SECTION 00 01 00
CONTRACT DOCUMENTS

2025 TAYLOR WATER MAIN REHABILITATION DESIGN

City of Taylor
23555 Goddard Rd
Taylor, MI 48180

November 9, 2026

25251 Northline Rd, Taylor, MI 48180

TAY3164-23T

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SECTION 00 11 13
ADVERTISEMENT FOR BIDS

2025 Taylor Water Main Rehabilitation Design

City of Taylor has implemented online project bidding using **OpenGov** . Only electronic bids submitted through www.opengov.com will be accepted for this project.

Sealed Bids will be received by the City of Taylor through OpenGov until 10:00 A.M., Local Time, 12-15-2026. Shortly after the bid closing time a bid tabulation will be prepared and posted online.

Sealed Bids can also be received by City of Taylor at the Clerk's Office, 23555 Goddard, Taylor, Michigan, 48180, until 10:00 A.M., Local Time, 12-15-2026, at which time and place said Bids will be opened and publicly read aloud.

Bids will be received for the following Work:

This project includes the installation of approximately 49,600 LF of HDPE water main with sizes ranging from 8" to 16", 670 water services, 78 gate valves, 74 hydrants, and associated pavement repairs. The proposed work on Mary and Haskell Street must have final completion on or before Labor Day (Monday September 6, 2027) in order to allow for paving those streets before the end of the construction season through a separate contract. The proposed work on Wick Road will be completed on or before Friday November 10, 2027. This road is on schedule to be paved through the MDOT LAP program in 2028. The remaining work will be completed on or before Friday November 15, 2028..

Contract Documents may be examined at the following locations:

Contract Documents for bidding purposes are only available from Opengov starting on November 10, 2026. Contract Documents can be viewed and downloaded by registering with Opengov online (www.opengov.com).

A. Bids will be received electronically throught Opengov as outlined in Section 00 21 13 - Instruction to Bidders.

Each Bid will be accompanied by a bid bond, in the amount of at least **five (5)** percent of the amount bid, drawn payable to City of Taylor as security for the proper execution of the Agreement.

City of Taylor reserves the right to accept or reject any or all bids and to waive any informality in any bids should it consider same to be in its best interest.

The City of Taylor further reserves the right to waive defects in proposals, to enter into negotiations with any applicant, to re-solicit for proposals and to conduct an application evaluation review with any and all applicants. The City will not be responsible for any costs or fees associated with the preparation of a response to this request for proposals and/or qualifications.

The City of Taylor reserves the right to award 1, 2, 3, 4 or any combination thereof of all areas identified in this Proposal.

Bids may not be withdrawn for the period of 90 days after date of receiving bids.

Inquiries will be directed to Ben Clayton, Purchasing Director; contat information as provided in the "Invitatino to Bid".

Questions will be received until 12-04-2026 at 10:00 AM. No further questions will be answered after this date and time.

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SECTION 00 21 13
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.

B. The term "Bidder" means one who submits a Bid to Owner as distinct from a subbidder who submits a Bid to a Bidder.

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

D. The term "Owner" means City of Taylor, 23555 Goddard Rd, a Municipal Corporation and being a party of the first part of this Contract.

E. The term “Engineer” means Wade Trim, 25251 Northline Rd, Taylor, MI 48180, or a duly authorized representative.

1.02 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 the Owner in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by the Owner to do so, must furnish evidence, satisfactory to the Owner, of the Bidder's experience and familiarity with Work of the character specified, and Bidder's financial ability to properly prosecute the proposed Work to completion within the specified time. The evidence requested may include the following:

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

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

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

4. 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 the Owner that the Bidder is adequately prepared to fulfill the Contract.

1.03 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 himself 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 the Engineer in writing of conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between Contract Documents and such related documents.

6. Purchase official Procurement Documents from the 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 the Engineer in preparing the Contract Documents.

1. If such reports are not included as appendices to the Contract Documents, the 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. 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 their Bid each Bidder will, at Bidder's own expense, make such additional investigations and tests as the Bidder may deem necessary to determine Bidder's Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

C. On request, the Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of their Bid. Bidder must 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 the Contractor in performing the Work are identified in Section 01 11 00 - 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 the Owner nor the Engineer will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.

1. The submission of a Bid will constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, 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 the Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in Contract Documents and the resolution by the

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.

1.04 INTERPRETATIONS AND ADDENDA

A. Should any prospective bidder find discrepancies in, or omissions from the Plans, Specifications or other parts of the Contract Documents, the prospective bidder 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 must be made in the form of an Addendum issued to all prospective bidders who have taken out Contract Documents and all such Addenda will 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.

1.05 BID SECURITY

A. Bid Security must be made payable to the Owner, in an amount of **five (5)** percent of the Bidder's maximum Bid price, as indicated in Section 00 11 13 - Advertisement for Bids. Bid Bonds, if indicated as acceptable in Section 00 11 13, will be issued on the form included in the Contract Documents by a Surety meeting the requirements of paragraph 5.01 of Section 00 72 00 - General Conditions.

B. Bid Security of the Successful Bidder will be retained until such Bidder has executed Section 00 52 00 - 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, the Owner may annul the Notice of Award and the Bid Security of that Bidder will be forfeited.

C. Bid Security of any Bidder whom the Owner believes to have a reasonable chance of receiving the award may be retained by the 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.

1.06 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 Agreement.

1.07 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.

B. 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 the Contractor if acceptable to the Engineer, application for such acceptance will not be considered by the Engineer until after the effective date of the Agreement.

C. In addition, in no case will the Engineer’s denial of the Contractor’s application give rise to any claim for additional cost, it being understood by the Contractor that acceptance of substitute or an “or equal” item of material is at the sole discretion of the Engineer.

1.08 RECEIPT AND FORM OF BID

A. Bids must be submitted at the time and place indicated in the Advertisement for Bids and must be accompanied by the Bid Security and other required documents.

1. Bids must be submitted electronically as specified herein.

B. Bids received after the scheduled time and place indicated in the Advertisement for Bids will be returned unopened.

C. Owner invites bids on the Proposal and any other form(s) attached thereto.

D. The complete set of Contract Documents must be used in preparing Bids; neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.

