his obligations.

C. Direct purchase of any items by CONTRACTOR is not in compliance with this Specification and will not be permitted.

D. Control System Supplier shall assign a qualified representative to act as Project Engineer for the work efforts specified. Control System Supplier shall submit a resume outlining the qualifications of this individual to ENGINEER for approval within 3 days of notice to proceed. Project Engineer shall, at a minimum, have the following qualifications:

1. Successfully completed vendor factory training for the digital equipment supplied.
2. Successfully completed projects of similar size and complexity.

E. Project Engineer shall be interviewed at ENGINEER's office in Taylor, Michigan after the contract has been awarded. Individuals selected as Project Engineer must be approved by ENGINEER. Individuals not approved by ENGINEER shall not function as Project Engineer.

F. Project Engineer shall be the focal point for all design, fabrication, contract communications, and construction and shall be responsible for start-up and acceptance.

1. The Project Engineer shall be at the factory test, at the job site during the entire construction process start-up, and at the job site during the entire acceptance procedure.

2. Only qualified and approved Control System Suppliers will be accepted as meeting this Specification.

3. The Control System Supplier shall also assign a full-time service technician during the construction process effort to assist in verifying and making minor corrections to wiring which may be necessary as determined by ENGINEER.

4. The start-up/acceptance procedure shall not begin until all installation has been completed and any punch list items are minor in nature.

G. Installation and Start-up. Control System Supplier shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time by ground from the jobsite.

2.05 Training

A. General:

1. CONTRACTOR shall provide two 8-hour days of training of OWNER's personnel in aspects of operation and maintenance such as direction on calibration of field instruments, fuse locations, instruction manuals, etc.

2. At-the-plant training and instructions shall be given by the Project Engineer assigned to the project by the Control System Supplier or other personnel as approved by ENGINEER.

B. Digital Equipment:

1. Control System Supplier shall provide comprehensive instruction for the programmable controllers and software packages supplied. This instruction shall be performed by the manufacturer of the products at their factory training facility.

2. CONTRACTOR shall submit to ENGINEER, an outline of the proposed training courses to meet the requirements set forth below.

a. Hardware training (3 individuals)

(1) 1 day, Maintenance and Troubleshooting

b. Software training (3 individuals)

(1) 1 day, Software Concepts

3. CONTRACTOR shall also provide to ENGINEER a list of additional courses available from the manufacturer.

4. Upon review, ENGINEER may request that a substitution be made of a course content that better fits the needs of OWNER.

a. Such substitution shall only be requested for courses of equal length cost and availability. The content of these courses and proposed lengths shall be as follows:

C. OWNER shall determine actual division of attendance. Written course materials shall be included along with hands-on exercises with instructional equipment. Factory training shall be conducted on a schedule acceptable to OWNER and shall commence prior to system factory testing.

D. For training conducted at other then OWNER's facilities, CONTRACTOR shall bear all transportation (air fare, car rental, etc.) and subsistence (hotel, meals, etc.) costs for training.

1. Daily subsistence allowance shall be $150/day/person.

2. CONTRACTOR shall arrange for all training for OWNER with a minimum of 6 week notification of training schedule prior to actual course being provided.

3. Scheduling of courses and their contents shall be approved by ENGINEER and provided at a time and location agreeable to OWNER.

4. Course shall be conducted at locations normally established for such courses by manufacturers of software and computer products.

Part 3 Execution

3.01 Inspection

A. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of instruments and equipment.

3.02 Contractor's Certified Reports

A. CONTRACTOR shall submit a certified report for control panel and associated field instruments certifying that the equipment:

1. Has been properly installed under Control System Supplier's supervision.

2. Is in accurate calibration.

3. Was placed in operation in under Control System Supplier's presence.

4. Has been checked, inspected, calibrated, and adjusted as necessary.

5. Has been operated under maximum power variation conditions and has operated satisfactorily.

6. Is fully covered under the terms of the guarantee.

3.03 Demonstration and Final Operating Test Plans and Results

A. Submit for approval, a written plan for demonstrating that each system of equipment provided meets the specified operational requirements.

1. The plan shall include procedures to be used in final operational testing of entire system including description for each system of test methods and materials, testing instruments and recorders, a list of the equipment involved with the functional parameters to be recorded on each item, and shop drawings of required temporary bypasses and like facilities.

3.04 Preparation

A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

3.05 Installation

A. Instrumentation and accessory equipment shall be installed in accordance with the Control System Supplier's instructions.

1. Locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as approved by ENGINEER during construction.

2. Field verify information relevant to the placing of process control equipment and in case of any interference, proceed as determined by ENGINEER.

3. Furnish labor and materials necessary to complete the work in an approved manner.

B. Instrumentation loop diagrams on the Drawings indicate the intent of the interconnection for the instruments specified.

1. Work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, CONTRACTOR shall bear full responsibility for such violations and assume all costs arising there from.

2. Field instruments requiring power supplies shall be provided with local electrical shut-offs.

C. Brackets and hangers required for mounting of equipment shall be provided and shall be installed in a workmanlike manner so as to not interfere with other equipment.

1. CONTRACTOR shall investigate each space in the building through which equipment must pass to reach its final location.

2. If necessary, the manufacturer shall be required to ship this material in sections sized to permit passing through such restrictive areas in the building.

D. The shield on each process instrumentation cable shall be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground be employed for each shield.

1. Cable shields will be continuously maintained by termination to "shield" terminals which are not grounded except at the Main Control Panel. The sole exception is if the manufacturer requires ground of the shield at the field device.

E. Each pair of wires shall be tagged within four inches of each termination with the assigned cable, pair and terminal numbers.

1. Low energy signal (4-20 mAdc) shall be run in instrumentation cables in conduits separated from AC power, control and annunciator wiring.

2. Lifting eyes shall be removed from cabinets/assemblies.

3. Holes in cabinet or boxes shall be plugged.

4. The plug will be of the same color as the cabinet or box and shall be gasketed.

3.06 Instrument Calibration

A. Provide the services of factory trained instrumentation technicians, tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications instructions for calibration.

B. Each instrument shall be calibrated at 10%, 50%, and 90% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments shall have accuracies traceable to the National Bureau of Standards, as applicable.

C. Provide a list and basic specifications for instruments used.

D. Provide a written report to ENGINEER on each instrument certifying that it has been calibrated to its published specified accuracy.

1. Report shall include applicable data as listed below plus any defects noted, correction action required and correction made.

2. Data shall be recorded on prepared forms and shall include not less than the following items.

a. Facility identification (name, location).
b. Loop identification (name or function).
c. Equipment tag and serial numbers.
d. Scale ranges and units.
e. Test mode or type of test.
f. Input values or settings.
g. Expected outputs and tolerances.
h. Date of actual calibration.
i. Actual readings.
j. Explanations or special notes as applicable.
k. Tester's certification with name and signature.

3.07 System Validation

A. Provide the services of factory trained and field experienced instrumentation engineer(s) to validate each system to verify that each system is operational and performing its intended function within system tolerance.

1. System tolerance is defined as the root-mean-square sum of the system component published specified accuracies from input to output.

B. Validate each system by simulating inputs at the first element in loop (i.e., sensor) of 10%, 50%, and 90% of span, or on/off and verifying loop output devices (i.e., recorder, indicator, alarm, etc., except controllers).

1. During system validation, make provisional settings on levels, and alarms.

2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.

3. Verify that alarms and logic sequences operate in accordance with the specifications.

C. Cause malfunctions to sound alarms or switch to standby to check system operation. Check all systems thoroughly for correct operation.

D. Immediately correct defects and malfunctions disclosed by tests. Use new parts and materials as required and approved and retest.

E. Provide a report certifying completion of validation of each instrument system.

1. Report shall indicate calculated system tolerances, data verifying that the system meets these tolerances, and any provisional settings made to devices.

2. Data sheets shall be similar to those used for calibration.

3.08 Final Operational Testing and Acceptance

A. Upon completion of instrument calibration and system validation, test system under process conditions.

1. The intent of this test is to demonstrate and verify the operational interrelationship of the instrumentation systems.

2. Testing shall include, but not be limited to, specified operational modes, taking process variables to their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.

B. Immediately correct defects and malfunctions with approved methods and materials in each case and repeat and testing.

C. Upon completion of final operational testing, submit certified report, with substantiating data sheets, indicating that total instrumentation and control system meets the functional requirements specified herein.

D. Testing shall be observed by ENGINEER.

1. Notify ENGINEER in writing a minimum of 48 hours prior to the proposed date for commencing the testing.

2. Upon completion of this test CONTRACTOR shall begin or have begun system start-up.

3. OWNER reserves the right to set the schedule.

3.09 Start-Up Assistance

A. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of 1 day at the project site to assist ENGINEER in field checkout and start-up of software. This period shall be scheduled by ENGINEER.

B. Provide the services of a factory trained and field experienced instrumentation engineer for a minimum of two (2) working days to assist OWNER's personnel during startup of the system. Purpose of this assistance is to support in making final adjustments of settings on the instrument systems.

3.10 Coordination

A. Work shall be coordination with other trades involved in the construction project.

B. Work shall be carefully laid out in advance so that architectural, structural, mechanical, electrical, and instrumentation features of construction will be coordinated.

3.11 Digital Equipment

A. Digital equipment supplier shall provide an authorized, service representative for a minimum of three times at jobsite, including once during installation and start-up and once during acceptance to inspect and check out the control system.

B. Service representative shall revisit jobsite for 8 hours per day as often as necessary after installation until trouble is corrected and equipment has passed acceptance test and is operating satisfactorily to ENGINEER.

End of Section

Exhibit 1
Project Forms

1. Certificate of Substantial Completion
2. Construction Change Requisition / Work Order
3. Field Order
4. Request for Information
5. City of Flint Material Disposal Form

Certificate of Substantial Completion

350-02
(Rev. 08/2018)

PROJECT: _____

OWNER: _____

CONTRACTOR: _____

CONTRACT DATE: _____ PROJECT NO.: _____

DATE OF ISSUANCE: _____

PROJECT OR DESIGNATED PORTION SHALL INCLUDE:

_____
_____
_____
_____

The Work performed under this Contract has been reviewed and found to be Substantially Complete. The date of Substantial Completion of the Project or portion thereof designated above is hereby established as _____ which is also the date of commencement of applicable warranties required by the Contract Documents except as stated below.

DEFINITION OF DATE OF SUBSTANTIAL COMPLETION

The date of Substantial Completion of the Work or designated portion thereof, is the date certified by the ENGINEER when construction is sufficiently complete, in accordance with the Contract Documents, so the OWNER can occupy or utilize the Work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, prepared by the ENGINEER is attached hereto. The failure to include any items on such list does not alter the responsibility of the CONTRACTOR to complete all Work in accordance with the Contract Documents. The date of commencement of warranties for items on the attached list will be the date of final payment unless otherwise agreed to in writing.

The responsibilities of the OWNER and the CONTRACTOR for security, maintenance, heat, utilities, damage to the Work and insurance shall be as follows:

(Note - OWNER's and CONTRACTOR's legal and insurance counsel should determine and review insurance requirements and coverage; CONTRACTOR shall secure consent of surety company, if any.)

OWNER shall have 45 days after receipt of this certificate during which he may make written objection to ENGINEER and CONTRACTOR as to any provisions of the certificate or attached list. Such objection may be cause for this Certificate of Substantial Completion to be null and void.

_____ _____ _____
ENGINEER By Date

CLEAR FORM

WADE TRIM

CLEAR FORM

☐ CONSTRUCTION CHANGE REQUISITION
☐ WORK ORDER

NO. _____

305.05
(Rev. 04/2019)

Prepared By: _____ **Date:** _____
Page: ____ **of** ____

WT Project No.:		**Project Name:**	
Owner / Municipality:			
Owner Project No.:		**Department:**	
Project Location:			
Contractor:		**Subcontractor:**	

Description or Work:

Reason:

Item No.	Description	Unit	Quantity Increase (Decrease)	Unit Price	Amount Increase (Decrease)
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
					$ 0.00
				Net Cost	**$ 0.00**

Request for Contract Time Extension: ☐ Add _____ Days ☐ Not Applicable

_____ _____ _____ _____
Contractor (Representative) Date Wade Trim (Representative) Date

WADE TRIM

☐ **CONSTRUCTION CHANGE REQUISITION**
☐ **WORK ORDER**
No. _____
(continued)

Date: _____
Page: _____ of _____

Work Order Authorization: ☐ Approved ☐ Approved as Noted ☐ Not Approved

If authorized, the Contractor agrees to do the work outlined above under the direction of the Engineer, and to accept as payment in full the basis of payment as indicated.

Contract Time: ☐ Add Time Extension of _____ Days ☐ Not Applicable

Accepted By: _____ _____
Contractor (Representative) Date

Recommended By: _____ _____
Wade Trim (Representative) Date

Approved By: _____ _____
Owner (Representative) Date

FIELD ORDER NO. _____

305.04
(Rev. 11/2018)

WT Project No.:		**Project Name:**	
Owner / Municipality:			
Owner Project No.:		**Department:**	
Project Location:			
Contractor:		**Subcontractor:**	

Date:	
Prepared by:	
Subject / Description:	

Classification:

☐ Clarification or ☐ Interpretation of Contract Documents

☐ Minor Change in Work Which Does Not Involve Contract Price or Contract Time

☐ Minor Change in Addition to Work

Reason:

Resident Project Representative Date

Contractor's Authorized Representative Date

CLEAR FORM

REQUEST FOR INFORMATION (RFI) NO. _____

311-01
(Rev. 12/2018)

WT Project No.:		**Project Name:**	
Owner / Municipality:			
Owner Project No.:		**Department:**	
Project Location:			
Contractor:		**Subcontractor:**	

RFI Subject:			
Division:		**Spec Section:**	
Plan Sheet No(s).:			
Date Received:		**Requested Response Date:**	
Returned to Contractor:			

Information Requested

Attachments

WADE TRIM

RFI NO. _____

Response

Attachments

Response by: _____ **Date:** _____

THIS REPLY IS GIVEN WITH THE EXPRESSED UNDERSTANDING THAT IT DOES NOT CONSTITUTE BASIS FOR CHANGE IN PRICE OR TIME OF THE CONTRACT UNLESS OTHERWISE INDICATED.

CLEAR FORM

THE CITY OF FLINT, MI

MATERIAL DISPOSAL PLAN (MDP)

This form is to be submitted when removal and off-site disposal of excavation spoils, demolished material or other debris is required from a City of Flint project.

All excavated and demolished material from a construction site that is not to be reused must be properly removed and disposed at an approved facility. If the material is to be disposed of in the City of Flint, a permit or written authorization must be obtained from the City. If it is to be disposed of outside the City limits, documentation must be provided that the Contractor has complied with all the rules and regulations of the local community and that the disposal facility or property owner has given their approval to accept the material. One copy of this form must be completed for each disposal / stockpile site if the Contractor plans to use more than one site. A copy of this plan must be on file with the City and Engineer before initiating construction.

General Project Information and Certification

Date Submitted: _____ City of Flint Project No: _____

Contractor: _____ Project Name: _____

In submitting this Material Disposal Plan (MDP), the above named contractor expressly certifies that all material to be removed from the construction site will be hauled in accordance with all applicable federal, state, and local highway and traffic rules, regulations and laws, and that the Material Disposal Plan meets all federal, state, and local rules and regulations with regard to the removal and disposal of this material.

Contractor Contact: _____ Title: _____

Signature: _____ Date: _____

Disposal of Material within the City of Flint

Is the material to be disposed of within the City of Flint? Yes[1] _____ No _____

'Attach a copy of the disposal permit if the above answer is "Yes".

Disposal of Material outside of the City of Flint

Is the material to be disposed of outside of the City of Flint? Yes[2] _____ No _____

'Provide the following information if material is to be removed from the site and disposed outside the City of Flint.

Disposal Site: _____ Site Address: _____

Municipality: _____ _____

Is a permit for the above municipality required? Yes[3] _____ No _____

Attach a copy of the municipal permit

Directions to Site _____

_____

Disposal Facility / Property Owner Acknowledgement

I hereby acknowledge that I have agreed to accept material from _____, to be disposed of at our facility / property as described above and that it is my understanding that the above named contractor will meet all federal, state, and local rules and regulations with regard to the removal and transport of this material.

Facility Owner: _____ Title: _____

Signature: _____ Date: _____

Exhibit 2
Geotechnical Report

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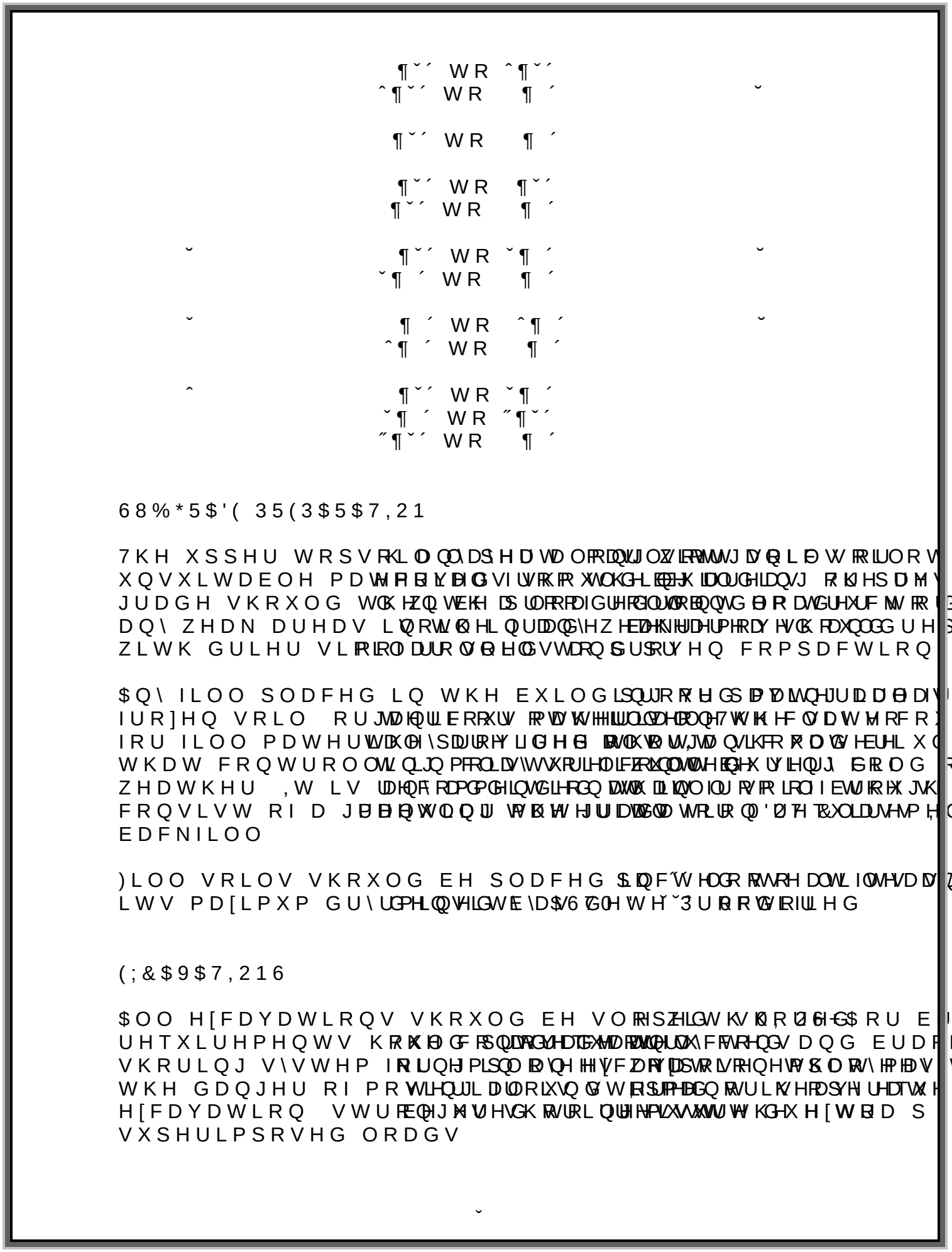