E. Bidder must acknowledge of receipt of Addenda as provided for in the electronic bidding platform. Failure to acknowledge Addenda will be cause for rejection of bid.

F. The Legal Status of Bidder Form, located in Section 00 43 45 - Legal Status of Bidder, must be submitted with each Bid 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.

G. Other documents to be attached to the Proposal and made a condition thereof are identified in the Proposal.

H. A tabulation of the amounts of the base bids and any alternates will be made available after the opening of Bids.

I. To obtain Contract Documents and submit a Bid, Bidders:

1. Must proceed to the Wade Trim website at www.wadetrim.com/Resources and download the Contract Documents.

1.09 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 the Owner and promptly thereafter demonstrates to the reasonable satisfaction of the Owner that

there was a material and substantial mistake in the preparation of their Bid, that Bidder may withdraw their Bid and the Bid Security will be returned.

1. Thereafter, at the sole option of the Owner, that Bidder will be disqualified from further Bidding on the Work to be provided under the Contract Documents.

1.10 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.

B. 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.

C. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

D. In evaluating Bids, the Owner will 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 the Owner's intent to accept alternates (if any are accepted) in the order in which they are listed in the Bid form but the Owner may accept them in any order or combination.

E. Subject to the approval of the 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.

F. The Contract will be considered to have been awarded after the approval of the Owner has been duly obtained and a formal Notice of Award duly served on the Successful Bidder by the Owner.

G. If the Contract is to be awarded, the Owner will give the Successful Bidder a Notice of Award within 90 days after the day of the Bid opening, unless such other time is specified in the Advertisement for Bids.

H. The Contract will not be binding upon the Owner until the Agreement has been duly executed by the Bidder and the duly authorized officials of the Owner.

1.11 SIGNING OF AGREEMENT

A. Within fifteen (15) days after the Owner gives a Notice of Award to the Successful Bidder, the Contractor must sign and deliver the specified number of counterparts of the Agreement to the Owner with all other Contract Documents attached.

B. Within ten (10) thereafter, the Owner will deliver two (2) fully signed counterparts to the Contractor. Engineer will identify, date or correct those portions of the Contract Documents not fully signed, dated or executed by the Owner and the Contractor and such identification, dating or correction will be binding on all parties.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 42 43
PROPOSAL

Owner: City of Taylor

Project: 2025 Taylor Water Main Rehabilitation Design

Project Location: Mary Street and Wilkie from Wick Rd to Telegraph and Haskell Street from Westlake St to Telegraph

BIDDER INFORMATION

Bidder Name:_____

By (Printed Name):_____

Signature:_____

Address:_____

Phone No:_____

Email:_____

Bidder proposes and agrees, if their Bid is accepted, to enter into an Agreement with the City of Taylor 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 the Agreement, and in accordance with the Contract Documents.

In submitting their Bid, Bidder represents, as more fully set forth in the Agreement, that:

Bidder has examined copies of Contract Documents, (consisting of Plans dated Ready for Bidders date and Project Manual dated Ready for Bidders date) which Bidder understands and accepts as sufficient for the purpose, including any and all Addenda officially issued, the receipt of which has been acknowledged.

A. Addendum _____ Acknowledged by: Date:

B. Addendum _____ Acknowledged by: Date:

C. Addendum _____ Acknowledged by: Date:

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.

Bidder, by submitting a Bid, agrees that their 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 the City of Taylor.

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

Area 4

Item	Description	Quantity	Unit	Unit Price	Amount
1	Mobilization	1	LS	$_____	$_____
2	Traffic Maintenance and Control	1	LS	$_____	$_____

3	Audio Video Route Survey	1	LS	$_____	$_____
4	Inspector Days	_____	Days	$ 1,000	$_____
5	Minor Traffic Devices	1	LS	$_____	$_____
6	Concrete Pavement, Remove	400	SYD	$_____	$_____
7, 8	Concrete Drive and Sidewalk, Remove	175	SF	$_____	$_____
9	Bituminous Pavement, Remove	550	SY	$_____	$_____
10	Concrete Curb and Gutter, Remove	100	LF	$_____	$_____
11	Fire Hydrant, Remove	6	EACH	$_____	$_____
12	Gate Valve and Well. Remove	4	EACH	$_____	$_____
13	Sign, Salvage	1	EACH	$_____	$_____
14	Inlet Filter	75	EACH	$_____	$_____
15	Check Dam	80	EACH	$_____	$_____
16	Adjust Structure	1	EACH	$_____	$_____
17	Water Main, 8-Inch, HDPE, Directional Drill	6,300	LF	$_____	$_____
18	Water Main, 8-Inch, HDPE, Pipe Burst Ex 6-Inch	80	LF	$_____	$_____
19	Water Main, 8-Inch, HDPE, Pipe Bursting Ex 8-Inch	660	LF	$_____	$_____
20	Gate Valve and Well, 8-Inch	13	EACH	$_____	$_____
21	Water Main, Abandon with Flowable Fill	32	CY	$_____	$_____
22	Water Service, HDPE, 1-Inch, Long	73	EACH	$_____	$_____
23	Water Service, HDPE, 1-Inch, Short	49	EACH	$_____	$_____
24	Curb Stop and Box, 1-Inch	122	EACH	$_____	$_____
25	Water Service, HDPE, 2-Inch, Long	2	EACH	$_____	$_____
26	Curb Stop and Box, 2-Inch	2	EACH	$_____	$_____
27	Water Service (Beyond Property Line), HDPE, 1-Inch, Directional Drilled	350	LF	$_____	$_____
27A	Water Service from Property Line to Meter, K Copper, 1-Inch	15	EACH	$_____	$_____