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Construction **T**esting **S**ervices
3300 E. Bristol Road, Burton, MI 48529
PHONE: (810) 603-0766
FAX: (810) 603-0786

JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 3
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/9/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		9" **Topsoil -** Medium Compact, Moist, Sandy, Black w/Roots					
	1						
3A	2	**Fill Sand -** Medium Compact, Moist, Brown	3				
SS			3				
	3	3'0"	3				
	4	**Fill Sand -** Compact, Moist, Brown w/Topsoil					
3B		4'6"	5				
SS	5	**Sand -** Compact, Moist, Brown w/Pebble **(SM - Silty Sand)**	6	12.4	99.6		
			7				
	6	6'0"					
		6'9" **Sand -** Compact, Wet, Brown w/Grey Silt Seams					
3C	7		4				
SS			4				
	8		6				
		Silt - Compact, Wet, Clayey, Grey					
	9						
3D		9'6"	3				
SS	10		5				
			7				
	11						
		Clay - Stiff, Moist, Silty, Sandy, Blue					
	12						
	13	13'0"					
	14						
3E		**Clay -** Firm, Moist, Blue w/Red Sand Layers	2				
SS	15		3				
			5				
	16	16'0"					
	17						
	18						
		Clay - Stiff, Moist, Blue w/Pebble					
	19						
3F			4				
SS	20		5				
		20'6"	5				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	6	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	18	FT.	0	INS.
G.W. AFTER 3 HOURS	6	FT.	7	INS.
G.W. VOLUMES	Heavy			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 4
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/9/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
	1		1'0" **Topsoil -** Medium Compact, Moist, Sandy, Clayey, Black w/Roots					
4A	2			2				
SS				2				
	3			4				
	4		**Clay -** Firm, Moist, Sandy, Brown w/occ Pebble	2				
4B								
SS	5		**(CL - Low Plasticity Clay)**	3	10.9	130.8	1778	15.5
				3				
	6							
4C	7			2				
SS				3				
	8		7'9"	4				
	9							
4D				5				
SS	10			7				
				7				
	11							
	12							
	13		**Sand -** Compact, Moist, Brown					
	14							
4E				8				
SS	15			10				
				11				
	16							
	17							
	18		18'0"					
	19							
4F			**Sand -** Compact, Wet, Brown w/occ Pebble	3				
SS	20			5				
			20'6"	5				
	21		**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	18	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	18	FT.	0	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES	Heavy			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 5
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/9/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
			9" **Topsoil -** Medium Compact, Moist, Sandy, Clayey, Black w/Roots					
	1							
5A	2		**Sand -** Medium Compact, Moist, Brown	2				
SS				2				
	3		3'0"	3				
	4							
5B				2				
SS	5		**Clay -** Firm to Stiff, Moist, Sandy, Brown w/occ Pebble &	3	18.5	122.3	2097	15.5
				4				
	6		Oxidation **(CL - Low Plasticity Clay)**					
5C	7			3				
SS			7'6"	5				
	8			8				
	9							
5D				3				
SS	10			4				
				6				
	11							
	12							
	13		**Sand -** Medium Compact, Moist, Brown					
	14							
5E				2				
SS	15			3				
				4				
	16							
	17							
	18		17'9"					
	19		**Sand -** Medium Compact, Wet, Brown					
5F			19'6"	4				
SS	20		**Sand -** Compact, Wet, Grey	5				
			20'6"	12				
	21		**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	17	FT.	9	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	18	FT.	2	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 6
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/9/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
			5" **Topsoil -** Medium Compact, Moist, Sandy, Black w/occ Pebble					
	1							
6A	2			3				
SS				5				
	3		**Clay -** Stiff, Moist, Sandy, Brown w/occ Pebble & Oxidation	5				
			(CL - Low Plasticity Clay)					
	4							
6B				5				
SS	5			8	16.7	140.1	11264	14.7
			5'6"	9				
	6							
6C	7		**Clay -** Very Stiff, Moist, Brown w/Pebble	6				
SS				13				
	8			16				
			8'6"					
	9							
6D				8				
SS	10			11				
				16				
	11							
	12							
	13		**Sand -** Compact, Moist, Silty, Brown					
	14							
6E				7				
SS	15			11				
				13				
	16							
	17		17'0"					
	18							
	19		**Sand -** Compact, Wet, Brown					
6F				4				
SS	20			5				
			20'6"	8				
	21		**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	17	FT.	9	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	16	FT.	4	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 7
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
	1	**Topsoil -** Medium Compact, Moist, Sandy, Brown w/Roots					
		1'0"					
7A SS	2		2				
	3		3				
			5				
	4	**Clay -** Firm, Moist, Silty, Sandy, Variegated					
7B		**(CL - Low Plasticity Clay)**	3				
SS	5		3	24.3	129.4	4867	15.5
			5				
	6						
		6'0"					
7C SS	7	**Clay -** Very Stiff, Moist, Silty, Sandy, Brown w/Wet Sand Seams	3				
			7				
	8		9				
		8'0"					
	9	**Clay -** Very Stiff, Moist, Silty, Sandy, Brown & Blue					
7D			8				
SS	10		9				
		10'0"	10				
	11						
	12						
	13						
		Clay - Stiff to Very Stiff, Moist, Silty, Blue					
	14						
7E			6				
SS	15		6				
			7				
	16						
		16'6"					
	17						
	18						
		Clay - Extremely Stiff, Moist, Silty, Blue					
	19						
7F			11				
SS	20		16				
			20				
	21	**Continued**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	6	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	13	FT.	4	INS.
G.W. AFTER 10 HOURS	4	FT.	2	INS.
G.W. VOLUMES	Heavy			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 7
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
	21							
	22							
	23		**Clay -** Extremely Stiff, Moist, Silty, Blue					
	24							
7G				15				
SS	25			16				
			25'6"	19				
	26		**End of Boring**					
	27							
	28							
	29							
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	6	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	13	FT.	4	INS.
G.W. AFTER 10 HOURS	4	FT.	2	INS.
G.W. VOLUMES	Heavy			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 8
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		6" **Topsoil -** Medium Compact, Moist, Sandy, Clayey, Black w/Roots					
	1						
8A	2		3				
SS			4				
	3	**Clay -** Stiff, Moist, Silty, Sandy, Variegated	5				
		(CL - Low Plasticity Clay)					
	4						
8B			3				
SS	5	5'0"	4	25.8	125.2	2040	15.5
			4				
	6	6'0" **Clay -** Stiff, Moist, Silty, Sandy, Variegated w/Brown Sand Seams					
8C	7		4				
SS			6				
	8	**Clay -** Stiff, Moist, Silty, Sandy, Brown	10				
	9						
8D		9'6"	6				
SS	10		7				
			7				
	11						
		Clay - Stiff, Moist, Silty, Blue					
	12						
	13	13'0"					
	14						
8E			3				
SS	15	**Sand -** Compact, Wet, Brown	4				
			7				
	16						
	17	17'0"					
	18						
	19	**Clay -** Stiff, Moist, Silty, Sandy, Blue					
8F			5				
SS	20		5				
		20'6"	5				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	5	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	7	FT.	0	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 9
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
			6" **Topsoil -** Compact, Moist, Sandy, Black w/Roots					
	1							
9A	2			6				
SS			**Sand -** Compact, Moist, Brown w/Pebbles	7				
	3			7				
			3'9"					
	4							
9B				10				
SS	5			10	5.9			
				13				
	6							
9C	7			12				
SS				15				
	8			17				
			Sand - Compact to Very Compact, Moist, Brown w/Pebble & Stone **(SM - Silty Sand)**					
	9							
9D				13				
SS	10			14				
				16				
	11							
	12							
	13		13'0"					
	14							
9E				4				
SS	15			5				
				6				
	16							
	17		**Sand -** Compact, Wet, Brown w/Gravel					
	18							
	19							
9F				4				
SS	20			4				
			20'6"	6				
	21		**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	13	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	11	FT.	7	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES	Heavy			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 10
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		4" **Topsoil -** Medium Compact, Moist, Sandy, Black w/Roots					
	1						
10A	2		2				
SS			3				
	3		3				
		Sand - Medium Compact to Compact, Moist, Brown					
	4						
10B			3				
SS	5		5				
			5				
	6	6'0"					
10C	7		3				
SS			3	16.5	106.3		
	8		5				
		Sand - Medium Compact to Compact, Wet, Brown					
	9	**(SM - Silty Sand)**					
10D			3				
SS	10		4				
			6				
	11						
		11'6"					
	12						
	13	**Sand -** Compact, Wet, Grey					
	14						
10E		14'6"	2				
SS	15		4				
			5				
	16						
	17						
	18	**Clay -** Stiff, Moist, Sandy, Blue w/Wet Sand Seams					
	19						
10F			5				
SS	20		6				
		20'6"	6				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	6	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	6	FT.	6	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 11
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/9/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		5" **Topsoil -** Compact, Moist, Sandy, Dark Brown w/Roots					
	1						
11A	2		4				
SS			7				
	3		7				
		Sand - Medium Compact to Compact, Moist, Brown					
	4	**(SP - Poorly Graded Sand)**					
11B			3				
SS	5		4	3.1	93.5		
			5				
	6						
		6'9"					
11C	7		3				
SS		7'6" **Clay -** Stiff, Moist, Sandy, Brown	6				
	8		7				
		8'6" **Clay -** Stiff, Moist, Silty, Sandy, Blue w/Wet Sand Seams					
	9						
11D			7				
SS	10		6				
			10				
	11						
	12						
	13	**Clay -** Stiff, Moist, Blue w/Wet Sand Seams					
	14						
11E			4				
SS	15		6				
			9				
	16						
	17	17'0"					
	18						
	19	**Clay -** Very Stiff, Moist, Silty, Sandy, Blue					
11F			6				
SS	20		9				
		20'6"	11				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	7	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	11	FT.	6	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES	Light			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 12
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		5" **Topsoil -** Compact, Moist, Sandy, Dark Brown w/Roots					
	1						
12A	2	**Possible Fill Sand -** Compact, Moist, Brown w/Pebble &	5				
SS		occ/Stone	7				
	3		7				
		3'6"					
	4						
12B			2				
SS	5		3	12.2	121.8		
		Possible Fill Sand - Medium Compact, Moist, Clayey, Brown	4				
	6	w/occ Pebble & Stone **(SC - Clayey Sand)**					
12C	7		3				
SS		7'7"	4				
	8		5				
		8'6" **Clay -** Stiff, Moist, Sandy, Variegated w/Black Tint					
	9						
12D		9'6" **Clay -** Stiff, Moist, Silty, Blue	8				
SS	10		9				
			11				
	11						
	12						
	13						
	14						
12E			4				
SS	15	**Sand -** Compact, Wet, Fine, Grey	4				
			7				
	16						
	17						
	18						
	19						
12F			7				
SS	20		8				
		20'6"	9				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	13	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	12	FT.	7	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 13
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		6" **Topsoil -** Medium Compact, Moist, Sandy, Dark Brown w/Roots					
	1						
13A	2	**Sand -** Medium Compact, Moist, Brown w/occ Pebble & Stone	3				
SS			4				
	3		4				
		3'6"					
	4						
13B		**Clay -** Very Stiff, Moist, Silty, Sandy, Variegated	4				
SS	5	**(CL - Low Plasticity Clay)**	7	18.6	132.2	8029	15.5
			9				
	6	6'0"					
13C	7	**Clay -** Very Stiff, Moist, Silty, Sandy, Brown & Blue	5				
SS			7				
	8	8'3"	10				
	9						
13D			4				
SS	10	**Clay -** Stiff, Moist, Silty, Sandy, Blue	6				
			8				
	11						
		11'6"					
	12						
	13						
	14						
13E			7				
SS	15		9				
			10				
	16	**Clay -** Very Stiff, Moist, Silty, Sandy, Blue w/occ Pebble					
	17						
	18						
	19						
13F			8				
SS	20		11				
		20'6"	12				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	FT.	INS.
G.W. ENCOUNTERED AT	FT.	INS.
G.W. ON COMPLETION	FT.	INS.
G.W. AFTER HOURS	FT.	INS.
G.W. VOLUMES None		

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 14
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
			4" **Topsoil -** Medium Compact, Moist, Sandy, Dark Brown w/Roots					
	1							
14A	2			3				
SS			**Sand -** Medium Compact, Moist, Slightly Clayey, Brown w/Pebble	3				
	3			5				
	4							
14B			4'6"	3				
SS	5			5	12.9	134.5	4988	12.1
				8				
	6		**Clay -** Stiff, Moist, Sandy, Variegated **(CL - Low Plasticity Clay)**					
14C	7		7'0"	8				
SS				12				
	8			13				
	9							
14D			**Clay -** Very Stiff to Extremely Stiff, Moist, Silty, Sandy, Brown	10				
SS	10		w/occ Pebble & Stone	15				
				19				
	11							
			11'6"					
	12							
	13							
	14							
14E				8				
SS	15			9				
				9				
	16		**Clay -** Very Stiff, Moist, Sandy, Blue w/occ Pebble					
	17							
	18							
	19							
14F				7				
SS	20			8				
			20'6"	10				
	21		**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	FT.	INS.
G.W. ENCOUNTERED AT	FT.	INS.
G.W. ON COMPLETION	FT.	INS.
G.W. AFTER HOURS	FT.	INS.
G.W. VOLUMES None		

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 15
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 9/7/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		6" **Topsoil -** Medium Compact, Moist, Sandy, Dark Brown w/Roots					
	1						
		Sand - Medium Compact, Moist, Brown w/Pebble					
15A	2		3				
SS		2'6"	4				
	3		5				
	4	**Clay -** Stiff, Moist, Silty, Sandy, Variegated w/occ Pebble					
15B			3				
SS	5	**(CL - Low Plasticity Clay)**	4	14.3	131.5	2482	15.5
			6				
	6	6'0"					
15C	7		5				
SS			8				
	8		14				
	9						
15D		**Clay -** Very Stiff, Moist, Sandy, Brown	8				
SS	10		13				
			17				
	11						
	12						
		12'6"					
	13						
	14						
15E			10				
SS	15		11				
			12				
	16						
	17	**Clay -** Very Stiff, Moist, Silty, Sandy, Blue w/occ Pebble					
	18						
	19						
15F			10				
SS	20		12				
		20'6"	15				
	21	**End of Boring**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	FT.	INS.
G.W. ENCOUNTERED AT	FT.	INS.
G.W. ON COMPLETION	FT.	INS.
G.W. AFTER HOURS	FT.	INS.
G.W. VOLUMES None		

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 16
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 10/25/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
			4" **Asphalt**					
	1		1'0" **Fill Sand -** Medium Compact, Moist, Dark Brown w/Broken Asphalt					
16A	2			2				
SS			**Sand -** Medium Compact, Moist, Brown w/Pebble	3				
	3		2'8"	5				
			3'6" **Clay -** Firm, Moist, Silty, Sandy, Variegated w/Green Tint					
	4							
16B				1				
SS	5			1	15.2			
				1				
	6							
16C	7			0				
SS				0				
	8		**Sand -** Loose, Wet, Fine, Brown **(SM-Silty Sand)**	1				
	9							
16D				0				
SS	10			0				
				1				
	11							
	12		12'0"					
	13							
	14							
16E				4				
SS	15		**Clay -** Stiff, Moist, Silty, Sandy, Blue w/occ Pebble	5				
				7				
	16							
	17		17'0"					
	18							
	19		**Clay -** Extremely Stiff, Moist, Sandy, Blue w/occ Pebble					
16F				9				
SS	20			16				
				18				
	21		**Continued**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	3	FT.	6	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	2	FT.	6	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 16
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 10/25/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
	21							
	22							
	23							
	24							
16G				9				
SS	25		**Clay -** Extremely Stiff, Moist, Sandy, Blue w/occ Pebble	19				
				22				
	26							
	27							
	28							
	29							
16H				11				
SS	30			18				
			30'6"	24				
	31		**End of Boring**					
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	3	FT.	6	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	2	FT.	6	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES	Heavy			

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 17
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 10/25/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
		4" **Topsoil -** Medium Compact, Moist, Sandy, Black w/Roots					
	1						
		Sand - Medium Compact, Moist, Brown w/Pebble & occ/Stone					
17A	2		3				
SS		2'9"	3				
	3	**Clay -** Firm, Moist, Silty, Sandy, Variegated w/Green Tint,	2				
		Possible Swamp Bottom					
	4	4'0"					
17B			1				
SS	5	**Clay -** Firm, Moist, Silty, Sandy, Variegated w/occ Pebble	2				
			2				
	6	6'0"					
17C	7		2				
SS			3	14.7	132.8	2982	15.5
	8	**Clay -** Stiff, Moist, Silty, Sandy, Brown **(CL - Low Plasticity Clay)**	6				
	9						
17D		9'6"	3				
SS	10		5				
			14				
	11	**Clay -** Very Stiff, Moist, Silty, Sandy, Blue w/Brown Sand Seams					
		11'9"					
	12						
	13						
		Clay - Stiff, Moist, Silty, Sandy, Blue w/occ Pebble					
	14						
17E			3				
SS	15	15'0"	4				
			6				
	16	**Clay -** Stiff, Moist, Silty, Sandy, Blue w/occ Pebble & Wet Grey					
		Sand Seams					
	17	17'0"					
	18						
	19	**Clay -** Extremely Stiff, Moist, Silty, Sandy, Blue w/occ Pebble					
17F			10				
SS	20		18				
			22				
	21	**Continued**					

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	15	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	23	FT.	6	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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JOB NO. S-19-219 **LOG OF SOIL BORING NO.** 17
PROJECT: City of Flint Secondary Water Supply
LOCATION: Flint, Michigan
DATE: 10/25/19 **SURFACE ELEVATION:** Existing

Sample & Type	Depth	Legend	Soil Description	SPT Blows per 6"	Moisture %	Natural Wt. P.C.F.	Unc. Comp. Strength	Str. %
	21							
	22							
	23							
	24							
17G				10				
SS	25		**Clay -** Extremely Stiff, Moist, Silty, Sandy, Blue w/occ Pebble	13				
				14				
	26							
	27							
	28							
	29							
17H				12				
SS	30			17				
			30'6"	18				
	31		**End of Boring**					
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
OTHER -

BORING PLUGGED WITH NATURAL SOIL

*** The soil descriptions shown on the logs are from visual observations. No classification tests were performed.**

Standard Penetration Test - Driving 2" OD Sampler 1' With 140# Hammer Falling 30"; Count Made At 6" Intervals.