	Directional Bored				
27B	Water Service, Connection to Water Meter	15	EACH	$_____	$_____
28	Fire Hydrant Assembly	17	EACH	$_____	$_____
29	Connection to Ex 8 Inch Water Main w/ 8"x8" Tee and Cutting in Sleeve	2	EACH	$_____	$_____
30	Connection to Ex 8 Inch Water Main W/ 8-Inch MJ Sleeve	2	EACH	$_____	$_____
31	Connection to Ex 12-Inch Water Main w/ 12"x8" Tee and Cutting in Sleeve	1	EACH	$_____	$_____
32	Sanitary Sewer Pre-Construction TV	52	EACH	$_____	$_____
33	Sanitary Sewer Post-Construction TV	52	EACH	$_____	$_____
34	Aggregate Base Course, 21 AA	475	TON	$_____	$_____
35	Concrete Pavement, 7-Inch	300	SYD	$_____	$_____
36	Concrete Pavement, 9-Inch	75	SY	$_____	$_____
37	Curb and gutter, Concrete	95	LF	$_____	$_____
38	Concrete Sidewalk Ramp, ADA, 6-Inch With 6-Inch Subbase	160	SF	$_____	$_____
39	Bituminous Wearing Course, 5E1	20	TON	$_____	$_____
40	Bituminous Leveling Course, 4E1	20	TON	$_____	$_____
41	Restoration w/3" Topsoil, Seed, Fertilizer, and Mulch	15,500	SYD	$_____	$_____
42	Maintenance Aggregate	6	CY	$_____	$_____
43	Permit Allowance	1	LS	$_____	$_____
44	Exploratory Excavation	20	EACH	$_____	$_____
45	Irrigation Allowance	1	LS	$_____	$_____

Total Contract Price for Area 4 (Items 1 through 45) $_____

Area 1

Item	Description	Quantity	Unit	Unit Price	Amount

201	Mobilization	1	LS	$_____	$_____
202	Traffic Maintenance and Control	1	LS	$_____	$_____
203	Audio Video Route Survey	1	LS	$_____	$_____
204	Inspector Days	_____	Days	$ 1,000	$_____
205	Minor Traffic Devices	1	LS	$_____	$_____
206	Concrete Pavement, Remove	675	SYD	$_____	$_____
206A	Earth Excavation	10	CYD	$_____	$_____
207, 208	Concrete Drive and Sidewalk, Remove	44,000	SF	$_____	$_____
209	Bituminous Pavement, Remove	850	SY	$_____	$_____
210	Curb and Gutter, Remove	200	LF	$_____	$_____
211	Storm Sewer, Remove	900	LF	$_____	$_____
212	Catch Basin, Remove	15	EACH	$_____	$_____
213	Fire Hydrant, Remove	31	EACH	$_____	$_____
214	Gate Valve and Well, Remove	34	EACH	$_____	$_____
215	Inlet Filter	500	EACH	$_____	$_____
215A	Check Dam		EACH	$_____	$_____
216	Adjust Structure	3	EACH	$_____	$_____
217	Water Main, 8-Inch, HDPE SDR11, Directional Drill	3,000	LF	$_____	$_____
218	Water Main, 8-Inch, HDPE SDR11, Pipe Burst Ex 6-Inch	14,750	LF	$_____	$_____
219	Water Main, 8-Inch, HDPE SDR11, Pipe Bursting Ex 8-Inch	10,250	LF	$_____	$_____
219A	Water Main, 16-Inch, HDPE SDR11, Pipe Burst Ex 16-Inch	150	LF	$_____	$_____
219B	Water Main, Abandon w/ Flowable Fill	10	CY	$_____	$_____
220	Gate Valve and Well, 8-Inch	58	EACH	$_____	$_____
220A	Gate Valve and Well, 16-Inch	3	EACH	$_____	$_____
221	Steel Casing Pipe, 12-Inch	20	LF	$_____	$_____
222	Water Service, HDPE, 1-Inch, Long	240	EACH	$_____	$_____
223	Water Service, HDPE, 1-Inch, Short	285	EACH	$_____	$_____

224	Curb Stop and Box, 1-Inch	525	EACH	$_____	$_____
225	Water Service, HDPE, 2-Inch, Long	1	EACH	$_____	$_____
226	Curb Stop and Box, 2-Inch	2	EACH	$_____	$_____
226A	Water Service (Beyond Property Line), HDPE, 1-Inch, Directional Drilled	1,200	LF	$_____	$_____
226B	Water Service from Property Line to Meter, K Copper, 1-Inch Directional Bored	15	EACH	$_____	$_____
226C	Water Service, Connection to Water Meter	15	EACH	$_____	$_____
227	Fire Hydrant Assembly	51	EACH	$_____	$_____
228	Connection to Ex 6- Inch Water Main w/ 8"x6" Reducer	2	EACH	$_____	$_____
229	Connection to Ex 8-Inch Water Main w/8”x8” Tee	4	EACH	$_____	$_____
230	Connection to Ex 8-Inch Water Main w/ 16"x8" Tee	1	EACH	$_____	$_____
231	Connection to Ex 12-Inch Water Main w/ 12"x8" Tee and Cutting in Sleeve	6	EACH	$_____	$_____
232	Connection to Ex 8” Water Main w/ 8” MJ Sleeve	2	EACH	$_____	$_____
233	Sanitary Sewer Pre-Construction TV	63	EACH	$_____	$_____
234	Sanitary Sewer Post-Construction TV	63	EACH	$_____	$_____
234A	12-Inch Storm Sewer	800	LF	$_____	$_____
234B	15-Inch Storm Sewer	250	LF	$_____	$_____
234C	30-Inch Storm Sewer	20	LF	$_____	$_____
235	Aggregate Base Course, 21AA	725	TON	$_____	$_____
236	Concrete Pavement, 7-Inch	750	SYD	$_____	$_____
236A	Concrete Pavement, 9-Inch	350	SY	$_____	$_____
236B	Concrete Pavement, 10-Inch	100	SY	$_____	$_____
236C	Concrete Pavement w/ Integral Curb, 9-Inch	300	SY	$_____	$_____