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	15	FT.	0	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. ON COMPLETION	23	FT.	6	INS.
G.W. AFTER HOURS		FT.		INS.
G.W. VOLUMES Heavy				

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MECHANICAL ANALYSIS REPORT

Date:	**1/19/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**1B**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		4.1	3.1	3.1	97
3/8"		1.2	0.9	4.1	96
#4		6.8	5.2	9.3	91
#8		6.1	4.7	14.0	86
#16		2.4	1.8	15.8	84
#30		12.2	9.4	25.2	75
#50		15.7	12.1	37.3	63
#100		35.3	27.1	64.4	36
#200		13.6	10.4	74.8	25
LBW		32.8	25.2	100.0	0
TOTAL		130.2			

			WT (gm)	%	SPEC %
DRY WT.	130.2	CRUSHED PARTICLES			
WASH WT.	99.0	CLAY-IRONSTONE			
LOSS	31.2	(1) SOFT PARTICLES INCLUDING			
PAN	1.6	CLAY-IRONSTONE			
TOTAL LBW	32.8	(2) CHERT			
% LBW	25.2	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SM or Silty Sand

Tested By: Jack F. Geerlings, P.E. Reviewed by: Jack F. Geerlings, P.E.

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MECHANICAL ANALYSIS REPORT

Date:	**1/19/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**3B**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		0.0	0.0	0.0	100
3/8"		0.0	0.0	0.0	100
#4		0.0	0.0	0.0	100
#8		0.0	0.0	0.0	100
#16		1.0	0.9	0.9	99
#30		4.7	4.2	5.1	95
#50		5.9	5.2	10.3	90
#100		50.6	44.9	55.2	45
#200		33.6	29.8	85.0	15
LBW		16.9	15.0	100.0	0
TOTAL		112.7			

			WT (gm)	%	SPEC %
DRY WT.	112.7	CRUSHED PARTICLES			
WASH WT.	97.0	CLAY-IRONSTONE			
LOSS	15.7	(1) SOFT PARTICLES INCLUDING			
PAN	1.2	CLAY-IRONSTONE			
TOTAL LBW	16.9	(2) CHERT			
% LBW	15.0	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SM or Silty Sand

Tested By: Jack F. Geerlings, P.E. Reviewed by: Jack F. Geerlings, P.E.

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MECHANICAL ANALYSIS REPORT

Date:	**1/19/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**9B**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		0.0	0.0	0.0	100
3/8"		2.8	2.6	2.6	97
#4		21.0	19.2	21.8	78
#8		22.1	20.3	42.1	58
#16		10.1	9.3	51.3	49
#30		18.9	17.3	68.7	31
#50		4.2	3.8	72.5	27
#100		6.5	6.0	78.5	22
#200		5.0	4.6	83.0	17
LBW		18.5	17.0	100.0	0
TOTAL		109.1			

			WT (gm)	%	SPEC %
DRY WT.	109.1	CRUSHED PARTICLES			
WASH WT.	91.3	CLAY-IRONSTONE			
LOSS	17.8	(1) SOFT PARTICLES INCLUDING			
PAN	0.7	CLAY-IRONSTONE			
TOTAL LBW	18.5	(2) CHERT			
% LBW	17.0	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SM or Silty Sand

Tested By: Jack F. Geerlings, P.E. Reviewed by: Jack F. Geerlings, P.E.

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MECHANICAL ANALYSIS REPORT

Date:	**1/19/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**10C**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		0.0	0.0	0.0	100
3/8"		0.0	0.0	0.0	100
#4		0.0	0.0	0.0	100
#8		0.3	0.2	0.2	100
#16		0.8	0.7	0.9	99
#30		6.4	5.3	6.2	94
#50		9.9	8.2	14.5	86
#100		48.0	39.9	54.4	46
#200		33.2	27.6	82.0	18
LBW		21.7	18.0	100.0	0
TOTAL		120.3			

			WT (gm)	%	SPEC %
DRY WT.	120.3	CRUSHED PARTICLES			
WASH WT.	100.1	CLAY-IRONSTONE			
LOSS	20.2	(1) SOFT PARTICLES INCLUDING			
PAN	1.5	CLAY-IRONSTONE			
TOTAL LBW	21.7	(2) CHERT			
% LBW	18.0	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SM or Silty Sand

Tested By: Jack F. Geerlings, P.E. Reviewed by: Jack F. Geerlings, P.E.

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MECHANICAL ANALYSIS REPORT

Date:	**1/19/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**11B**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		0.0	0.0	0.0	100
3/8"		0.0	0.0	0.0	100
#4		0.0	0.0	0.0	100
#8		0.0	0.0	0.0	100
#16		0.0	0.0	0.0	100
#30		0.0	0.0	0.0	100
#50		1.7	1.7	1.7	98
#100		86.6	84.4	86.1	14
#200		10.5	10.2	96.3	4
LBW		3.8	3.7	100.0	0
TOTAL		102.6			

			WT (gm)	%	SPEC %
DRY WT.	102.6	CRUSHED PARTICLES			
WASH WT.	99.2	CLAY-IRONSTONE			
LOSS	3.4	(1) SOFT PARTICLES INCLUDING			
PAN	0.4	CLAY-IRONSTONE			
TOTAL LBW	3.8	(2) CHERT			
% LBW	3.7	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SP or Poorly Graded Sand

Tested By: Jack F. Geerlings, P.E. Reviewed by: Jack F. Geerlings, P.E.

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MECHANICAL ANALYSIS REPORT

Date:	**1/19/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**12B**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		0.0	0.0	0.0	100
3/8"		1.7	1.2	1.2	99
#4		4.0	2.9	4.1	96
#8		4.1	3.0	7.1	93
#16		2.9	2.1	9.2	91
#30		10.1	7.3	16.5	83
#50		6.2	4.5	21.0	79
#100		22.5	16.3	37.4	63
#200		14.9	10.8	48.2	52
LBW		71.4	51.8	100.0	0
TOTAL		137.8			

			WT (gm)	%	SPEC %
DRY WT.	137.8	CRUSHED PARTICLES			
WASH WT.	68.0	CLAY-IRONSTONE			
LOSS	69.8	(1) SOFT PARTICLES INCLUDING			
PAN	1.6	CLAY-IRONSTONE			
TOTAL LBW	71.4	(2) CHERT			
% LBW	51.8	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SC or Silty Clay. The loss by wash on this sample is over 50% so it could also be classified as CL or a Clay with Low Plasticity.

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MECHANICAL ANALYSIS REPORT

Date:	**11/8/2019**	**Job No.**	**S-19-219**	**Client:**	**Wade Trim**
Project:	**Secondary Water Supply**	**Location:**	**Flint, MI**	**Supplier:**	**On-Site**
Material:	**Granular**	**Sample Location:**	**16B**	**Spec.:**	

SIEVE SIZE	SPEC	WEIGHT RETAINED	FRACTION RETAINED	% RETAINED	CUM. PASS
1 1/2"		0.0	0.0	0.0	100
1"		0.0	0.0	0.0	100
3/4"		0.0	0.0	0.0	100
1/2"		0.0	0.0	0.0	100
3/8"		0.0	0.0	0.0	100
#4		0.0	0.0	0.0	100
#8		0.0	0.0	0.0	100
#16		0.0	0.0	0.0	100
#30		0.0	0.0	0.0	100
#50		1.6	1.5	1.5	98
#100		85.6	82.1	83.7	16
#200		10.7	10.3	94.0	6
LBW		6.3	6.0	100.0	0
TOTAL		104.2			

			WT (gm)	%	SPEC %
DRY WT.	104.2	CRUSHED PARTICLES			
WASH WT.	98.3	CLAY-IRONSTONE			
LOSS	5.9	(1) SOFT PARTICLES INCLUDING			
PAN	0.4	CLAY-IRONSTONE			
TOTAL LBW	6.3	(2) CHERT			
% LBW	6.0	SUM of (1)+(2)	0.0		

Under the Unified Classification System this material would be classified SP or Poorly Graded Sand

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**2B**	**Depth:**	**5'**		
Unconfined Compression Strength (lb./ft.^{2})			**3938**		
Strain at Failure (%)			**13.8**		
Natural Unit Weight (lb./ft.^{3})			**129.4**		

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	3.3	317
0.050	1.7	1.51	6.7	639
0.075	2.6	1.52	9.7	916
0.100	3.4	1.54	12.8	1198
0.125	4.3	1.55	16.0	1485
0.150	5.2	1.57	19.2	1766
0.175	6.0	1.58	23.0	2096
0.200	6.9	1.59	26.3	2375
0.225	7.8	1.61	29.9	2675
0.250	8.6	1.62	33.9	3004
0.275	9.5	1.64	36.5	3204
0.300	10.3	1.66	39.3	3417
0.325	11.2	1.67	42.1	3625
0.350	12.1	1.69	44.2	3769
0.375	12.9	1.71	45.9	3876
0.400	13.8	1.72	47.1	3938
0.425	14.7	1.74		0
0.450	15.5	1.76		0

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	146.3
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	124.4
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	17.6
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	129.4

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**4B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**1778**
Strain at Failure (%)	**15.5**
Natural Unit Weight (lb./ft.^{3})	**130.8**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	2.6	250
0.050	1.7	1.51	4.5	429
0.075	2.6	1.52	5.7	538
0.100	3.4	1.54	7.1	665
0.125	4.3	1.55	8.4	779
0.150	5.2	1.57	9.7	892
0.175	6.0	1.58	11.1	1011
0.200	6.9	1.59	12.3	1111
0.225	7.8	1.61	13.5	1208
0.250	8.6	1.62	14.7	1303
0.275	9.5	1.64	15.8	1387
0.300	10.3	1.66	16.8	1461
0.325	11.2	1.67	17.8	1533
0.350	12.1	1.69	18.7	1595
0.375	12.9	1.71	19.6	1655
0.400	13.8	1.72	20.3	1697
0.425	14.7	1.74	21.0	1738
0.450	15.5	1.76	21.7	1778

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	147.9
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	133.4
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	10.9
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	130.8

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**5B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**2097**
Strain at Failure (%)	**15**
Natural Unit Weight (lb./ft.^{3})	**122.3**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	1.6	154
0.050	1.7	1.51	2.5	238
0.075	2.6	1.52	3.4	321
0.100	3.4	1.54	4.3	403
0.125	4.3	1.55	5.3	492
0.150	5.2	1.57	6.4	589
0.175	6.0	1.58	7.5	683
0.200	6.9	1.59	8.7	786
0.225	7.8	1.61	10.1	903
0.250	8.6	1.62	11.5	1019
0.275	9.5	1.64	12.9	1132
0.300	10.3	1.66	14.4	1252
0.325	11.2	1.67	16.2	1395
0.350	12.1	1.69	18.0	1535
0.375	12.9	1.71	20.2	1706
0.400	13.8	1.72	21.9	1831
0.425	14.7	1.74	23.9	1978
0.450	15.5	1.76	25.6	2097

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	138.3
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	116.7
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	18.5
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	122.3

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**6B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**11264**
Strain at Failure (%)	**14.7**
Natural Unit Weight (lb./ft.^{3})	**140.1**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	15	1442
0.050	1.7	1.51	24.7	2354
0.075	2.6	1.52	34.1	3221
0.100	3.4	1.54	44.5	4167
0.125	4.3	1.55	52.5	4872
0.150	5.2	1.57	61.6	5665
0.175	6.0	1.58	70.5	6424
0.200	6.9	1.59	77.6	7006
0.225	7.8	1.61	85.1	7612
0.250	8.6	1.62	91.7	8126
0.275	9.5	1.64	97.8	8585
0.300	10.3	1.66	104.0	9042
0.325	11.2	1.67	109.1	9394
0.350	12.1	1.69	113.8	9704
0.375	12.9	1.71	118.8	10031
0.400	13.8	1.72	122.2	10216
0.425	14.7	1.74	136.1	11264
0.450	15.5	1.76	129.7	10626

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	158.4
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	135.7
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	16.7
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	140.1

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**7B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**4867**
Strain at Failure (%)	**15.5**
Natural Unit Weight (lb./ft.^{3})	**129.4**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	6.9	663
0.050	1.7	1.51	11.1	1058
0.075	2.6	1.52	15.0	1417
0.100	3.4	1.54	19.2	1798
0.125	4.3	1.55	23.1	2144
0.150	5.2	1.57	27.1	2492
0.175	6.0	1.58	30.8	2807
0.200	6.9	1.59	34.4	3106
0.225	7.8	1.61	37.9	3390
0.250	8.6	1.62	41.1	3642
0.275	9.5	1.64	44.2	3880
0.300	10.3	1.66	47.1	4095
0.325	11.2	1.67	49.7	4280
0.350	12.1	1.69	52.2	4451
0.375	12.9	1.71	54.3	4585
0.400	13.8	1.72	56.1	4690
0.425	14.7	1.74	57.9	4792
0.450	15.5	1.76	59.4	4867

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	146.3
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	117.7
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	24.3
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	129.4

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**8B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**2040**
Strain at Failure (%)	**15.5**
Natural Unit Weight (lb./ft.^{3})	**125.2**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	1.4	135
0.050	1.7	1.51	2.3	219
0.075	2.6	1.52	3.5	331
0.100	3.4	1.54	4.8	449
0.125	4.3	1.55	6.0	557
0.150	5.2	1.57	7.4	681
0.175	6.0	1.58	8.8	802
0.200	6.9	1.59	10.3	930
0.225	7.8	1.61	12.0	1073
0.250	8.6	1.62	13.6	1205
0.275	9.5	1.64	15.3	1343
0.300	10.3	1.66	17.0	1478
0.325	11.2	1.67	18.8	1619
0.350	12.1	1.69	20.4	1740
0.375	12.9	1.71	21.9	1849
0.400	13.8	1.72	23.1	1931
0.425	14.7	1.74	24.0	1986
0.450	15.5	1.76	24.9	2040

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	141.6
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	112.6
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	25.8
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	125.2

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**13B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**8029**
Strain at Failure (%)	**15.5**
Natural Unit Weight (lb./ft.^{3})	**132.3**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	4.6	442
0.050	1.7	1.51	8.3	791
0.075	2.6	1.52	12.0	1134
0.100	3.4	1.54	16.1	1507
0.125	4.3	1.55	20.6	1912
0.150	5.2	1.57	25.7	2363
0.175	6.0	1.58	31.2	2843
0.200	6.9	1.59	36.7	3314
0.225	7.8	1.61	42.7	3820
0.250	8.6	1.62	49.5	4387
0.275	9.5	1.64	56.1	4924
0.300	10.3	1.66	62.4	5425
0.325	11.2	1.67	69.2	5959
0.350	12.1	1.69	76.0	6481
0.375	12.9	1.71	82.2	6941
0.400	13.8	1.72	88.0	7357
0.425	14.7	1.74	93.4	7730
0.450	15.5	1.76	98.0	8029

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	149.6
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	126.1
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	18.6
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	132.3

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**14B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**4988**
Strain at Failure (%)	**12.1**
Natural Unit Weight (lb./ft.^{3})	**134.5**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	9.4	904
0.050	1.7	1.51	14.8	1411
0.075	2.6	1.52	18.4	1738
0.100	3.4	1.54	23.1	2163
0.125	4.3	1.55	27.1	2515
0.150	5.2	1.57	31.5	2897
0.175	6.0	1.58	36.0	3280
0.200	6.9	1.59	40.0	3612
0.225	7.8	1.61	44.4	3972
0.250	8.6	1.62	47.7	4227
0.275	9.5	1.64	51.2	4494
0.300	10.3	1.66	54.5	4738
0.325	11.2	1.67	57.0	4908
0.350	12.1	1.69	58.5	4988
0.375	12.9	1.71	58.9	4973
0.400	13.8	1.72		0
0.425	14.7	1.74		0
0.450	15.5	1.76		0

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	152.1
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	134.7
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	12.9
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	134.5

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**9/19/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**15B**	**Depth:**	**5'**		

Unconfined Compression Strength (lb./ft.^{2})	**2482**
Strain at Failure (%)	**15.5**
Natural Unit Weight (lb./ft.^{3})	**131.5**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	1.8	173
0.050	1.7	1.51	3.5	334
0.075	2.6	1.52	5.0	472
0.100	3.4	1.54	6.7	627
0.125	4.3	1.55	8.3	770
0.150	5.2	1.57	10.0	920
0.175	6.0	1.58	11.7	1066
0.200	6.9	1.59	13.5	1219
0.225	7.8	1.61	15.3	1369
0.250	8.6	1.62	17.0	1506
0.275	9.5	1.64	18.8	1650
0.300	10.3	1.66	20.6	1791
0.325	11.2	1.67	22.3	1920
0.350	12.1	1.69	24.0	2047
0.375	12.9	1.71	25.8	2178
0.400	13.8	1.72	27.4	2291
0.425	14.7	1.74	28.9	2392
0.450	15.5	1.76	30.3	2482

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	148.7
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	130.1
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	14.3
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	131.5

* Moisture content was determined on entire sample after compression test

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UNCONFINED COMPRESSION TEST

Date:	**11/6/2019**	**Job No.**	**S-19-219**	**Project:**	**Flint Secondary Water Supply**
Sample:	**17C**	**Depth:**	**7.5"**		

Unconfined Compression Strength (lb./ft.^{2})	**2982**
Strain at Failure (%)	**15.5**
Natural Unit Weight (lb./ft.^{3})	**132.8**

Deflection in.	Strain %	Area in^2	Load lb.	Pressure lb/ft^2
0.025	0.9	1.50	2.1	202
0.050	1.7	1.51	4.3	410
0.075	2.6	1.52	6.0	567
0.100	3.4	1.54	8.1	758
0.125	4.3	1.55	9.9	919
0.150	5.2	1.57	11.8	1085
0.175	6.0	1.58	14.0	1276
0.200	6.9	1.59	16.2	1463
0.225	7.8	1.61	18.0	1610
0.250	8.6	1.62	20.4	1808
0.275	9.5	1.64	22.5	1975
0.300	10.3	1.66	24.7	2148
0.325	11.2	1.67	26.7	2299
0.350	12.1	1.69	28.8	2456
0.375	12.9	1.71	30.9	2609
0.400	13.8	1.72	32.8	2742
0.425	14.7	1.74	34.7	2872
0.450	15.5	1.76	36.4	2982

SAMPLE DIAMETER (in.)	1.375	WET WEIGHT (g)	150.2
SAMPLE LENGTH (in.)	2.900	DRY WEIGHT (g)	131.0
SAMPLE VOLUME (in.^{3})	4.306	MOISTURE (%) *	14.7
SAMPLE VOLUME (cm^3)	70.566	WET DENSITY pcf	132.8

* Moisture content was determined on entire sample after compression test

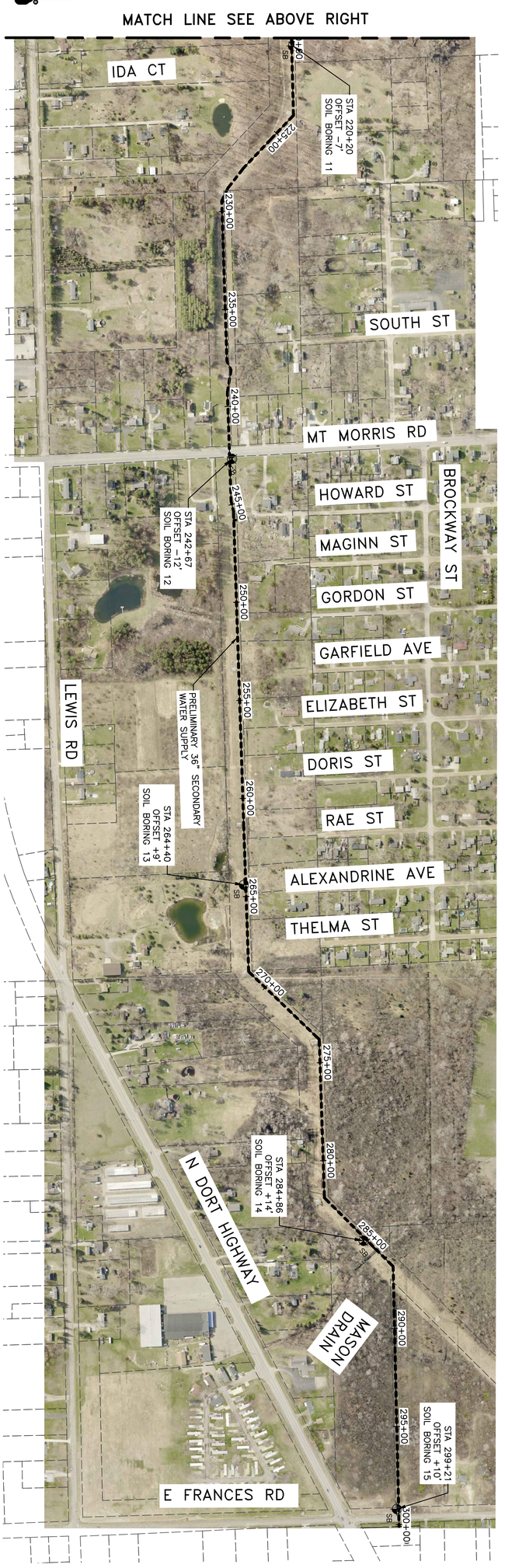
Know what's below. Call before you dig. 811

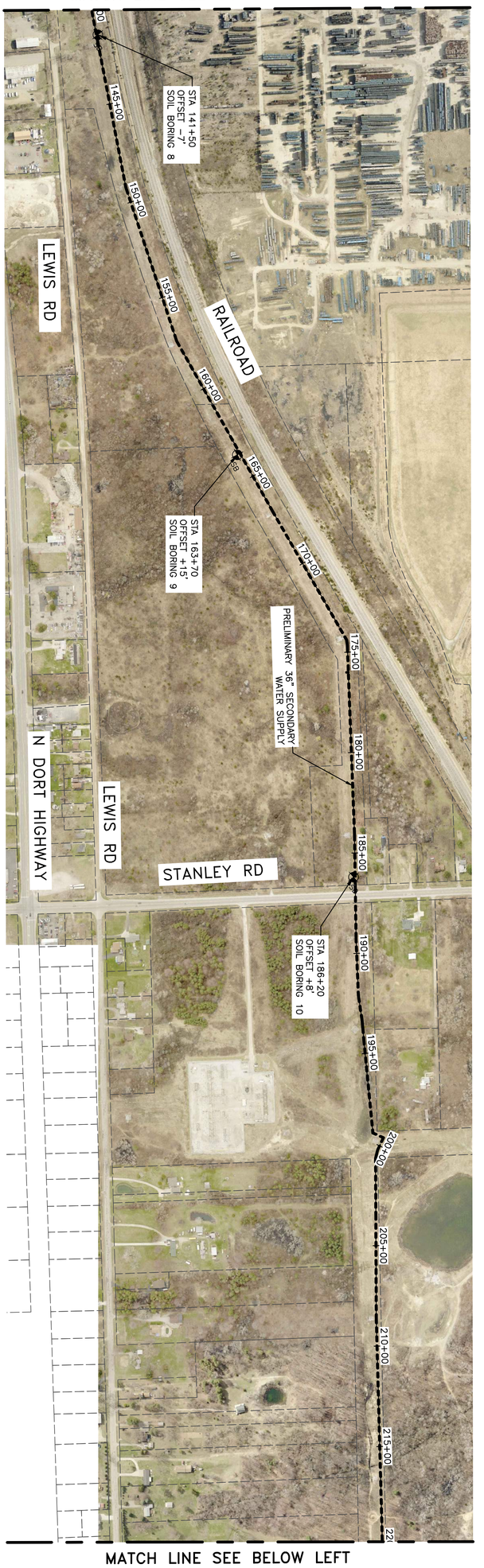
SHEET	JOB NO.	ISSUED FOR:	DATE:	BY:
1	COF1068.01F			

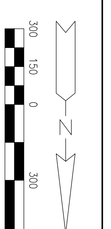
CITY OF FLINT
1101 S. SAGINAW STREET
FLINT, MI 48502
36" SECONDARY WATER SUPPLY
PRELIMINARY ROUTE SHEET 1

WADE TRIM
555 S. Saginaw Street, Suite 201
Flint, MI 48502
810.235.2555
www.wadetrim.com

REV#	DATE	DESCRIPTION	BY





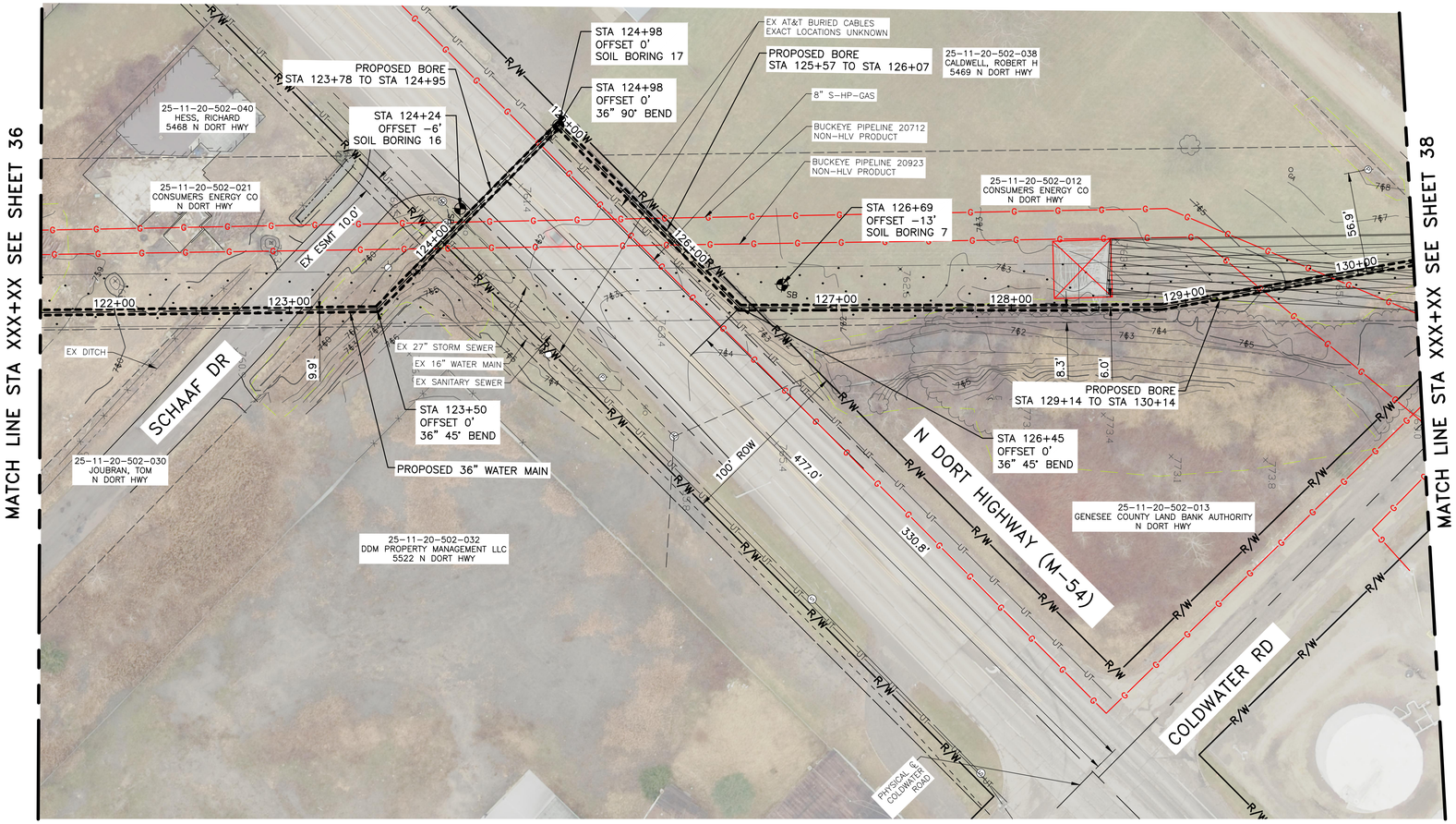


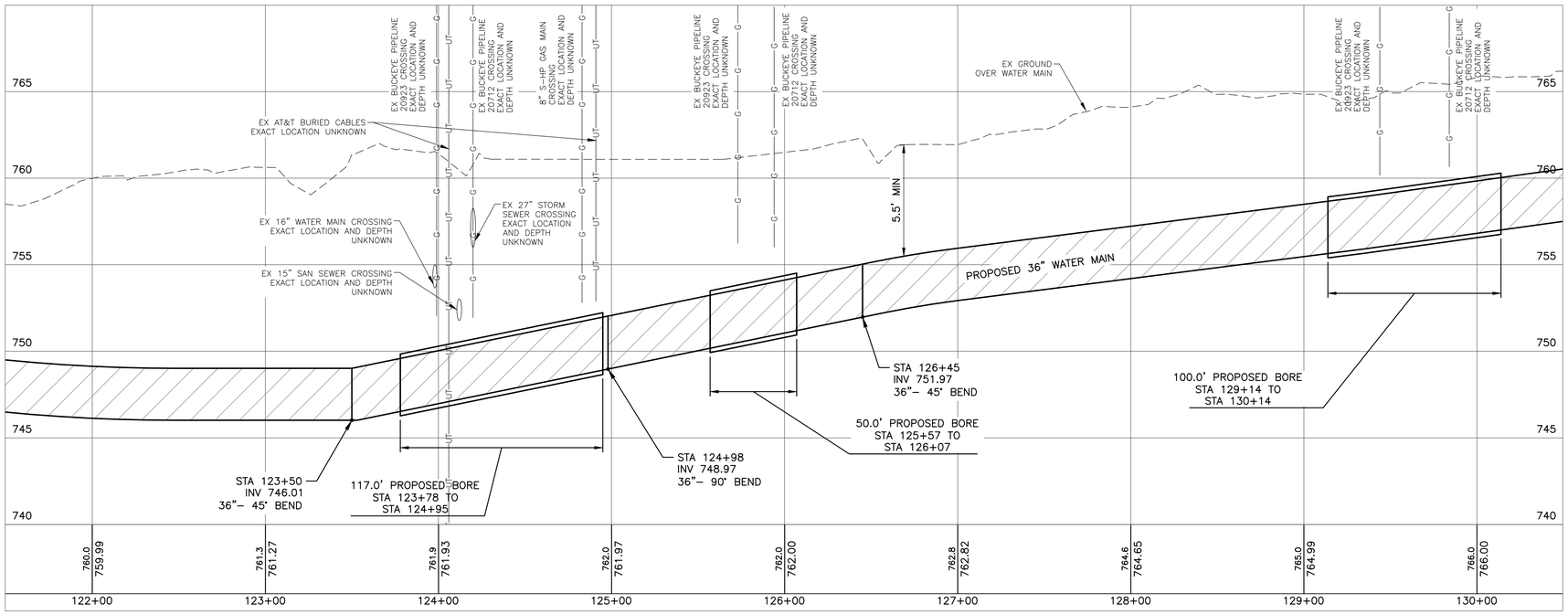
SHEET	JOB NO.	ISSUED FOR:	DATE:	BY:
2	COF1068.01F			

CITY OF FLINT
1101 S. SAGINAW STREET
FLINT, MI 48502
36" SECONDARY WATER SUPPLY
PRELIMINARY ROUTE SHEET 2

WADE TRIM
555 S. Saginaw Street, Suite 201
Flint, MI 48502
810.235.2555
www.wadetrim.com

REV#	DATE	DESCRIPTION	BY





PRELIMINARY
10/14/19

811 Know what's below. Call before you dig.

PROJECT MANAGER: Jason R. Kenyon, PE
C:\PW_WORK2\D0948736\C1UP-PLTS-PLAN-PROF-3.DWG - PP-17 - PLOTTED 10/14/2019 4:17 PM BY RUGGLES, TIMOTHY
FIELD BOOK INFORMATION:

REV#	DATE	DESCRIPTION	BY

WADE TRIM
555 S. Saginaw Street, Suite 201
Flint, MI 48502
810.235.2555
www.wadetrim.com

CITY OF FLINT
1101 S. SAGINAW STREET
FLINT, MI 48502

36" SECONDARY WATER SUPPLY
PLAN AND PROFILE SHEEET 17

ISSUED FOR: DATE: BY:

JOB NO. COF1068.01F

SHEET 37

Exhibit 3
Wetland Report

WETLAND DELINEATION

City of Flint Secondary Water Supply

Property located in Sections 6, 7, 20, and 29 of Genesee Township; Sections 7 and 18 of Beecher CDP; and Sections 29 and 32 of the City of Flint; T08N, R07E, Genesee County, Michigan

Prepared By:

streamside
ecological services

Prepared For:

October 25, 2019

Introduction

Streamside Ecological Services, Inc. (SES) conducted a wetland delineation within approximately 6 miles of linear power corridor within Genesee Township and the City of Flint from Frances Road south the City of Flint's water treatment plant. (**Figure 1, Attachment A**). The delineation was performed at the request of Mr. Jason Kenyon of Wade Trim. The purpose of this work was to identify the extent, location and regulatory status of wetlands within the assessment area and to identify potential resource impacts associated with construction of a proposed secondary water supply line for the City of Flint.

Methods

On September 18, 19, and 26, 2019, SES conducted a wetland review and delineation pursuant to statutory language and Rules of Part 303, Wetland Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 P.A. 451, as amended. As required, specific methodology followed that set forth in the 1987 U.S. Army Corps of Engineers Wetland Delineation Manual including the Northcentral and Northeast Regional Supplement. The specific areas delineated include land located approximately 50 feet either side of a proposed 36-inch secondary water supply line. The delineated wetland boundaries were flagged in the field with survey ribbon and sequentially numbered to aid in visualizing and surveying the boundaries. All boundaries were subsequently surveyed by Wade Trim.

Results and Discussion

Fifty-one wetland boundaries were delineated marking thirty-four wetland areas (Figures 2 through 15, **Attachment A**). The flag numbers and letters used to identify each wetland are shown on the figures in **Attachment A**, and listed in Table 1 of **Attachment B**. Photographs of each wetland area are provided in **Attachment C**.

The vast majority of the assessment area consists of a Consumers Energy power corridor that travels through urbanized land (industrial and residential) within and adjacent to the City of Flint. Much of the corridor has been disturbed in the past with areas containing excavations, spoils piles, and dumping of human refuse; particularly within the

southern segments. It is also apparent that woody vegetation, primarily common buckthorn (*Rhamnus cathartica*), is managed throughout the corridor by cutting, burning, and chemical treatment. Common buckthorn is highly prevalent adjacent to the corridor, and glossy buckthorn (*Frangula alnus*) is prevalent within wetlands that contain woody vegetation. There is also evidence of chemical treatment of giant reed grass (*Phragmites australis*) in some areas.

The vast majority of the wetland types present consisted of emergent and wet meadow wetland dominated by invasive plant species. A total of 60 plant species were identified within the wetlands, adjacent to the delineated boundaries, with 13 adventive species present (Table 36, **Attachment B**). The most prevalent invasive plant species within the wetlands were giant reed grass and reed canary grass (*Phalaris arundinacea*). Sixty-five percent of the wetlands identified contain giant reed grass, most of which were strongly dominated by this species. Similarly, approximately fifty percent of the wetlands identified include reed canary grass.

Representative wetland data sheets of emergent, wet meadow, and woody wetlands are presented in **Attachment D**. Representative data sheets are presented in the interest of time and length of this report. Additional data sheets will be made available upon request.

In addition to wetlands, the corridor was assessed to determine if any streams under the jurisdiction of Part 301, Inland Lakes and Streams of NREPA are present. Available mapping shows three drains are present within or near the corridor; the Mason, Riskin and Cornwell Drains.

The Mason Drain (Wetland 4) is a trapezoidal ditch with a heavily vegetated bed in the open corridor, and with open channel features in the adjacent wooded area. The drain at the time of inspection had slow to no flow with 1 to 3 inches of clear water and an organic bed.

Available mapping identifies the Riskin Drain to be present immediately north of Carpenter Road. However, no wetlands or watercourses were identified in this area. Maps also indicate this drain begins near the assessment area without a watershed large enough to collect water or establish flow sufficient to create a defined channel.

The Cornwell Drain (Wetland 29) is an open channel west and east of the assessment area, without a defined channel within the open power corridor (likely enclosed). The channel has been excavated west of the power corridor with side cast spoils adjacent to the drain. East of the corridor, the channel travels through a wooded area dominated by common buckthorn. The channel is trapezoidal, with a silt bed approximately 6 feet wide, slow flow, and is less than 6 inches deep.

Regulatory Status

In Michigan, wetlands are regulated by Part 303 of NREPA if they greater than five acres in size. Wetlands are also regulated if they are contiguous to (within 500 feet of) or have a surface water connection to an inland lake, stream, or pond regardless of size.

Given the narrow width of the assessment area, wetlands that continued outside the corridor were assumed to be greater than 5 acres in size, and/or contiguous to a surface water and assumed regulated. Aerial photographs were also used to identify proximity of each wetland to any surface water.

Based on our assessments, all wetlands were determined to be regulated with the exception of Wetlands 16 and 30. Both these wetlands are small, isolated depressional areas contained within the corridor, and further than 500 feet from any surface water.

In addition, it is our opinion that the open channel portions of the Mason Drain and Cornwell Drain have defined banks and beds, and are regulated under Michigan's Inland Lakes and Streams statute (Part 301 of NREPA), barring exemptions afforded county drains.

Please note that the information in this report represents our opinion only and the Department of Environment, Great Lakes and Energy is the state agency that has final authority over the regulatory status and location of all wetland/upland boundary lines and inland stream jurisdiction.