236D	Concrete Pavement w/ Integral Curb, 10-Inch	125	SY	$_____	$_____
236E	Concrete Drive, 6-Inch	4000	SF	$_____	$_____
236F	Concrete Pavement W/ Integral Curb, 7-Inch	600	SY	$_____	$_____
237	Curb and gutter, Concrete	600	LF	$_____	$_____
238	Bituminous Wearing Course, 5E1	100	TON	$_____	$_____
239	Bituminous Leveling Course, 4E1	100	TON	$_____	$_____
240	Restoration w/3" Topsoil, Seed, Fertilizer, and Mulch	81,000	SYD	$_____	$_____
241	Maintenance Aggregate	40	CY	$_____	$_____
242	Sidewalk, Concrete, 4-Inch w/ 4-Inch Subbase	41,000	SF	$_____	$_____
242A	Sidewalk, Concrete Ramp, ADA, 6-Inch	1500	SF	$_____	$_____
243	Remove and Replace Sign	11	EACH	$_____	$_____
243A	Tree Removal, 6-Inch to 18-Inch	1	EACH	$_____	$_____
244	Tree Removal, 19-Inch to 36-Inch	1	EACH	$_____	$_____
244A	Irrigation Allowance	1	LS	$_____	$_____
244B	Permit Allowance	1	LS	$_____	$_____
244C	Exploratory Excavation	10	EACH	$_____	$_____
245	Guardrail, Remove	10	LF	$_____	$_____

Total Contract Price for Area 1 (Items 201 through 245)
$_____

Area 2

Item	Description	Quantity	Unit	Unit Price	Amount
401	Mobilization	1	LS	$_____	$_____
402	Traffic Maintenance and Control	1	LS	$_____	$_____
403	Audio Video Route Survey	1	LS	$_____	$_____
404	Inspector Days	_____	Days	$ 1,000	$_____
405	Minor Traffic Devices	1	LS	$_____	$_____
406	Concrete Pavement, Remove	340	SYD	$_____	$_____
406A	Bituminous Pavement, Remove	50	SYD	$_____	$_____

407, 408	Concrete Drive and Sidewalk, Remove	10,200	SF	$_____	$_____
409	Curb and Gutter, Remove	15	LF	$_____	$_____
410	Storm Sewer, Remove	10	LF	$_____	$_____
410A	Catch Bain, Remove	1	EACH	$_____	$_____
411	Fire Hydrant, Remove	9	EACH	$_____	$_____
412	Gate Valve and Well, Remove	5	EACH	$_____	$_____
413	Inlet Filter	51	EACH	$_____	$_____
414	Check Dam	197	EACH	$_____	$_____
415	Water Main, 8-Inch, HDPE SDR11, Directional Drill	2,200	LF	$_____	$_____
416	Water Main, 8-Inch, HDPE SDR11, Pipe Burst Ex 6-Inch	5,000	LF	$_____	$_____
417	Water Main, 8-Inch, HDPE SDR11, Pipe Bursting Ex 8-Inch	925	LF	$_____	$_____
418	Water Main, Abandon w/ Flowable Fill	10	CY	$_____	$_____
419	Gate Valve and Well, 8-Inch	20	EACH	$_____	$_____
420	Water Service, HDPE, 1-Inch, Long	56	EACH	$_____	$_____
421	Water Service, HDPE, 1-Inch, Short	56	EACH	$_____	$_____
422	Curb Stop and Box, 1-Inch	112	EACH	$_____	$_____
423	Water Service, HDPE, 2-Inch, Long	6	EACH	$_____	$_____
424	Curb Stop and Box, 2-Inch	10	EACH	$_____	$_____
424A	Water Service from Property Line to Meter, K Copper, 1-Inch Directional Bored	15	EACH	$_____	$_____
424B	Water Service, Connection to Water Meter	15	EACH	$_____	$_____
425	Fire Hydrant Assembly	14	EACH	$_____	$_____
426	Connection to Ex 6-Inch Water Main w/ 8"x6" Tee	1	EACH	$_____	$_____
429	Connection to Ex 8-Inch Water Main w/ 8” Cross	3	EACH	$_____	$_____

430	Connection to Ex 8” Water Main w/ 8”x8” Tee	1	EACH	$_____	$_____
431	Connection to Ex 12” Water Main w/ 12”x8” Tee	3	EACH	$_____	$_____
432	Connection to Ex 6” Water Main w/ 90Deg bend and 8”x6” Reducer	1	EACH	$_____	$_____
434	12-Inch Storm Sewer, C76, CL IV RCP, Trench B	10	LF	$_____	$_____
435	Aggregate Base Course, 21AA	110	TON	$_____	$_____
436	Concrete Pavement, 7-Inch	100	SYD	$_____	$_____
437	Concrete Pavement w/ Integral Curb, 9-Inch	175	SY	$_____	$_____
438	Concrete Drive, 6-Inch	600	SF	$_____	$_____
439	Curb and gutter, Concrete	20	LF	$_____	$_____
440	Bituminous Wearing Course, 5E1	18	TON	$_____	$_____
441	Bituminous Leveling Course, 4E1	18	TON	$_____	$_____
442	Restoration w/3" Topsoil, Seed, Fertilizer, and Mulch	22,100	SYD	$_____	$_____
443	Maintenance Aggregate	10	CY	$_____	$_____
444	Sidewalk, Concrete, 4-Inch w/ 4-Inch Subbase	9,400	SF	$_____	$_____
445	Concrete Sidewalk Ramp, ADA, 6-Inch w/ 6-Inch Subbase	200	SF	$_____	$_____
446	Sanitary Sewer Pre-Construction TV	30	EACH	$_____	$_____
446A	Irrigation Allowance	1	LS	$_____	$_____
446B	Permit Allowance	1	LS	$_____	$_____
446C	Exploratory Excavation	10	EACH	$_____	$_____
447	Sanitary Sewer Post-Construction TV	30	EACH	$_____	$_____

Total Contract Price for Area 2 (Items 401 through 447) $_____

Area 3

Item	Description	Quantity	Unit	Unit Price	Amount

501	Mobilization	1	LS	$_____	$_____
502	Traffic Maintenance and Control	1	LS	$_____	$_____
503	Audio Video Route Survey	1	LS	$_____	$_____
504	Inspector Days	_____	Days	$ 1,000	$_____
505	Minor Traffic Devices	1	LS	$_____	$_____
506	Concrete Pavement, Remove	700	SYD	$_____	$_____
506A	Bituminous Pavement, Remove	900	SYD	$_____	$_____
507, 508	Concrete Drive and Sidewalk, Remove	7,000	SF	$_____	$_____
509	Curb and Gutter, Remove	125	LF	$_____	$_____
510	Fire Hydrant, Remove	7	EACH	$_____	$_____
511	Gate Valve and Well, Remove	14	EACH	$_____	$_____
512	Inlet Filter	68	EACH	$_____	$_____
513	Check Dam	34	EACH	$_____	$_____
514	Adjust Structure	1	EACH	$_____	$_____
515	Water Main, 8-Inch, HDPE SDR11, Pipe Burst Ex 6-Inch	470	LF	$_____	$_____
516	Water Main, 8-Inch, HDPE SDR11, Pipe Bursting Ex 8-Inch	1,500	LF	$_____	$_____
517	Water Main, 12-Inch, HDPE SDR11, Pipe Bursting Ex 8-Inch	4,500	LF	$_____	$_____
518	Water Main, 12-Inch, HDPE SDR11, Directional Drill	350	LF	$_____	$_____
519	Water Main, 16-Inch, HDPE SDR11, Pipe Burst Ex 16-Inch	150	LF	$_____	$_____
520	Water Main, Abandon w/ Flowable Fill	40	CY	$_____	$_____
521	Gate Valve and Well, 8-Inch	11	EACH	$_____	$_____
522	Gate Valve and Well, 12-Inch	11	EACH	$_____	$_____
522A	Gate Valve and Well, 16-Inch	1	EACH	$_____	$_____
523	Water Service, HDPE, 1-Inch, Long	26	EACH	$_____	$_____

524	Water Service, HDPE, 1-Inch, Short	32	EACH	$_____	$_____
525	Curb Stop and Box, 1-Inch	58	EACH	$_____	$_____
526	Water Service, HDPE, 2-Inch, Short	2	EACH	$_____	$_____
527	Curb Stop and Box, 2-Inch	2	EACH	$_____	$_____
527A	Water Service from Property Line to Meter, K Copper, 1-Inch Directional Bored	15	EACH	$_____	$_____
527B	Water Service, Connection to Water Meter	15	EACH	$_____	$_____
528	Fire Hydrant Assembly	12	EACH	$_____	$_____
530	Connection to Ex 6-Inch Water Main w/ 12”x6” Tee Reducer	7	EACH	$_____	$_____
531	Connection to Ex 8-Inch Water Main w/ 8” MJ Sleeve	5	EACH	$_____	$_____
532	Connection to Ex 8” Water Main w/ 12”x8” Tee	24	EACH	$_____	$_____
533	Connection to Ex 12” Water Main w/ 12”x12” Tee and Cutting in Sleeve	2	EACH	$_____	$_____
534	Connection to Ex 12” Water Main w/ 12” MJ Sleeve	2	EACH	$_____	$_____
534A	Connection to Ex 16-Inch Water Main w/ 16x12 Tee	1	EACH	$_____	$_____
535	Connection to Ex 16-Inch Water Main w/ 16” MJ Sleeve	2	EACH	$_____	$_____
535A	Sanitary Sewer Pre-Construction TV	32	EACH	$_____	$_____
535B	Sanitary Sewer Post-Construction TV	32	EACH	$_____	$_____
536	Aggregate Base Course, 21AA	600	TON	$_____	$_____
537	Concrete Pavement, 7-Inch	100	SYD	$_____	$_____

538	Concrete Pavement, 9-Inch	1000	SYD	$_____	$_____
539	Concrete Drive, 6-Inch	950	SF	$_____	$_____
540	Curb and gutter, Concrete	325	LF	$_____	$_____
541	Bituminous Wearing Course, 5E1	215	TON	$_____	$_____
542	Bituminous Leveling Course, 4E1	215	TON	$_____	$_____
543	Restoration w/3" Topsoil, Seed, Fertilizer, and Mulch	12,250	SYD	$_____	$_____
544	Maintenance Aggregate	10	CY	$_____	$_____
544A	Permit Allowance	1	LS	$_____	$_____
544B	Irrigation Allowance	1	LS	$_____	$_____
544C	Exploratory Excavation	10	EACH	$_____	$_____
545	Sidewalk, Concrete, 4-Inch w/ 4-Inch Subbase	4,500	SF	$_____	$_____
546	Concrete Sidewalk Ramp, ADA, 6-Inch w/ 6-Inch Subbase	1,300	SF	$_____	$_____
546A	Ground Monitoring for Directional Drill	1	LS	$_____	$_____
547	Tree Removal, 6-Inch to 18-Inch	4	EACH	$_____	$_____

Total Contract Price for Area 3 (Items 501 through 547) $_____

Total Contract Price for all work (Items 1throught 547) $_____

Bidder, by submitting a Bid, thereby certifies that Bidder or a qualified designated person in Bidder's employ has examined the Contract Documents provided by the City of Taylor for bidding purposes. Further, they certify that Bidder or Bidder's qualified employee has reviewed the Bidder’s proposed construction methods and finds them compatible with the conditions which Bidder anticipates from the information provided for Bidding.

Bidder, by submitting a Bid, agrees to complete the Work under any job circumstances or field conditions present and/or ascertainable prior to bidding. In addition, Bidder agrees to complete the Work under whatever conditions Bidder may create by Bidder's own sequence of construction, construction methods, or other conditions he may create, at no additional cost to the City of Taylor.

Bidder, by submitting a Bid, declares that Bidder has familiarized them self with the location of the proposed Work and the conditions under which it must be constructed. Also, Bidder has carefully examined the Plans, the Specifications, and the Contract Documents, which Bidder understands and accepts as sufficient for the purpose, and agrees that Bidder will Contract with the City of Taylor to furnish all labor, material, tools, and equipment necessary to do all Work specified and prescribed for the completion of the Project.

Bidder will provide a bid bond, in the amount of at least five (5) percent of the amount Bid, drawn payable to City of Taylor as security for the proper execution of the Agreement.

Bidder, by submitting a Bid, agrees that 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 15 days after the date of City of Taylor's Notice of Award.

Bidder, by submitting a Bid, agrees that time is of the essence and, if awarded Contract, that the Work will be Completed on or before the dates/days as specified in the Agreement.

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

Engineering and inspection costs incurred after the final completion date will be paid by the Contractor to the City of Taylor as specified in the Conditions of the Contract and Agreement.