Attachment A

Figures

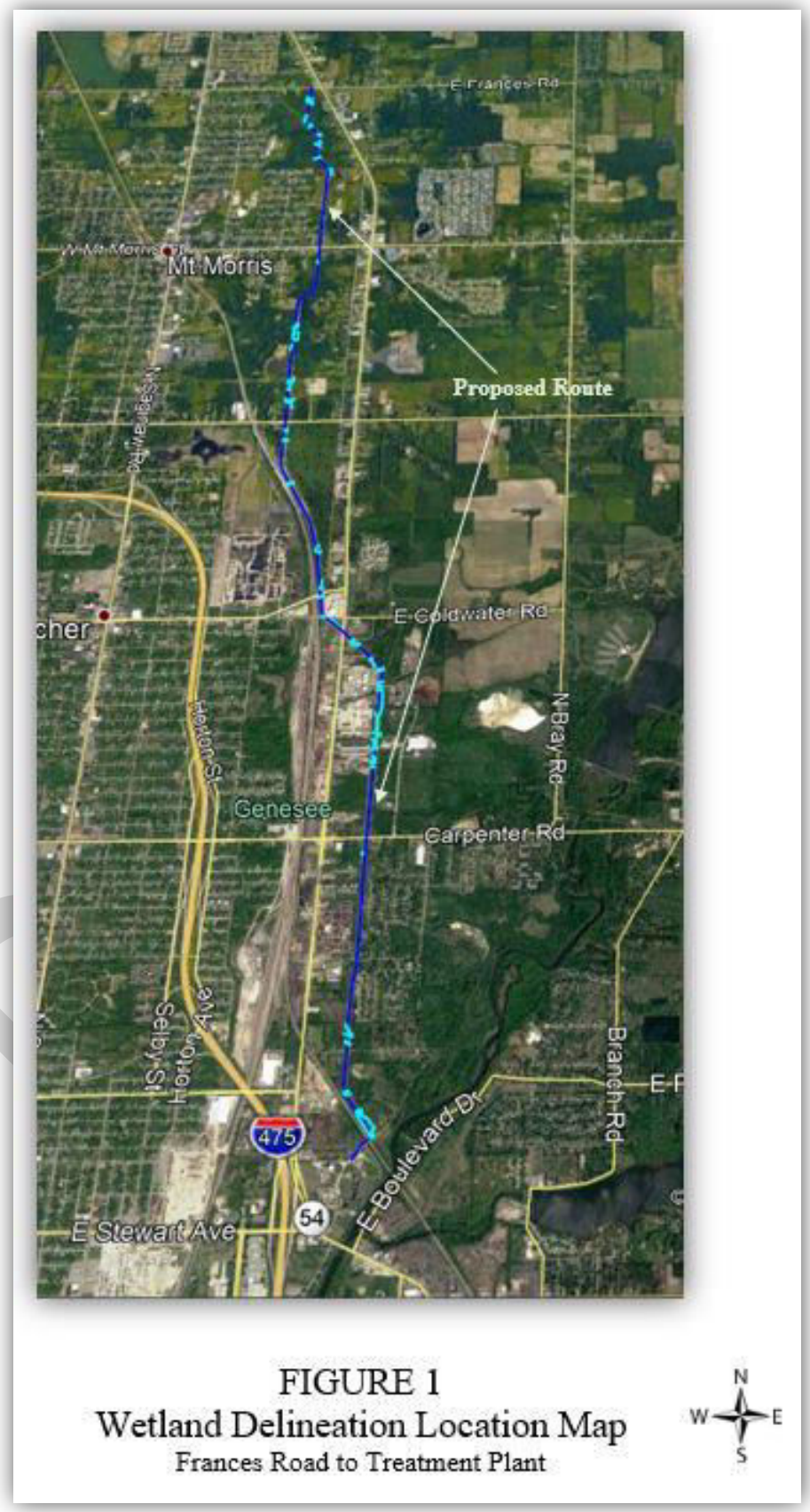
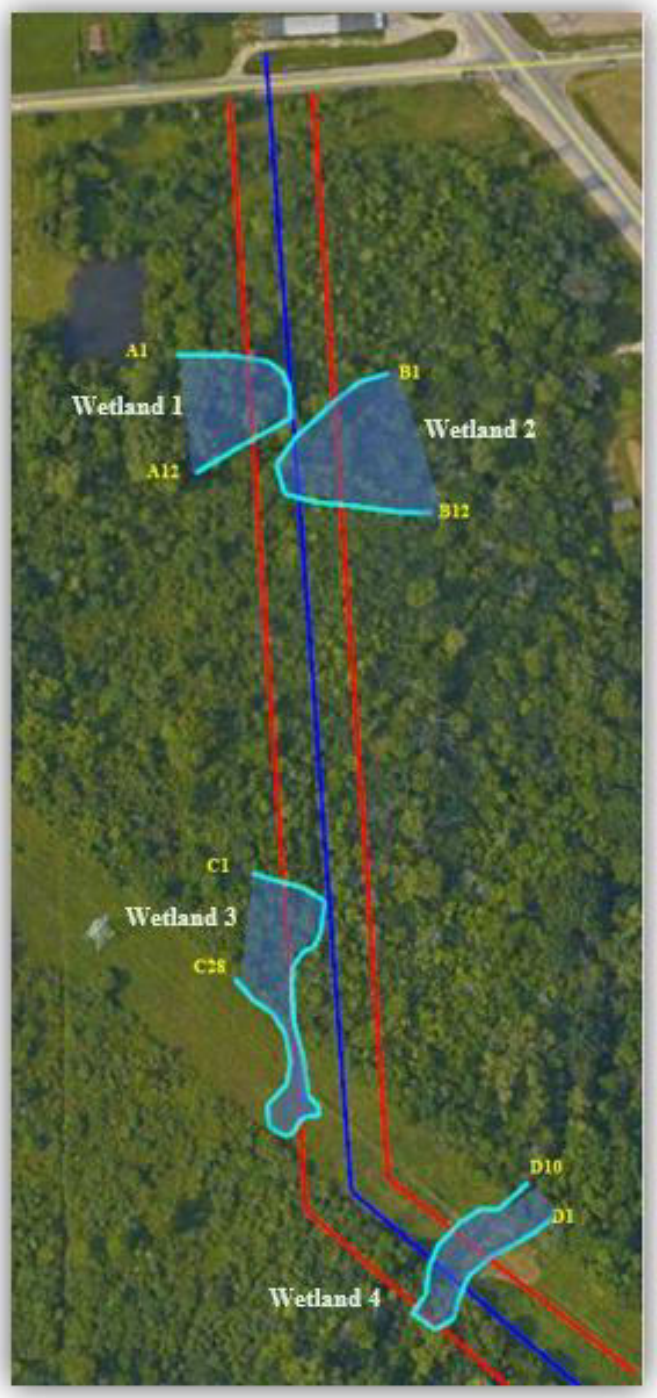


FIGURE 1
Wetland Delineation Location Map
Frances Road to Treatment Plant

FIGURE 2
Wetland Delineation Overview
Frances Road to Mt. Morris Road



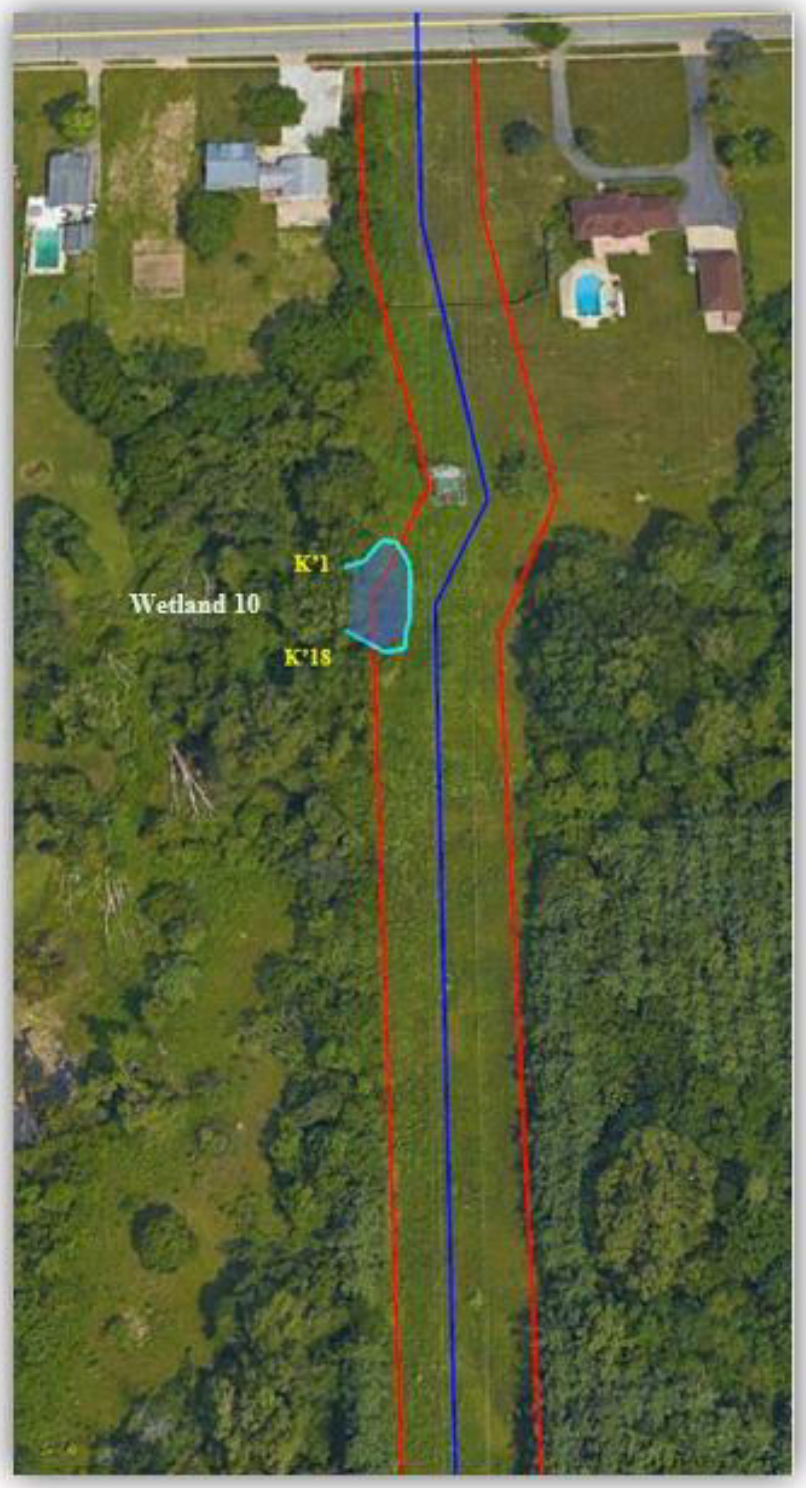
Wetland

FIGURE 3
Wetland Delineation
Frances Road to Mt. Morris Road
Wetlands 1 – 4

N
W E
S

FIGURE 4
Wetland Delineation
Frances Road to Mt. Morris Road
Wetlands 5 – 9

FIGURE 5
Wetland Delineation Overview
Mt. Morris Road to Stanley Road



Wetland

FIGURE 6
Wetland Delineation
Mt. Morris Road to Stanley Road
Wetland 10

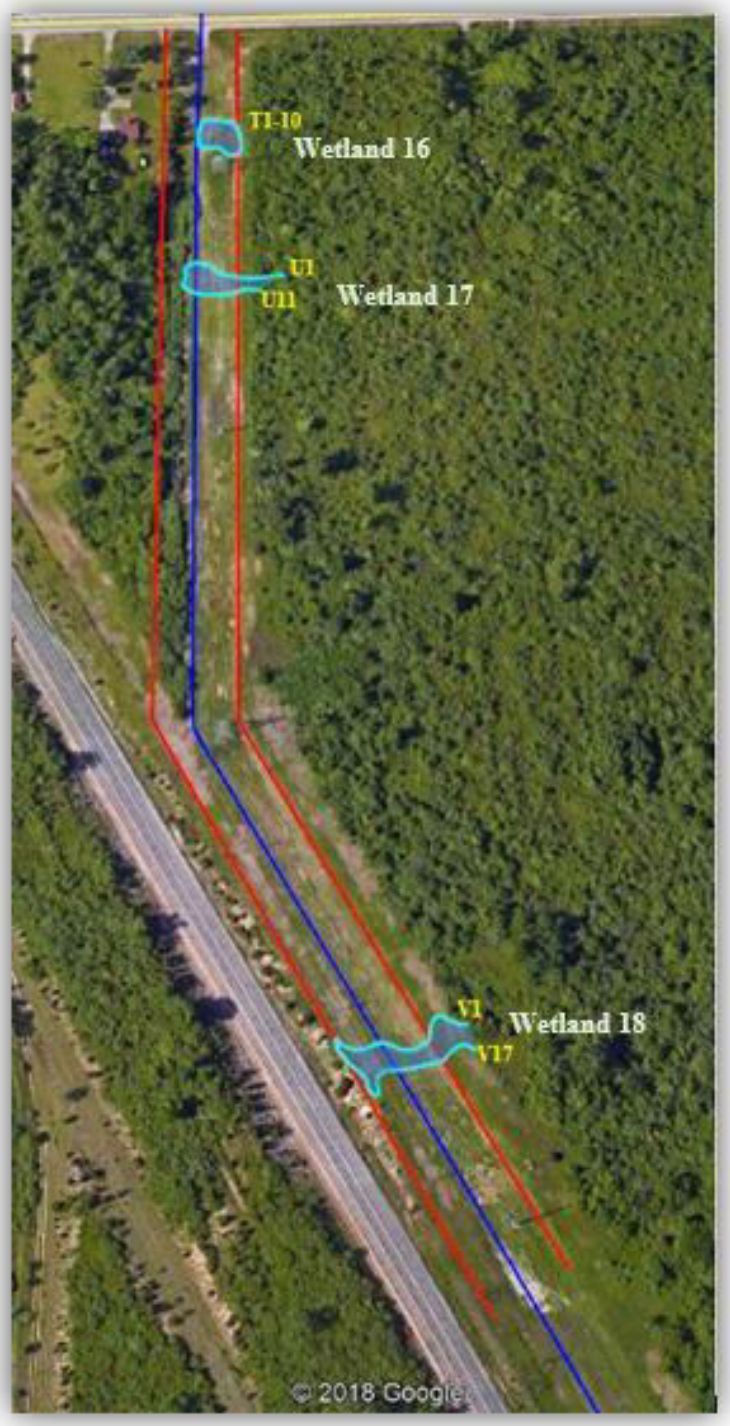
N
W E
S

Wetland

FIGURE 7
Wetland Delineation
Mt. Morris Road to Stanley Road
Wetlands 11 – 15

N
W E
S

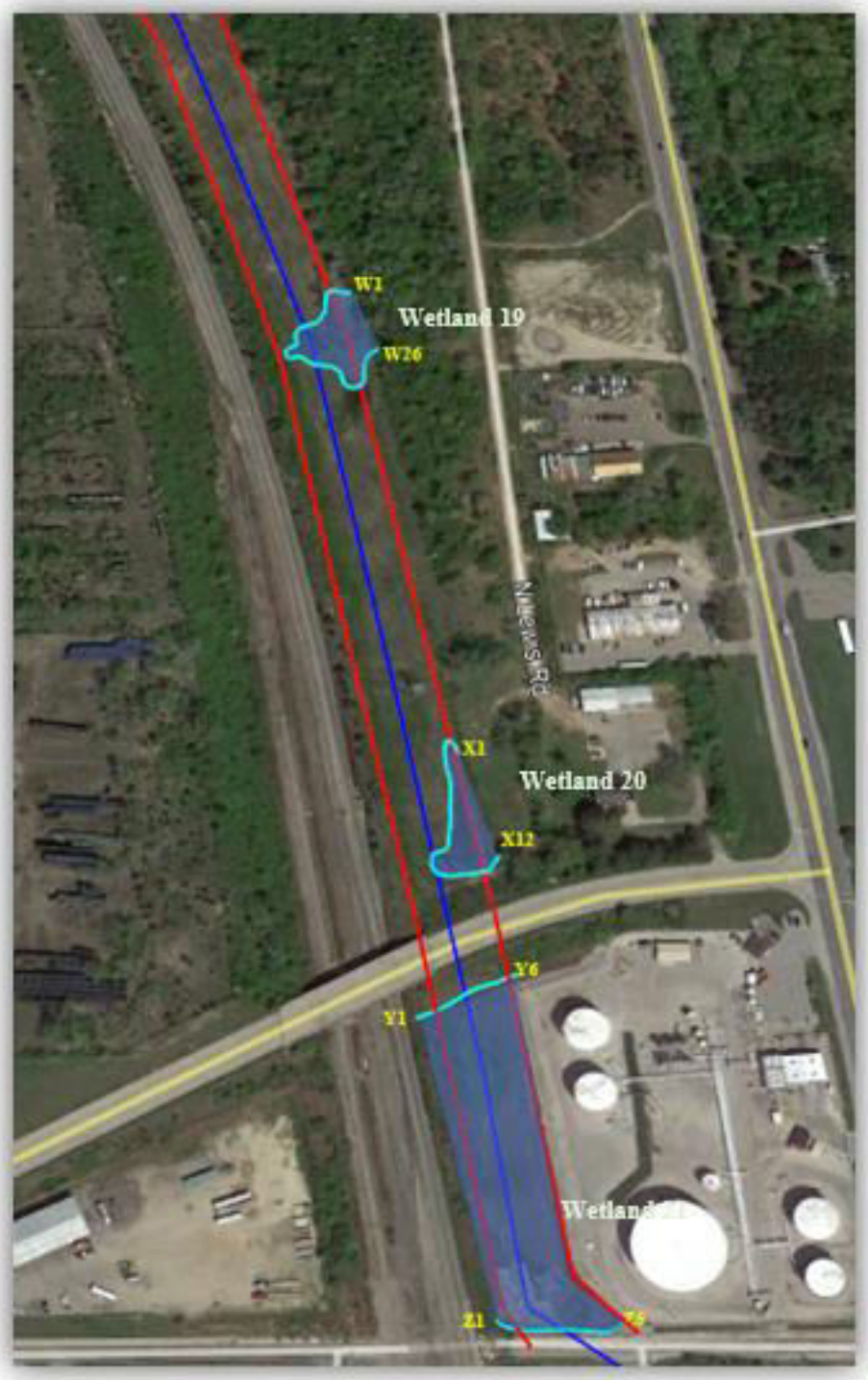
FIGURE 8
Wetland Delineation Overview
Stanley Road to Coldwater