Proposals may not be withdrawn for a period of 60 days after bid opening.

The following documents are made a condition of this Proposal:

A. Required Bid Security

B. Legal Status of Bidder

C. Non-Collusion Affidavit

END OF SECTION

SECTION 00 43 13
BID BOND FORM

KNOW ALL BY THESE PRESENT, that we, the undersigned, _____ as Principal, hereinafter called the Principal, 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 Owner, 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 2025 Taylor Water Main Rehabilitation Design.

NOW, THEREFORE, if the Owner accepts the Bid of the Principal and the Principal will enter into a Contract with the 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 pays to the Owner the difference not-to-exceed the penalty hereof between the amount specified in said Bid and such larger amount for which the Owner may in good faith contract with another party to perform the Work covered by said Bid, then this obligation will 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)

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SECTION 00 43 45
LEGAL STATUS OF BIDDER

(The Bidder should check the appropriate box and complete the information requested therein)

☐ A corporation, duly authorized and doing business under the laws of the State of Michigan, for whom _____ whose signature is affixed to this Bid, is duly authorized to execute contracts.

☐ A limited liability company, duly authorized and doing business under the laws of the State of Michigan, for whom _____, whose signature is affixed to this Bid, is duly authorized to execute contracts.

☐ A partnership, all partners with their addresses are:

_____ _____

_____ _____

_____ _____

☐ An individual, whose signature is affixed to this Bid.

_____ _____

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SECTION 00 45 13
STATEMENT OF BIDDER'S QUALIFICATIONS

This Proposal is submitted in the name of:

(Print) _____

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

Street: _____ City: _____

State: _____ Zip Code: _____

The undersigned hereby declares their legal status as checked below:

- ☐ Sole Proprietor
- ☐ Sole Proprietor doing business under an assumed name
- ☐ Co-partnership

The Assumed Name of the Co-Partnership is registered in the County of _____,

- ☐ Corporation incorporated under the laws of the State of _____.

The Corporation is:

- ☐ authorized to conduct business in the State of
- ☐ not now authorized to conduct business in the State of
- ☐ 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: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Name: _____ Title: _____

Address: _____

Signed this _____ day of _____, 20_____

By: _____

Printed Name: _____

Title: _____

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SECTION 00 45 19
NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

State of _____)

) ss:

County of _____)

_____, being first duly sworn, deposes and says that:

They are the of _____ (Position) of _____ (Firm), the Bidder that has submitted the attached Bid;

They are fully informed with respect to the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

Such Bid is genuine and is not a collusive or sham bid;

Neither the Bidder nor any of its officers, partners, members, managers, owners, agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, entity or person to submit a collusive or sham bid in connection with the Contract Documents for which the attached Bid has been submitted or to refrain from bidding in connection with the Contract Documents or has in any manner, directly or indirectly, sought by agreement, collusion, communication or conference with any other Bidder, entity or person to fix the price or prices in the attached Bid or that of any other Bidder or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against City of Taylor, or any person or other entity interested in the proposed Contract Documents; and

The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees or parties having interest, including this affiant.

Name of Bidder: _____

Signed By: _____

Title: _____

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

_____ Notary Public

_____ County, Michigan

Acting in the County of: _____ __

Notary Seal

My Commission Expires: _____

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SECTION 00 51 00
NOTICE OF AWARD

Attention: _____ Date: _____

Project: 2025 Taylor Water Main Rehabilitation Design

Pursuant to the provisions of Article 1.11 of the Instructions to Bidders (Section 00 21 13), you are hereby notified that the _____ (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 consists of: Project Description as delineated in your Bid submitted to City of Taylor on 12-15-2026.

Please comply with the following conditions within15 days of the date of this Notice of Award; that is by _____, 20_____.

Deliver to Engineer _____ (_____) fully executed counterparts of the Agreement (Section 00 52 00) including all the Contract Documents.

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, Section 00 72 00).

Deliver with the executed Agreement the Insurance Certificates (and other evidence of insurance) as specified in the General Conditions (Article 5, Section 00 72 00).

Please do not date Agreement and Contract Security (Bonds), as these will be dated by the Owner when executed by them.

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.

Within10 days after you comply with those conditions, Owner will return to you 2 fully signed counterparts of the Agreement with the Contract Documents attached.

In accordance with paragraph 2.05 of the General Conditions (Section 00 72 00), please submit to Engineer the required schedules prior to the scheduling of a Pre-Construction Meeting.

Owner: _____

Authorized Signature: _____

Copy to Wade Trim

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SECTION 00 52 00
AGREEMENT

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

Contractor will complete the Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Project Description This project includes the installation of approximately 49,600 LF of HDPE water main through a combination of pre-chlorinated pipe bursting and directional drilling with sizes ranging from 8" to 16", 670 water services, 78 gate valves, 74 hydrants, and associated pavement repairs.

The proposed work on Mary and Haskell Street must have final completion on or before Labor Day (Monday September 6, 2027) in order to allow for paving those streets before the end of the construction season through a separate contract. The proposed work on Wick Road will be completed on or before Friday November 10, 2027. This road is on schedule to be paved through the MDOT LAP program in 2028. The remaining work will be completed on or before Friday November 15, 2028 and ready for final payment in accordance with paragraph 14.11 of Section 00 72 00 - General Conditions

Engineering and inspection costs incurred after the specified final completion date will be paid by the Contractor to the Owner prior to final payment authorization.

Charges will be made at such times and in such amounts as the Engineer will invoice the Owner, provided however said charges will be in accordance with the Engineer's current rate schedule at the time the costs are incurred.

The costs of the Engineer incurred after the specified final completion date will be deducted from the Contractor's progress payments.

Owner and Contractor recognize that time is of the essence of this Agreement and that the Owner will suffer financial loss if the Work is not Substantially Complete within the time specified in paragraph 1.03.A above, plus any extensions thereof allowed in accordance with Article 12 of Section 00 72 00. They also recognize the delays, expense and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by the Owner if the Work is not Substantially Complete on time. Accordingly, instead of requiring any such proof, the Owner and the Contractor agree that as liquidated damages for delay (but not as penalty) the Contractor will pay the Owner One thousand Dollars ($1,000.00) for each day that expires after the time specified in paragraph 1.03.A above for Substantial Completion until the Work is Substantially Complete.

Liquidated damages charged will be deducted from the Contractor's progress payment.

Owner will pay Contractor as provided in the attached Proposal for performance of the Work in accordance with the Contract Documents.

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 will apply:

Person representing the Contractor who will submit written requests for progress payments will be:

_____ _____

Person representing the Owner to whom requests for progress payments are to be submitted will be:

_____

Contractor's representative, listed above, will submit Applications for Payment on the form provided in the Contract Documents in accordance with Article 14 of Section 00 72 00. Applications for Payment will be processed as provided in Section 00 72 00.

In order to induce the Owner to enter into this Agreement, the Contractor makes the following representations:

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.

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 (Section 00 73 00).

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 above as the Contractor 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 the Contractor for such purposes.

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

Contractor has given Engineer written notice of conflicts, errors or discrepancies that Engineer has discovered in the Contract documents and the written resolution thereof by Engineer is acceptable to the Contractor.

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

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

This Agreement

Performance and other Bonds

Notice of Award

Notice to Proceed (if issued)

Conditions of the Contract (including Section 00 72 00 - General Conditions and Section 00 73 00 - Supplementary Conditions, if any)

Specifications contained within Division 01 through 49 of the Project Manual

Plans bearing the following general title: 2025 Taylor Water Main Rehabilitation Design

Addenda numbers _____ to _____, inclusive

Documentation submitted by the Contractor prior to Notice of Award

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

Terms used in this Agreement which are defined in Article 1 of Section 00 72 00 will have the meanings indicated in Section 00 72 00.

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.

Owner and Contractor each binds them self, partners, successors, assigns and legal representatives to the other party hereto, their partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

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 the Owner and the Contractor, who 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.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in three counterparts. One counterpart each has been delivered to Owner and Contractor, and one counterpart has been delivered to the Engineer. The Contract Documents have been signed or identified by Owner and Contractor.

This Agreement will be effective on _____, 20____.

Owner: City of Taylor

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

_____

_____

_____

Contractor: _____

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

_____

_____

_____

License No. _____

Agent for service of process: _____

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SECTION 00 55 00
NOTICE TO PROCEED

To: _____ Date: _____, 20_____

_____

Attention: _____

Project: 2025 Taylor Water Main Rehabilitation Design

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 dates of Substantial Completion and Final Completion are set forth in the Agreement: they are _____, and _____, respectively.

The following conditions must be met by Contractor:

In accordance with Article 2.05 of Section 00 72 00 - General Conditions, please submit to the Engineer the required Schedules prior to the scheduling of a Pre-Construction Meeting.

In accordance with Article 2.05 of Section 00 72 00 - General Conditions, please request a Pre-Construction Meeting from the Engineer prior to delivery of any materials or start of any construction.

Notify the Engineer a minimum of **three (3)** full working days' notice to schedule a Pre-Construction Meeting.

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

Owner: _____

Authorized Signature: _____

COPY TO Wade Trim

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SECTION 00 60 00
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 Change Directive
3. Field Order
4. Final Inspection Request
5. Non-Compliance Notice / Order to Remove Defective Work
6. Open Items List
7. Punch List Items
8. Request for Information
9. Warranty Data Sheet

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 00 61 12.13
LABOR AND MATERIAL PAYMENT BOND FORM

Bond No. _____

KNOW ALL BY THESE PRESENT, 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 _____, 20_____, 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 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 will 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 will be void; otherwise, it will remain in full force and effect.

Signed and sealed 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 of Surety: _____

Telephone: _____

SECTION 00 61 13.13
PERFORMANCE BOND FORM

Bond No. _____

KNOW ALL BY THESE PRESENT, 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 _____, 20_____, 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 will 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 will in all respects comply with the terms and conditions of said contract, and their 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 will be void; otherwise, this bond and obligation will be and remain in full force and effect.

Signed and sealed 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 of Surety: _____

Telephone: _____ _

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SECTION 00 61 19.13
MAINTENANCE AND GUARANTEE BOND FORM

Bond No. _____

KNOW ALL BY THESE PRESENT, 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 _____, 20_____, for _____

_____

_____

Herein referred to and made 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 will 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 will 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 will not be required to, take immediate steps to repair such defects without notice to Contractor. In such event, Owner will not be required to obtain the lowest bid for the performance of the Work or any part thereof, and all sums actually paid therefore will be charged to the Contractor or Surety. In this regard, the judgment of Owner will be final and conclusive. Contractor will, 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 will 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 fail to do as hereinbefore specified, they will 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 _____, 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 of Surety: _____

Telephone: _____

SECTION 00 62 75
ENGINEER'S CERTIFICATE FOR PAYMENT

Job Number: _____ Certificate Number: _____ Date: _____

Owner: _____ Contractor: _____

Project: _____

Contract Date: _____

Substantial Completion: _____ Extended To: _____

Final Completion: _____ 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: _____ 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 Engineer's 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) Contractor is entitled to payment of the TBalance Due This Certificate.

Certified By: _____ Date: _____

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SECTION 00 62 76
CONTRACTOR'S APPLICATION FOR PAYMENT

Job Number: _____ Application No: _____ Date: _____

Owner: _____ Contractor: _____

Project: _____

Contract Date: _____

Period of this Application: _____ to _____ _____ _____

****

Total Earned To Date: _____ Less Total Earned to Due: _____ _

Previous Certificate: _____ Total Earned this Application: _____

CONTRACTOR'S CERTIFICATION

The undersigned Contractor certifies that to the best of Contractor's 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 Contractor for Work for which previous Certificates for Payment were issued and payments received from Owner, and that current payment shows herein is now due.

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 will 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.

By: _____ Title: _____

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SECTION 00 62 77
PAYMENT SCHEDULE

Application No.: _____ Date: _____Period: _____

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

SECTION 00 63 25
SUBSTITUTION REQUEST FORM

Specification Section: _____

Specified Product: _____

Proposed Substitution: _____

Does specified product exceed, in any respect proposed substitution?	___Y	___N
Does substitution affect dimensions shown on Plans?	___Y	___N
Does substitution affect other trades more than original product?	___Y	___N
Does warranty differ from that specified?	___Y	___N
Does substitution affect cost to Owner?	___Y	___N
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:

Explain any differences between proposed substitution and specified product.