Wetland

FIGURE 9
Wetland Delineation
Stanley Road to Coldwater
Wetlands 16 – 18

N
W
E
S



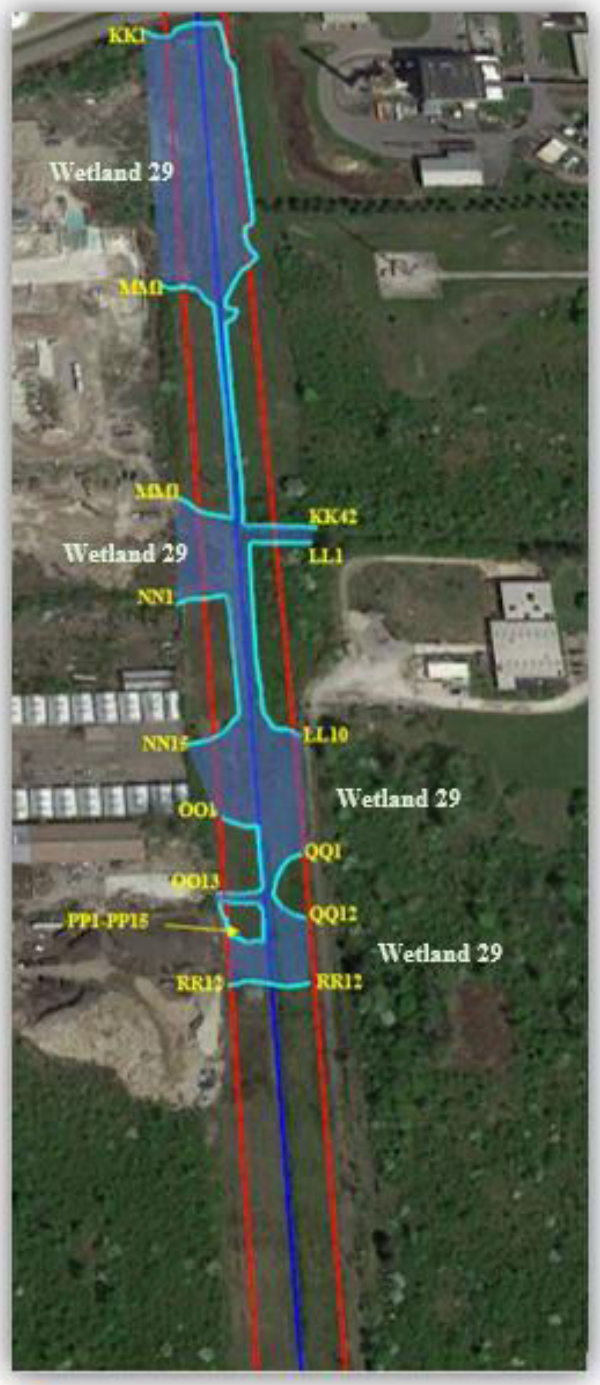
Wetland

FIGURE 10
Wetland Delineation
Stanley Road to Coldwater Road
Wetlands 19 – 21

N
W E
S

FIGURE 11
Wetland Delineation Overview
Coldwater Road to Carpenter Road

FIGURE 12
Wetland Delineation
Coldwater Road to Carpenter Road
Wetlands 22-28

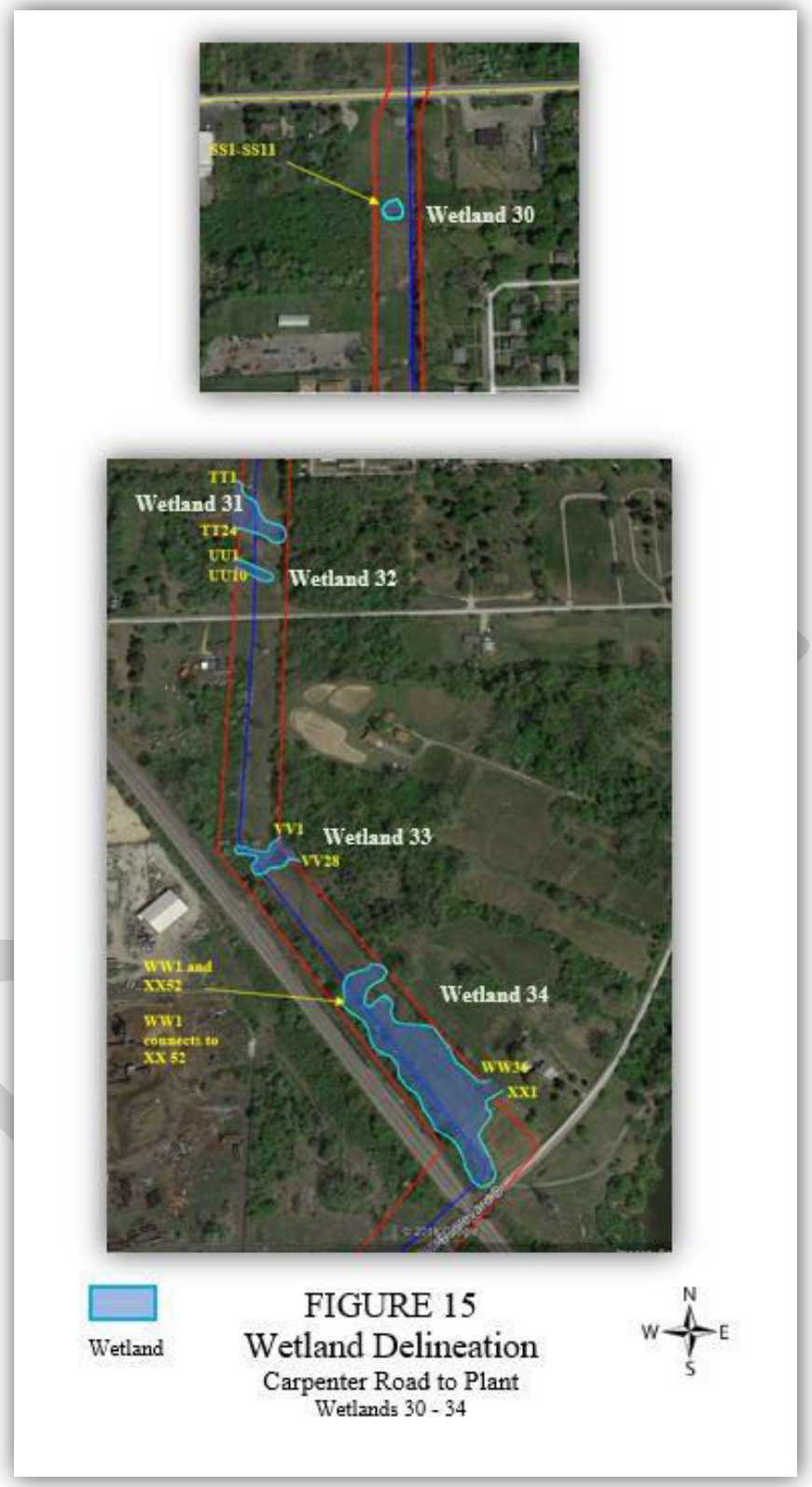


Wetland

FIGURE 13
Wetland Delineation
Coldwater Road to Carpenter Road
Wetland 29

N
W E
S

FIGURE 14
Wetland Delineation Overview
Carpenter Road to Plant


SS1-SS11
Wetland 30
TT1
Wetland 31
TT24
UU1
UU10
Wetland 32
VV1
Wetland 33
VV28
WW1 and XX52
Wetland 34
WW1 connects to XX 52
WW34
XX1
Wetland
FIGURE 15
Wetland Delineation
Carpenter Road to Plant
Wetlands 30 - 34
N
W
E
S

Attachment B

Tables

Table 1. Delineated Boundaries for Each Wetland Identified.

Wetland Area	Flag Letters/Numbers
1	A1-A12
2	B1-B12
3	C1-C28
4	D1-D10
5	E1-E6/F1-17
6	G1-G12
7	H1-H10/I1-I11
8	J1-J5
9	K1-K6
10	K'1-K'18
11	L1-L16
12	M1-M7/N1-N40
13	O1-O12
14	P1-P15/Q1-Q25
15	R1-R10/S1-S10
16	T1-T10
17	U1-U11
18	V1-V17
19	W1-W26
20	X1-X12
21	Y1-Y6/X1-X5
22	AA1-AA62
23	BB1-BB10
24	CC1-CC12/DD1-DD14/EE1-EE20
25	FF1-FF21
26	GG1-GG9
27	HH1-HH11/II1-II12
28	JJ1-JJ12
29	KK1-KK42/LL1-LL10/MM1-MM12/OO1-OO12/PP1-PP13/QQ1-QQ12/RR1-RR12
30	SS1-SS11
31	TT1-TT24
32	UU1-UU10
33	VV1-VV28
34	WW1-WW34/XX1-XX52

Table 2. Plant Lists Wetland 1 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Acer saccharinum*	silver maple	FACW
	Euthamia graminifolia	flat-top goldentop	FACW
	Frangula alnus	glossy buckthorn	FACW
	Glyceria striata	fowl mannagrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Populus deltoides	eastern cottonwood	FAC
	Populus tremuloides	quaking aspen	FAC
	Rhamnus cathartica	common buckthorn	FAC
	Ulmus americana	American elm	FACW
	Hydrology: Soils saturated within 6 inches of surface. Water stained leaves. Bare ground. Drainage channels. Water marks.		
Upland Side	*Clematis terniflora*	sweet autumn virginsbower	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Soildago altissima	Canada goldenrod	FACU
	Solidago flexicaulis	zigzag goldenrod	FACU

Table 3. Plant Lists Wetland 2 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Acer saccharinum*	silver maple	FACW
	Frangula alnus	glossy buckthorn	FACW
	Glyceria striata	fowl mannagrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Ulmus americana	American elm	FACW
	Hydrology: Soils saturated within 14 inches of surface. Bare ground. Drainage channels. Water marks.		
Upland Side	*Clematis terniflora*	sweet autumn virginsbower	FACU
	Clematis virginiana	devil's darning needles	FAC
	Parthenocissus quinquefolia	Virginia creeper	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Sanguinaria canadensis	bloodroot	FACU

Table 4. Plant Lists Wetland 3 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Carex grayi	gray's sedge	FACW
	Cornus amomum	silky dogwood	FACW
	Euthamia graminifolia	flat-top goldentop	FACW
	Frangula alnus	glossy buckthorn	FACW
	Geum canadense	white avens	FAC
	Glyceria striata	fowl mannagrass	OBL
	Leersia oryzoides	rice cutgrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Scirpus atrovirens	green bullrush	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Ulmus americana	American elm	FACW
	Viburnum lentago	nannyberry	FAC
	Vitis riparia	riverbank grape	FACW
	Hydrology: Soils saturated within 6 inches of surface. Water stained leaves. Bare ground. Drainage channels. Water marks.		
Upland Side	*Centaurea stoebe*	spotted napweed	UPL
	Daucus carota	wild carrot	UPL
	Parthenocissus quinquefolia	Virginia creeper	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Sanguinaria canadensis	bloodroot	FACU
	Solidago altissima	Canada goldenrod	FACU
	Vitis riparia	riverbank grape	FACW

Table 5. Plant Lists Wetland 4 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Bidens frondosa*	beggertick	FACW
	Euthamia graminifolia	flat-top goldentop	FACW
	Leersia oryzoides	rice cutgrass	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Populus deltoides	eastern cottonwood	FAC
	Scirpus atrovirens	green bullrush	OBL
	Hydrology: Mason Drain - trapezoidal ditch heavily vegetated in open corridor; channel features in adjacent wooded area. Slow to no flow, 1-3 inches of water, clear.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Rhamnus cathartica	common buckthorn	FAC
	Rubus allegheniensis	Allegheny blackberry	FACU
	Rubus occidentalis	black raspberry	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 6. Plant Lists Wetland 5 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Apocynum cannabinum	indian hemp	FAC
	Asclepias incarnata	swamp milkweed	OBL
	Carex lacustris	hairy sedge	OBL
	Carex lupulina	hop sedge	OBL
	Echinochloa crus-galli	barnyard grass	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Hypericum perforatum	common St. johnswort	FACU
	Lycopus americanus	water hoarhound	OBL
	Penthorum sedoides	ditch stonecrop	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Populus deltoides	eastern cottonwood	FAC
	Scirpus atrovirens	green bullrush	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Spiraea alba	white meadowsweet	FACW
	Hydrology: Soils saturated within 12 inches of surface		
Upland	*Oenothera biennis*	common evening primrose	FACU

Side	*Cirsium arvense*	Canada thistle	FACU
	Phleum pratense	timothy	FACU

Table 6. (Cont.)

Scientific Name	Common Name	Wetland Rating
Prunus serotna	black cherry	FACU
Rhamnus cathartica	common buckthorn	FAC
Solidago altissima	Canada goldenrod	FACU

Table 7. Plant Lists Wetland 6 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Penthorum sedoides	ditch stonecrop	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Spiraea alba	white meadowsweet	FACW
	Hydrology: Soils saturated within 8 inches of surface. Drainage patterns. hummocked ground surface.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Rudbeckia hirta	blackeyed susan	FACU
	Solidago gigantea	smooth goldenrod	FACW
	Solidago altissima	Canada goldenrod	FACU

Table 8. Plant Lists Wetland 7 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Bidens frondosa	beggertick	FACW
	Carex lacustris	hairy sedge	OBL
	Carex lasiocarpa	wollyfruit sedge	OBL
	Echinochloa crus-galli	barnyard grass	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Frangula alnus	glossy buckthorn	FACW
	Fraxinus pennsylvanica	green ash	FACW
	Juncus effusus	common rush	OBL
	Leersia oryzoides	rice cutgrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW

	Penthorum sedoides	ditch stonecrop	OBL
	Phalaris arundinacea	reed canarygrass	FACW

Table 8. (Cont.)

	Scientific Name	**Common Name**	**Wetland Rating**
	Phragmites australis	giant reedgrass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Rumex crispus	curly dock	FAC
	Scirpus atrovirens	green bullrush	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Spiraea alba	white meadowsweet	FACW
	Ulmus americana	American elm	FACW
	Verbena hastata	swamp verbena	FACW
	Viburnum lentago	nannyberry	FAC
	Vitis riparia	riverbank grape	FACW
	Hydrology: Soils saturated within 8 inches of surface. Water stained leaves. Bare ground. Drainage channels. Hummocked ground.		
Upland Side	*Centaurea stoebe*	spotted napweed	UPL
	Cirsium arvense	Canada thistle	FACU
	Cirsium vulgare	bull thistle	FACU
	Daucus carota	wild carrot	UPL
	Elaeagnus umbellata	autumn olive	UPL
	Euthamia graminifolia	flat-top goldentop	FACW
	Parthenocissus quinquefolia	Virginia creeper	FACU
	Phleum pratense	timothy	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU

Table 9. Plant Lists Wetland 8 Boundaries

	Scientific Name	**Common Name**	**Wetland Rating**
Wetland Side	*Echinochloa crus-galli*	barnyard grass	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Hydrology: Marginal hydrology. Vegetation cut. Hummocks.		
Upland Side	*Cirsium arvense*	Canada thistle	FACU
	Daucus carota	wild carrot	UPL
	Elymus repens	quackgrass	FACU

Table 10. Plant Lists Wetland 9 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Echinochloa crus-galli*	barnyard grass	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Hydrology: Marginal hydrology. Vegetation cut. Hummocks.		
Upland Side	*Cirsium arvense*	Canada thistle	FACU
	Daucus carota	wild carrot	UPL
	Elymus repens	quackgrass	FACU

Table 11. Plant Lists Wetland 10 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Acer negundo*	boxelder	FAC
	Acer saccharinum	silver maple	FACW
	Bidens frondosa	beggertick	FACW
	Boehmeria cylindrica	nettle	OBL
	Carex lacustris	hairy sedge	OBL
	Glyceria striata	fowl mannagrass	OBL
	Impatiens capensis	jewelweed	FACW
	Leersia oryzoides	rice cutgrass	OBL
	Penthorum sedoides	ditch stonecrop	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Spiraea alba	white meadowsweet	FACW
	Hydrology: Soils saturated within 3 inches of surface. Water stained leave. Bare ground. Drainage channels. Water mark. Channel drains off site to west.		
Upland Side	*Cirsium arvense*	Canada thistle	FACU
	Euthamia graminifolia	flat-top goldentop	FACW
	Fragaria virginiana	Virginia strawberry	FACU
	Impatiens capensis	jewelweed	FACW
	Parthenocissus quinquefolia	Virginia creeper	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Rubus allegheniensis	Allegheny blackberry	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 12. Plant Lists Wetland 11 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Asclepias incarnata*	swamp milkweed	OBL
	Bidens frondosa	beggertick	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Impatiens capensis	jewelweed	FACW
	Leersia oryzoides	rice cutgrass	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reed grass	FACW
	Scirpus atrovirens	green bullrush	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Spiraea alba	white meadowsweet	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Hydrology: Soils saturated at surface. Drainage channels. Channel/swale present.		
Upland Side	*Centaurea stoebe*	spotted napweed	UPL
	Daucus carota	wild carrot	UPL
	Rubus allegheniensis	Allegheny blackberry	FACU
	Solidago altissima	Canada goldenrod	FACU
	Symphyotrichum novae-angliae	New England aster	FACW

Table 13. Plant Lists Wetland 12 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Alisma subcordatum*	American water plantain	OBL
	Bidens frondosa	beggertick	FACW
	Cyperus esculentus	yellow nursedge	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Eutrochium maculatum	spotted joe pye weed	OBL
	Glyceria striata	fowl mannagrass	OBL
	Lobelia siphilitica	great blue lobelia	OBL
	Lythrum salicaria	purple loostrife	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reed grass	FACW
	Schoenoplectus tabernaemontani	softstem bullrush	OBL
	Scirpus atrovirens	green bullrush	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Spiraea alba	white meadowsweet	FACW
	Symphyotrichum novae-angliae	New England aster	FACW

Table 13. (Cont.)

Hydrology: Soils saturated within 2 inches of surface. Drainage channels. Water stained leaves.

	Scientific Name	Common Name	Wetland Rating
Upland Side	*Daucus carota*	wild carrot	UPL
	Geranium maculatum	geranium	FACU
	Melilotus officinalis	sweetclover	FACU
	Quercus alba	white oak	FACU
	Quercus rubra	red oak	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU

Table 14. Plant Lists Wetland 13 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Equisetum hyemale*	horsetail	FACW
	Phragmites australis	giant reedgrass	FACW
	Populus deltoides	eastern cottonwood	FAC
	Salix amygdaloides	peachleaf willow	FACW
	Salix interior	sandbar willow	FACW
	Salix matsudana	corkscrew willow	NR
	Salix nigra	black willow	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Symphyotrichum novae-angliae	New England aster	FACW

Hydrology: Saturated soils at surface. Bare ground. Crayfish chimneys. Pond immediately off site to west.

Upland Side	*Centaurea stoebe*	spotted napweed	UPL
	Melilotus officinalis	sweetclover	FACU
	Phragmites australis	giant reedgrass	FACW
	Sassafras albidum	sassafras	FACU
	Solidago altissima	Canada goldenrod	FACU
	Solidago gigantea	smooth goldenrod	FACW
	Tilia americana	basswood	FACU

Table 15. Plant Lists Wetland 14 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Acer negundo*	boxelder	FAC
	Carex lacustris	hairy sedge	OBL
	Cephalanthus occidentalis	common buttonbush	OBL
	Eupatorium perfoliatum	common boneset	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Eutrochium maculatum	spotted joe pye weed	OBL
	Fraxinus pennsylvanica	green ash	FACW
	Glyceria striata	fowl mannagrass	OBL
	Leersia oryzoides	rice cutgrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phragmites australis	giant reed grass	FACW
	Populus deltoides	eastern cottonwood	FAC
	Rhamnus cathartica	common buckthorn	FAC
	Salix amygdaloides	peachleaf willow	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Hydrology: Soils saturated within 1 - 8 inch of surface. Drainage channels and hummocks.		
Upland Side	*Achillea millefolium*	yarrow	FACU
	Daucus carota	wild carrot	UPL
	Lonicera sp.	Honeysuckle	N/A
	Phleum pratense	timothy	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Rosa multiflora	multiflora rose	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 16. Plant Lists Wetland 15 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Acer negundo*	boxelder	FAC
	Apocynum cannabinum	indian hemp	FAC
	Asclepias incarnata	swamp milkweed	OBL
	Eupatorium perfoliatum	common boneset	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Fraxinus pennsylvanica	green ash	FACW
	Glyceria striata	fowl mannagrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phragmites australis	giant reed grass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Solidago gigantea	smooth goldenrod	FACW
	Thelypteris palustris	marsh fern	OBL
	Hydrology: Soild saturated within 12 inches of surface. Drainage channels and hummocks.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Elymus repens	quackgrass	FACU
	Geranium maculatum	geranium	FACU
	Phragmites australis	giant reed grass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Solidago gigantea	smooth goldenrod	FACW

Table 17. Plant Lists Wetland 16 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Asclepias incarnata	swamp milkweed	OBL
	Carex lupulina	hop sedge	OBL
	Juncus torreyi	torrey's rush	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reed grass	FACW
	Scirpus atrovirens	green bullrush	OBL
	Scirpus cyperinus	wollgrass	OBL
	Hydrology: Cracked soils. Bare ground. Shallow depression.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Elaeagnus umbellata	autumn olive	UPL
	Elymus repens	quackgrass	FACU
	Rhamnus cathartica	common buckthorn	FAC

Table 18. Plant Lists Wetland 17 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Carex lupulina	hop sedge	OBL
	Eupatorium perfoliatum	common boneset	OBL
	Juncus effusus	common rush	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phragmites australis	giant reed grass	FACW
	Scirpus atrovirens	green bullrush	OBL
	Scirpus cyperinus	wollgrass	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Hydrology: Soild saturated within 12 inches of surface. Hummocks.		
Upland Side	*Achillea millefolium*	yarrow	FACU
	Agrostis gigantea	redtop	FACW
	Solidago altissima	Canada goldenrod	FACU

Table 19. Plant Lists Wetland 18 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Bidens frondosa	beggertick	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Juncus effusus	common rush	OBL
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Penthorum sedoides	ditch stonecrop	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Verbena hastata	swamp verbena	FACW
	Hydrology: Soils saturated within 12 inches of surface. Drainage channels. Site rutted by tire tracks.		
Upland Side	*Centaurea stoebe*	spotted napweed	UPL
	Cirsium arvense	Canada thistle	FACU
	Phleum pratense	timothy	FACU
	Rubus occidentalis	black raspberry	FACU
	Solidago altissima	Canada goldenrod	FACU
	Verbena hastata	swamp verbena	FACW

Table 20. Plant Lists Wetland 19 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Asclepias incarnata	swamp milkweed	OBL
	Eupatorium perfoliatum	common boneset	OBL
	Gentiana andrewsii	closed bottle gentian	FACW
	Impatiens capensis	jewelweed	FACW
	Juncus torreyi	torrey's rush	FACW
	Lycopus americanus	water hoarhound	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phragmites australis	giant reedgrass	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Verbena hastata	swamp verbena	FACW
	Hydrology: Soils saturated within 12 inches of surface. Drainage channels. Hummocked ground		
Upland Side	*Daucus carota*	wild carrot	UPL
	Cirsium arvense	Canada thistle	FACU
	Elaeagnus umbellata	autumn olive	UPL
	Prunus serotna	black cherry	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU
	Verbascum thapsus	common mullein	UPL

Table 21. Plant Lists Wetland 20 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Eupatorium perfoliatum*	common boneset	OBL
	Phragmites australis	giant reedgrass	FACW
	Hydrology: Soils saturated within 12 inches of surface. Hummocked ground.		
Upland Side	*Rhamnus cathartica*	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU
	Verbascum thapsus	common mullein	UPL

Table 22. Plant Lists Wetland 21 Boundaries			
	Scientific Name	**Common Name**	**Wetland Rating**
Wetland Side	*Typha angustifolia*	narrow-leavedcattail	OBL
	Phragmites australis	giant reedgrass	FACW
	Hydrology: Soils saturated within 6 inches of surface. Hummocked ground.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Elymus repens	quackgrass	FACU
	Monarda fistulosa	bergamot	FACU
	Phragmites australis	giant reedgrass	FACW

Table 23. Plant Lists Wetland 22 Boundaries			
	Scientific Name	**Common Name**	**Wetland Rating**
Wetland Side	*Phragmites australis*	giant reedgrass	FACW
	Salix interior	sandbar willow	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Typha angustifolia	narrow-leaved cattail	OBL
	Verbena hastata	swamp verbena	FACW
	Hydrology: Soils saturated within 6 inches of surface. Bare ground. Drainage channels. Open channel NE of power line (culvert on either end).		
Upland Side	*Lonicera sp.*	honeysuckle	N/A
	Maintained lawn	Maintained lawn	N/a
	Polygonum cuspidatum	Japanese Knotweed	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU

Table 24. Plant Lists Wetland 23 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Phragmites australis*	giant reedgrass	FACW
	Juncus torreyi	torrey's rush	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Salix interior	sandbar willow	FACW
	Hydrology: Marginal. Drainage channels. Hummocked ground.		
Upland Side	*Cichorium intybus*	chickory	FACU
	Daucus carota	wild carrot	UPL
	Melilotus officinalis	sweetclover	FACU
	Phragmites australis	giant reedgrass	FACW
	Solidago altissima	Canada goldenrod	FACU

Table 25. Plant Lists Wetland 24 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Ambrosia artemisiifolia*	ragweed	FACU
	Apocynum cannabinum	indian hemp	FAC
	Equisetum hyemale	horsetail	FACW
	Fraxinus pennsylvanica	green ash	FACW
	Juncus torreyi	torrey's rush	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reedgrass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Solidago gigantea	smooth goldenrod	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Toxicodendron radicans	poison ivy	FAC
	Ulmus americana	American elm	FACW
	Verbena hastata	swamp verbena	FACW
	Hydrology: Soils saturated within 2 inches of surface. Water stained leaves. Bare ground. Drainage channels. FO wetland east end dominated by *Phragmites australis*.		
Upland Side	*Asclepias syriaca*	common milkweed	FACU
	Daucus carota	wild carrot	UPL
	Parthenocissus quinquefolia	Virginia creeper	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Toxicodendron radicans	poison ivy	FAC
	Verbascum thapsus	common mullein	UPL

Table 26. Plant Lists Wetland 25 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Ambrosia artemisiifolia*	ragweed	FACU
	Lycopus americanus	water hoarhound	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reedgrass	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Hydrology: Disturbed. Bare ground. Drainage channels. Hummocked ground.		
Upland Side	*Ambrosia artemisiifolia*	ragweed	FACU
	Elymus repens	quackgrass	FACU
	Phragmites australis	giant reedgrass	FACW

Table 27. Plant Lists Wetland 26 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Carex vulpinoidea*	fox sedge	FACW
	Fraxinus pennsylvanica	green ash	FACW
	Glyceria striata	fowl mannagrass	OBL
	Leersia oryzoides	rice cutgrass	OBL
	Populus deltoides	eastern cottonwood	FACW
	Typha angustifolia	narrow-leaved cattail	OBL
	Ulmus americana	American elm	FACW
	Hydrology: PFO and wet meadow present. Soils saturated at surface. Water stained leaves. Bare ground. Drainage channels. Hummocked ground in open field area.		
Upland Side	*Geranium maculatum*	geranium	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU
	Zanthoxylum americanum	common prickly ash	FACU

Table 28. Plant Lists Wetland 27 Boundaries			
	Scientific Name	**Common Name**	**Wetland Rating**
Wetland Side	*Juncus effusus*	common rush	OBL
	Juncus torreyi	torrey's rush	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reedgrass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Hydrology: Soils saturated within 6 inches of surface. Drainage channels - ditch continues to east.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Solidago altissima	Canada goldenrod	FACU

Table 29. Plant Lists Wetland 28 Boundaries			
	Scientific Name	**Common Name**	**Wetland Rating**
Wetland Side	*Phragmites australis*	giant reedgrass	FACW
	Hydrology: Soils saturated within 12 inches of surface. Hummocked ground. Monotypic stand of giant reed grass.		
Upland Side	*Parthenocissus quinquefolia*	Virginia creeper	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Rubus allegheniensis	Allegheny blackberry	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 30. Plant Lists Wetland 29 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Euthamia graminifolia	flat-top goldentop	FACW
	Juncus effusus	common rush	OBL
	Leersia oryzoides	rice cutgrass	OBL
	Lycopus americanus	water hoarhound	OBL
	Phragmites australis	giant reedgrass	FACW
	Salix interior	sandbar willow	FACW
	Solidago gigantea	smooth goldenrod	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Typha angustifolia	narrow-leaved cattail	OBL
	Hydrology: Soils saturated within 6 inches of surface. Drainage channel in center (old ag drain). Hummocked ground. Strongly dominated by giant reed grass. Cornwell Drain (excavated off site to west. Shallow, minimal flow, narrow channel. Continues off site to the east and west.		
Upland Side	*Ambrosia artemisiifolia*	ragweed	FACU
	Daucus carota	wild carrot	UPL
	Elaeagnus umbellata	autumn olive	UPL
	Elymus repens	quackgrass	FACU
	Maintained lawn	Maintained Lawn	N/A
	Melilotus officinalis	sweetclover	FACU
	Melilotus officinalis	sweetclover	FACU
	Phragmites australis	giant reedgrass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Rubus allegheniensis	Allegheny blackberry	FACU
	Solidago altissima	Canada goldenrod	FACU
	Taraxacum officinale	dandilion	FACU
	Zanthoxylum americanum	common prickly ash	FACU

Table 31. Plant Lists Wetland 30 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Agrostis gigantea*	redtop	FACW
	Asclepias incarnata	swamp milkweed	OBL
	Bidens frondosa	beggertick	FACW
	Carex lacustris	hairy sedge	OBL
	Euthamia graminifolia	flat-top goldentop	FACW
	Juncus effusus	common rush	OBL
	Lycopus americanus	water hoarhound	OBL
	Phalaris arundinacea	reed canarygrass	FACW
	Rumex crispus	curly dock	FAC
	Schoenoplectus pungens	3-square	OBL
	Scirpus atrovirens	green bullrush	OBL
	Hydrology: Soils saturated within 6 inches of surface. Small depression.		
Upland Side	*Agrostis gigantea*	redtop	FACW
	Cirsium arvense	Canada thistle	FACU
	Daucus carota	wild carrot	UPL
	Fragaria virginiana	Virginia strawberry	FACU
	Phalaris arundinacea	reed canarygrass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Rubus allegheniensis	Allegheny blackberry	FACU
	Rubus occidentalis	black raspberry	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 32. Plant Lists Wetland 31 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Equisetum hyemale*	horsetail	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Juncus torreyi	torrey's rush	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reedgrass	FACW
	Spiraea alba	white meadowsweet	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Hydrology: Marginal. Bare ground. Highly disturbed. Adjacent to excavated pit.		
	Achillea millefolium	yarrow	FACU
	Agrostis gigantea	redtop	FACW
	Andropogon gerardii	big bluestem	FAC
	Daucus carota	wild carrot	UPL
	Elaeagnus umbellata	autumn olive	UPL
	Melilotus officinalis	sweetclover	FACU
	Pinus strobus	white pine	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU

Table 33. Plant Lists Wetland 32 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Carex lacustris*	hairy sedge	OBL
	Typha angustifolia	narrow-leaved cattail	OBL
	Hydrology: Drainage channel. Cut ditch.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Rhus typhina	staghorn sumac	UPL
	Rubus allegheniensis	Allegheny blackberry	FACU
	Rubus occidentalis	black raspberry	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 34. Plant Lists Wetland 33 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Alisma subcordatum*	water plantain	OBL
	Equisetum hyemale	horsetail	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Fraxinus pennsylvanica	green ash	FACW
	Juncus torreyi	torrey's rush	FACW
	Lythrum salicaria	purple loostrife	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phalaris arundinacea	reed canarygrass	FACW
	Phragmites australis	giant reedgrass	FACW
	Rhamnus cathartica	common buckthorn	FAC
	Salix amygdaloides	peachleaf willow	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Typha angustifolia	narrow-leaved cattail	OBL
	Hydrology: Soils saturated within 6 inches of surface. Drainage channels.		
Upland Side	*Achillea millefolium*	yarrow	FACU
	Andropogon gerardii	big bluestem	FACU
	Cichorium intybus	chickory	FACU
	Daucus carota	wild carrot	UPL
	Parthenocissus quinquefolia	Virginia creeper	FACU
	Phragmites australis	giant reedgrass	FACW
	Pinus strobus	white pine	FACU
	Rhamnus cathartica	common buckthorn	FAC
	Solidago altissima	Canada goldenrod	FACU
	Symphyotrichum pilosum	white old-field American aster	FACU

Table 35. Plant Lists Wetland 34 Boundaries

	Scientific Name	Common Name	Wetland Rating
Wetland Side	*Apocynum cannabinum*	indian hemp	FAC
	Bidens frondosa	beggertick	FACW
	Cornus amomum	silky dogwood	FACW
	Equisetum hyemale	horsetail	FACW
	Eupatorium perfoliatum	common boneset	OBL
	Frangula alnus	glossy buckthorn	FACW
	Fraxinus pennsylvanica	green ash	FACW
	Gentiana andrewsii	closed bottle gentian	FACW
	Juncus effusus	common rush	OBL
	Lythrum salicaria	purple loostrife	OBL
	Onoclea sensibilis	sensitive fern	FACW
	Phragmites australis	giant reedgrass	FACW
	Populus deltoides	eastern cottonwood	FAC
	Rhamnus cathartica	common buckthorn	FAC
	Scirpus atrovirens	green bullrush	OBL
	Solidago gigantea	smooth goldenrod	FACW
	Symphyotrichum novae-angliae	New England aster	FACW
	Viburnum lentago	nannyberry	FAC
	Hydrology: Soils saturated within 6 inches of surface. Standing water. Drainage channels. Water stained leaves. Bare ground. Hummocked ground.		
Upland Side	*Daucus carota*	wild carrot	UPL
	Fragaria virginiana	Virginia strawberry	FACU
	Lythrum salicaria	purple loostrife	OBL
	Rhamnus cathartica	common buckthorn	FAC
	Rubus allegheniensis	Allegheny blackberry	FACU
	Rubus occidentalis	black raspberry	FACU
	Solidago altissima	Canada goldenrod	FACU

Table 36. Native and Non-Native Plants identified along Wetland Side of Boundaries

Scientific Name	Common Name	Native/Non-Native
Acer negundo	boxelder	Native
Acer saccharinum	silver maple	Native
Agrostis gigantea	redtop	Non-Native
Alisma subcordatum	water plantain	Native
Ambrosia artemisiifolia	ragweed	Both
Apocynum cannabinum	indian hemp	Native
Asclepias incarnata	swamp milkweed	Native
Bidens frondosa	beggertick	Native
Boehmeria cylindrica	nettle	Native
Carex grayi	gray's sedge	Native
Carex lacustris	hairy sedge	Native
Carex lasiocarpa	wollyfruit sedge	Native
Carex lupulina	hop sedge	Native
Carex vulpinoidea	fox sedge	Native
Cephalanthus occidentalis	common buttonbush	Native
Cornus amomum	silky dogwood	Native
Cyperus esculentus	yellow nutsedge	Both
Echinochloa crus-galli	barnyard grass	Non-Native
Equisetum hyemale	horsetail	Native
Eupatorium perfoliatum	common boneset	Native
Euthamia graminifolia	flat-top goldentop	Native
Eutrochium maculatum	spotted joe pye weed	Native
Frangula alnus	glossy buckthorn	Non-Native
Fraxinus pennsylvanica	green ash	Native
Gentiana andrewsii	closed bottle gentian	Native
Geum canadense	white avens	Native
Glyceria striata	fowl mannagrass	Native
Hypericum perforatum	common St. Johnswort	Non-Native
Impatiens capensis	jewelweed	Native
Juncus effusus	common rush	Native
Juncus torreyi	torrey's rush	Native
Leersia oryzoides	rice cutgrass	Native
Lobelia siphilitica	great blue lobelia	Native
Lycopus americanus	water hoarhound	Native
Lythrum salicaria	purple loostrife	Non-Native
Onoclea sensibilis	sensitive fern	Native
Penthorum sedoides	ditch stonecrop	Native
Phalaris arundinacea	reed canarygrass	Non-Native
Phragmites australis	giant reedgrass	Non-Native
Populus deltoides	eastern cottonwood	Native
Populus tremuloides	quaking aspen	Native
Rhamnus cathartica	common buckthorn	Non-Native

Table 36 (Cont.)

Scientific Name	Common Name	Native/Non-Native
Rumex crispus	curly dock	Non-Native
Salix amygdaloides	peachleaf willow	Native
Salix interior	sandbar willow	Native
Salix matsudana	corkscrew willow	Non-Native
Schoenoplectus pungens	3-square	Native
Schoenoplectus tabernaemontani	softstem bullrush	Native
Scirpus atrovirens	green bullrush	Native
Scirpus cyperinus	wollgrass	Native
Solidago gigantea	smooth goldenrod	Native
Spiraea alba	white meadowsweet	Native
Symphyotrichum novae-angliae	New England aster	Native
Thelypteris palustris	marsh fern	Native
Toxicodendron radicans	poison ivy	Native
Typha angustifolia	narrow-leavedcattail	Non-Native
Ulmus americana	American elm	Native
Verbena hastata	swamp verbena	Native
Viburnum lentago	nannyberry	Native
Vitis riparia	riverbank grape	Native

Attachment C

Photographs

Wetland 1

Wetland 2

Wetland 3

Wetland 3

Wetland 4

Wetland 5

Wetland 6

Wetland 7

Wetland 7

Wetland 8

Wetland 9

Wetland 10

Wetland 10

Wetland 11

Wetland 12

Wetland 12

Wetland 13

Wetland 13

Wetland 14

Wetland 15

Wetland 16

Wetland 17

Wetland 18

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Wetland 24

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Wetland 25

Wetland 26

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Wetland 27

Wetland 28

Wetland 29

Wetland 29

Wetland 29

Wetland 30

Wetland 31

Wetland 32

Wetland 33

Wetland 34

Wetland 34

Wetland 34

Attachment D

Wetland Data Sheets

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/18/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point: Wet 2/Wet B-12
Investigator(s): Michael Nurse Section, Township, Range: 6, T08N, R07E
Landform (hillslope, terrace, etc.): Recessionial moraines Local relief (concave, convex, none): Linear
Slope (%): 0-3 Lat.: 43.13328 Long.: -83.68405 Datum: NA
Soil Map Unit Name: Conover loam NWI Classification: PSS1C
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- X Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	X	No	____	Depth (inches): 16
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 14

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: Wet 2/Wet B-12

Tree Stratum	Plot Size (30 ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Frangula alnus*	60	Y	FAC
2	*Ulmus americana*	20	Y	FACW
3				
4				
5				
6				
7				
8				
9				
10				
		80	= Total Cover	

Sapling/Shrub Stratum	Plot Size (15 ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Frangula alnus*	40	Y	FAC
2	*Ulmus americana*	10	Y	FACW
3				
4				
5				
6				
7				
8				
9				
10				
		50	= Total Cover	

Herb Stratum	Plot Size (1M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Glyceria striata*	5	Y	OBL
2	*Onoclea sensibilis*	5	Y	FACW
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		10	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	16	40
Sapling/Shrub Stratum	10	25
Herb Stratum	2	5
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across all Strata: 6 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	5	x 1 =	5
FACW species	35	x 2 =	70
FAC species	100	x 3 =	300
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column totals	140 (A)		375 (B)

Prevalence Index = B/A = 2.68

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 2/Wet B-12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-10	10YR 4/2	100					Loam	
10-18	10YR4/3	90	10YR 5/6	10			Loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) **(LRR R, MLRA 149B)**
___ Polyvalue Below Surface (S8) **(LRR R, MLRA**
___ Thin Dark Surface (S9) **(LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) **(LRR K, L)**
___ Loamy Gleyed Matrix (F2)
_X_ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) **(LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) **(LRR K, L, R)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR K, L, R)**
___ Dark Surface (S7) **(LRR K, L**
___ Polyvalue Below Surface (S8) **(LRR K, L)**
___ Thin Dark Surface (S9) **(LRR K, L)**
___ Iron-Manganese Masses (F12) **(LRR K, L, R)**
___ Piedmont Floodplain Soils (F19) **(MLRA 149B)**
___ Mesic Spodic (TA6) **(MLRA 144A, 145, 149B)**
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___Y___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/18/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point: Wet 2/ Upl B-12
Investigator(s): Michael Nurse Section, Township, Range: 6, T08N, R07E
Landform (hillslope, terrace, etc.): Recessionial moraines Local relief (concave, convex, none): Linear/concave
Slope (%): 0-3 Lat.: 43.13328 Long.: -83.68405 Datum: NA
Soil Map Unit Name: Brookston loam NWI Classification: none
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	X	No	____	Depth (inches): 20
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 18

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: Wet 2/ Upl B-12

Tree Stratum	Plot Size (30 ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Rhamnus cathartica*	60	Y	FAC
2				
3				
4				
5				
6				
7				
8				
9				
10				
		60	= Total Cover	

Sapling/Shrub Stratum	Plot Size (15 ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Rhamnus cathartica*	20	Y	FAC
2	*Frangula alnus*	1	N	FAC
3				
4				
5				
6				
7				
8				
9				
10				
		21	= Total Cover	

Herb Stratum	Plot Size (1M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Clematis terniflora*	15	Y	UPL
2	*Sanguinaria canadensis*	10	Y	FACU
3	*Rhamnus cathartica*	5	N	FAC
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		30	= Total Cover	

Woody Vine Stratum	Plot Size (15 ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Parthenocissus quinquefolia*	15	Y	FACU
2				
3				
4				
5				
		15	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	12	30
Sapling/Shrub Stratum	4	11
Herb Stratum	6	15
Woody Vine Stratum	3	8

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across all Strata: 5 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 40.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	86	x 3 =	258
FACU species	25	x 4 =	100
UPL species	15	x 5 =	75
Column totals	126 (A)		433 (B)

Prevalence Index = B/A = 3.44

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 2/ Upl B-12

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-6	10YR 3/3	100					Loam	
12-20	10YR4/3	90	10YR 5/4	10			Loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) **(LRR R, MLRA 149B)**
___ Polyvalue Below Surface (S8) **(LRR R, MLRA**
___ Thin Dark Surface (S9) **(LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) **(LRR K, L)**
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) **(LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) **(LRR K, L, R)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR K, L, R)**
___ Dark Surface (S7) **(LRR K, L**
___ Polyvalue Below Surface (S8) **(LRR K, L)**
___ Thin Dark Surface (S9) **(LRR K, L)**
___ Iron-Manganese Masses (F12) **(LRR K, L, R)**
___ Piedmont Floodplain Soils (F19) **(MLRA 149B)**
___ Mesic Spodic (TA6) **(MLRA 144A, 145, 149B)**
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___N___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/18/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point Wet 7/ Wet H9
Investigator(s): Michael Nurse Section, Township, Range: 6, T08N, R07E
Landform (hillslope, terrace, etc.): depressions on moraines Local relief (concave, convex, none): Linear/Convex
Slope (%): 0 - 2 Lat.: 43.09278 Long.: -83.67685 Datum: NA
Soil Map Unit Nam Brookston loam NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- X Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- X Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)
- X Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	X	No	X	Depth (inches): 10
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 8

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: Wet 7/ Wet H9

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1 M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Phalaris arundinacea*	40	Y	FACW
2	*Euthamia graminifolia*	25	Y	FAC
3	*Fraxinus pennsylvanica*	5	N	FACW
4	*Carex lacustris*	5	N	OBL
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		75	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	15	38
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across all Strata: 2 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	5	x 1 =	5	
FACW species	45	x 2 =	90	
FAC species	25	x 3 =	75	
FACU species	0	x 4 =	0	
UPL species	0	x 5 =	0	
Column totals	75	(A)	170	(B)

Prevalence Index = B/A = 2.27

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 7/ Wet H9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-6	10YR 3/2						silty loam	
6-12	10YR 3/1						Clay	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA**
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
_X_ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___Y___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/18/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point Wet 7/ Upl H9
Investigator(s): Michael Nurse Section, Township, Range: 6, T08N, R07E
Landform (hillslope, terrace, etc.): depressions on moraines Local relief (concave, convex, none): Linear/Convex
Slope (%): 0 - 2 Lat.: 43.09278 Long.: -83.67685 Datum: NA
Soil Map Unit Name: Metamora sandy loam NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes ____	No X	Depth (inches):	
Water table present?	Yes ____	No X	Depth (inches):	
Saturation present? (includes capillary fringe)	Yes ____	No X	Depth (inches):	

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

US Army Corps of Engineers Northcentral and Northeast Region

VEGETATION - Use scientific names of plants

Sampling Point: Wet 7/ Upl H9

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1 M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Daucus carota*	20	Y	
2	*Cirsium vulgare*	20	Y	FACU
3	*Solidago altissima*	20	Y	FACU
4	*Phleum pratense*	5	N	FACU
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		65	= Total Cover	

Woody Vine Stratum	Plot Size (15 ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Parthenocissus quinquefolia*	5	Y	FACU
2				
3				
4				
5				
		5	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	13	33
Woody Vine Stratum	1	3

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across all Strata: 4 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 0.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	50	x 4 =	200
UPL species	0	x 5 =	0
Column totals	50 (A)		200 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 7/ Upl H9

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-8	10YR 3/3						loamy sand	
8-16	10YR 6/3						loamy sand	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA**
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___N___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/19/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling PointWet 10/ Wet K'9
Investigator(s): Michael Nurse Section, Township, Range: 7, T08N, R07E
Landform (hillslope, terrace, etc.): Lakeplain Local relief (concave, convex, none): Linear
Slope (%): 0 - 2 Lat.: 43.11856 Long.: -83.68099 Datum: NA
Soil Map Unit Nam Sloan Silt Loam NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- X Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- X Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- X Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	X	No	____	Depth (inches): 5
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 3

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: Wet 10/ Wet K'9

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1 M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Impatiens capensis*	70	Y	FACW
2	*Leersia oryzoides*	5	N	OBL
3	*Bidens frondosa*	5	N	FACW
4	*Solidago gigantea*	5	N	FACW
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		85	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	17	43
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 1 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	5	x 1 =	5	
FACW species	80	x 2 =	160	
FAC species	0	x 3 =	0	
FACU species	0	x 4 =	0	
UPL species	0	x 5 =	0	
Column totals	85	(A)	165	(B)

Prevalence Index = B/A = 1.94

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 10/ Wet K'

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-10	10YR 3/1						silty loam	
6-12	10YR 3/1	95	10YR 3/4	5			silty loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) **(LRR R, MLRA 149B)**
___ Polyvalue Below Surface (S8) **(LRR R, MLRA**
___ Thin Dark Surface (S9) **(LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) **(LRR K, L)**
___ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) **(LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) **(LRR K, L, R)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR K, L, R)**
___ Dark Surface (S7) **(LRR K, L**
___ Polyvalue Below Surface (S8) **(LRR K, L)**
___ Thin Dark Surface (S9) **(LRR K, L)**
___ Iron-Manganese Masses (F12) **(LRR K, L, R)**
___ Piedmont Floodplain Soils (F19) **(MLRA 149B)**
___ Mesic Spodic (TA6) **(MLRA 144A, 145, 149B)**
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___Y___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/19/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point: Wet 10/ UPL K'
Investigator(s): Michael Nurse Section, Township, Range: 7, T08N, R07E
Landform (hillslope, terrace, etc.): Moraines Local relief (concave, convex, none): convex
Slope (%): 0 - 6 Lat.: 43.11856 Long.: -83.68099 Datum: NA
Soil Map Unit Name: Conover-Williamstown loams NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes ____	No X	Depth (inches):	
Water table present?	Yes ____	No X	Depth (inches):	
Saturation present? (includes capillary fringe)	Yes ____	No X	Depth (inches):	

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: Wet 10/ UPL K'S

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1 M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Solidago altissima*	80	Y	FACU
2	*Impatiens capensis*	5	N	FACW
3	*Fragaria virginiana*	5	N	FACU
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		90	= Total Cover	

Woody Vine Stratum	Plot Size (15 Ft)	Absolute % Cover	Dominant Species	Indicator Status
1	*Parthenocissus quinquefolia*	5	Y	FACU
2				
3				
4				
5				
		5	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	18	45
Woody Vine Stratum	1	3

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across all Strata: 2 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 0.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	5	x 2 =	10
FAC species	0	x 3 =	0
FACU species	90	x 4 =	360
UPL species	0	x 5 =	0
Column totals	95 (A)		370 (B)

Prevalence Index = B/A = 3.89

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 10/ UPL K'

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-10	10YR 4/3						clay loam	
10-20	10YR 5/6						clay loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA**
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___N___

Remarks:

US Army Corps of Engineers Northcentral and Northeast Region

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/26/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point/Vet 20/ Wet X1
Investigator(s): Michael Nurse Section, Township, Range: 18, T08N, R07E
Landform (hillslope, terrace, etc.): Moraines Local relief (concave, convex, none): Linear/Convex
Slope (%): 0 to 6 Lat.: 43.09278 Long.: -83.67685 Datum: NA
Soil Map Unit Name: Spinks-Oakville loamy sands NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- X Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- X Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)
- X Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes ____	No	X	Depth (inches):	____
Water table present?	Yes ____	No	X	Depth (inches):	____
Saturation present? (includes capillary fringe)	Yes X	No	____	Depth (inches):	12

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

US Army Corps of Engineers Northcentral and Northeast Region

VEGETATION - Use scientific names of plants

Sampling Point: /Wet 20/ Wet X1(

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Phragmites australis*	100	Y	FACW
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		100	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	20	50
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 1 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	100	x 2 =	200
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column totals	100 (A)		200 (B)

Prevalence Index = B/A = 2.00

Hydrophytic Vegetation Indicators:

- ___ Rapid test for hydrophytic vegetation
- X Dominance test is >50%
- X Prevalence index is ≤3.0*
- ___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
- ___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

US Army Corps of Engineers

Northcentral and Northeast Region

SOIL **Sampling Point:** /Vet 20/ Wet X1(

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-3	10YR 2/2	100					Loamy sand	
3-10	10YR 5/2	100					Loamy sand	small amount of clay

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) **(LRR R, MLRA 149B)**
___ Polyvalue Below Surface (S8) **(LRR R, MLRA**
___ Thin Dark Surface (S9) **(LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) **(LRR K, L)**
___ Loamy Gleyed Matrix (F2)
_X_ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) **(LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) **(LRR K, L, R)**
___ 5 cm Mucky Peat or Peat (S3) **(LRR K, L, R)**
___ Dark Surface (S7) **(LRR K, L**
___ Polyvalue Below Surface (S8) **(LRR K, L)**
___ Thin Dark Surface (S9) **(LRR K, L)**
___ Iron-Manganese Masses (F12) **(LRR K, L, R)**
___ Piedmont Floodplain Soils (F19) **(MLRA 149B)**
___ Mesic Spodic (TA6) **(MLRA 144A, 145, 149B)**
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? __Y__

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Genesee/Genesee Sampling Date: 9/19/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point: Wet 20/ upl X1C
Investigator(s): Michael Nurse Section, Township, Range: 18, T08N, R07E
Landform (hillslope, terrace, etc.): Moraines Local relief (concave, convex, none): Linear/Convex
Slope (%): 2 to 6 Lat.: 43.09278 Long.: -83.67685 Datum: NA
Soil Map Unit Name: Spinks-Oakville loamy sands NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? _____ (If no, explain in remarks)
Are vegetation _____, soil _____, or hydrology _____ significantly disturbed? Are "normal
Are vegetation _____, soil _____, or hydrology _____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes _____	No X	Depth (inches):	
Water table present?	Yes _____	No X	Depth (inches):	
Saturation present? (includes capillary fringe)	Yes _____	No X	Depth (inches):	

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

US Army Corps of Engineers Northcentral and Northeast Region

VEGETATION - Use scientific names of plants

Sampling Point: Wet 20/ upl X10

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Solidago altissima*	60	Y	FACU
2	*Verbascum thapsus*	10	N	
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		70	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	14	35
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across all Strata: 1 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 0.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	60	x 4 =	240
UPL species	0	x 5 =	0
Column totals	60 (A)		240 (B)

Prevalence Index = B/A = 4.00

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

Herbaceous layer mostly bare

SOIL **Sampling Point:** Wet 20/ upl X10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-10	10YR 4/3	100					fine sandy loam	
10-18	10YR 5/4	100					fine sandy loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA**
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___N___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Flint/Genesee Sampling Date: 9/19/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point: Vet 33/ Wet vv2
Investigator(s): Michael Nurse Section, Township, Range: 32, T08N, R07E
Landform (hillslope, terrace, etc.): Moraines Local relief (concave, convex, none): Linear
Slope (%): 0 to 2 Lat.: 43.06141 Long.: -83.67041 Datum: NA
Soil Map Unit Name: Colwood silt loam NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	Y	**Is the sampled area within a wetland?**	Y
Hydric soil present?	Y		
Indicators of wetland hydrology present?	Y	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- X Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	X	No	X	Depth (inches): 8
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 6

Indicators of wetland hydrology present? Y

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION - Use scientific names of plants

Sampling Point: Wet 33/ Wet vv2

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Phragmites australis*	50	Y	FACW
2	*Eupatorium perfoliatum*	10	N	FACW
3	*Symphyotrichum novae-angliae*	5	N	FACW
4	*Juncus torreyi*	5	N	FACW
5	*Phalaris arundinacea*	5	N	FACW
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		75	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	15	38
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across all Strata: 1 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 100.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	75	x 2 =	150
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column totals	75 (A)		150 (B)

Prevalence Index = B/A = 2.00

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation

X Dominance test is >50%

X Prevalence index is ≤3.0*

___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)

___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? Y

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** Vet 33/ Wet vv2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-10	10YR 2/2						silt	
10-18	10YR 6/2						silt	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA**
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___Y___

Remarks:

WETLAND DETERMINATION DATA FORM - Northcentral and Northeast Region

Project/Site: City of Flint Secondary Water Supply City/County: Flint/Genesee Sampling Date: 9/19/19
Applicant/Owner: Genesee County Drain Commissioner State: MI Sampling Point/Vet 33/ Upl vv2
Investigator(s): Michael Nurse Section, Township, Range: 32, T08N, R07E
Landform (hillslope, terrace, etc.): Lakeplain Local relief (concave, convex, none): Linear/Convex
Slope (%): 6 to 12 Lat.: 43.06141 Long.: -83.67041 Datum: NA
Soil Map Unit Name: Sisson fine sandy loam NWI Classification: None
Are climatic/hydrologic conditions of the site typical for this time of the year? ____ (If no, explain in remarks)
Are vegetation ____, soil ____, or hydrology ____ significantly disturbed? Are "normal
Are vegetation ____, soil ____, or hydrology ____ naturally problematic? circumstances" present? Yes
(If needed, explain any answers in remarks)

SUMMARY OF FINDINGS

Hydrophytic vegetation present?	N	**Is the sampled area within a wetland?**	N
Hydric soil present?	N		
Indicators of wetland hydrology present?	N	If yes, optional wetland site ID:	

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Microtopographic Relief (D4)

Field Observations:

Surface water present?	Yes	____	No	X	Depth (inches): ____
Water table present?	Yes	____	No	X	Depth (inches): ____
Saturation present? (includes capillary fringe)	Yes	X	No	____	Depth (inches): 20

Indicators of wetland hydrology present? N

Describe recorded data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

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VEGETATION - Use scientific names of plants

Sampling Point: /Net 33/ Upl vv2

Tree Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Sapling/Shrub Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
		0	= Total Cover	

Herb Stratum	Plot Size (1M)	Absolute % Cover	Dominant Species	Indicator Status
1	*Andropogon gerardii*	40	Y	FACU
2	*Achillea millefolium*	10	N	FACU
3	*Solidago altissima*	5	N	FACU
4	*Rhamnus cathartica*	5	N	FAC
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
		60	= Total Cover	

Woody Vine Stratum	Plot Size ( )	Absolute % Cover	Dominant Species	Indicator Status
1				
2				
3				
4				
5				
		0	= Total Cover	

50/20 Thresholds

	20%	50%
Tree Stratum	0	0
Sapling/Shrub Stratum	0	0
Herb Stratum	12	30
Woody Vine Stratum	0	0

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across all Strata: 1 (B)

Percent of Dominant Species that are OBL, FACW, or FAC: 0.00% (A/B)

Prevalence Index Worksheet

Total % Cover of:

OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	5	x 3 =	15
FACU species	55	x 4 =	220
UPL species	0	x 5 =	0
Column totals	60 (A)		235 (B)

Prevalence Index = B/A = 3.92

Hydrophytic Vegetation Indicators:

___ Rapid test for hydrophytic vegetation
___ Dominance test is >50%
___ Prevalence index is ≤3.0*
___ Morphogical adaptations* (provide supporting data in Remarks or on a separate sheet)
___ Problematic hydrophytic vegetation* (explain)

*Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines - All woody vines greater than 3.28 ft in height.

Hydrophytic vegetation present? N

Remarks: (Include photo numbers here or on a separate sheet)

SOIL **Sampling Point:** Net 33/ Upl vv2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (Inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type*	Loc**	Texture	Remarks
0-5	10YR 4/2						sandy loam	
5-15	10YR 6/3						sandy loam	

*Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains
**Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

___ Histisol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Suface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA**
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

*Indicators of hydrophytic vegetation and weltand hydrology must be present, unless disturbed or problematic

Restrictive Layer (if observed):
Type: _____
Depth (inches): _____

Hydric soil present? ___N___

Remarks:

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