Summarize experience with product and manufacturer in Project area.

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: _____

Signature: _____ Date: _____

Position: _____ Company: _____

Address: _____

Telephone: _____ Email: _____

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SECTION 00 63 70
CHANGE PROPOSAL FORM

Project: _____ Date: _____ _

Contractor: _____

Owner: _____ _

This Change Proposal is submitted in accordance with paragraph 10.06 of Section 00 72 00 - General Conditions. If this Change Proposal is accepted, either in whole or in part, a Change Order will be issued to modify the Contract Documents accordingly.

Detailed Description of Proposed Change	
____	
Attachments (List documents attached supporting requested change)	
____	
____	
____	
Change in Contract Price	**Change in Contract Time**
Original Contract Price:$____	Original Contract Time: Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Increase or Decrease from previously approved Change Order(s): $_____	Increase or Decrease from previously approved Change Order(s): Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Contract Price prior to this Change Proposal: $____	Contract Time prior to this Change Proposal: Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Increase or Decrease of this Change Proposal: $____	Increase or Decrease of this Change Proposal: Substantial Completion: MM-DD-YYYY Final Completion (days): MM-DD-YYYY
Contract Price incorporating this Change Proposal: $____	Contract Time incorporating this Change Proposal: Substantial Completion: MM-DD-YYYY Final Completion: MM-DD-YYYY
Engineer's Decision on Change Proposal	
____	

Contractor:	Engineer:	Owner:
By: _____	By: _____	By: _____ ___
Date: _____	Date: _____	Date: _____

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SECTION 00 65 16
CERTIFICATE OF SUBSTANTIAL COMPLETION

Project: 2025 Taylor Water Main Rehabilitation Design

Owner: City of Taylor

Contractor: _____

Contract Date: _____ Project No.: _____

Date of Issuance: _____

Project or Designated Portion will include: _____

The Work performed under this Contract has been reviewed and found to be Substantially Complete. The _____ which is also the date of commencement of applicable warranties required by the Contract Documents except as stated below. date of Substantial Completion of the Project or portion thereof designated above is hereby established as: _____

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 will be as follows:

_____

Owner will have **45** calendar days after receipt of this certificate during which Owner 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: _____

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SECTION 00 65 20
SWORN STATEMENT

State of Michigan

County of _____}

being duly sworn, deposes and says:

That _____ 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 the (Contractor) (Subcontractor) has (contracted) (subcontracted) for performance under the contract with the 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/ 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)

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 they make 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 their 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: Owner or Lessee of the property described herein may not relay on this Sworn Statement to avoid claim of a Subcontractor, supplier or laborer who has provided 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.

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 Complied Laws.

_____ day of _____, 20____.

Notary Public: _____

_____ County, Michigan

My Commission Expires: _____

INSTRUCTIONS

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.

An Owner or lessee may withhold payment to a Contractor or Subcontractor who has not provided a Sworn Statement. 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.

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.

If the contract provides for payments by the Owner to the 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 they will provide at least 5 business days' notice to the 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 Contractor.

SECTION 00 72 00
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 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 Contractor's 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 paragraph 9.04 and paragraph 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 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 will start to perform Contractor's 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 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.

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 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 will 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, will 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, will 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, will 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 Agreement to Owner, Contractor will 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 will furnish to Contractor up to five (5) copies 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 will start to perform the Work within 10 days of when the Contract Time commences to run, but no Work will be done at the Site prior to the date on which the Contract Time commences to run. Contractor will notify Engineer at least 3 working days in advance of the time Contractor 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, Contractor will request a Preconstruction Meeting from Engineer. A minimum of 3 full working days' notice will be required.

B. Prior to the scheduling of the Preconstruction Meeting, Contractor will 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, Owner, Engineer, and Contractor may send, and will accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor will 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, will 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 will be furnished and performed whether or not it is specifically called for.

C. No provision of any standard, specification, manual, code or instruction will 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 will 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 will 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 will promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor should reasonably have discovered and will 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 will report it to Engineer in writing at once, and, Contractor will 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 will 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 will 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 will submit to 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 will govern over scaled dimensions;

2. Plans will govern over Reference Standards;

3. Project Specifications will govern over Reference Standards 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. will 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 will 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 will 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 will 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 will 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 will 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 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 will 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:

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

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

3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such data, interpretations, opinions or information.

D. The cost of all the following will be included in the Contract Price and Contractor will have full responsibility for:

1. reviewing and checking all such information and data,

2. locating all Utilities during construction,

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

4. 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, Contractor will 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 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 will 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 will 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 wil 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 will 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 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 will 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 will, 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 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.

D. During such time, Contractor will be responsible for the safety and protection of such Underground Facility.

E. Owner's Statement to Contractor Regarding Utilities. After receipt of Engineer's written findings, conclusions, and recommendations, Owner will 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.

F. Possible Price and Times Adjustments:

1. Contractor will 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 will 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 Owner's written statement to Contractor regarding the Underground Facility in question.

4.05 REFERENCE POINTS

A. Owner will provide engineering surveys for construction to establish property corners, monuments, bench marks and similar reference points which in Contractor's judgment are necessary to enable Contractor to proceed with the Work. Contractor will be responsible for the

preservation of established reference points and will make no changes or relocations without the prior written approval of Owner. Contractor will 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 will 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 will 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 will 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 will 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 will 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 will 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 will 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 will 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 will 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 will also furnish such other Bonds as are required by the Supplementary Conditions.

B. All Bonds will 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. 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 will within 5 days thereafter substitute another Bond and Surety, both of which will 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 will 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 will 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 will 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 will be written by the same insurance carrier, though not necessarily in one policy.

4. Contractor will 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 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 will 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 will 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).

    e. Coverage will 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 will be adjusted with Owner and Contractor and paid to Owner and Contractor as Trustee for the other insureds.

6. Umbrella or Excess Liability:

    a. 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 will be at least as broad as the primary or underlying policy(ies) and will apply both to Contractor's General Liability and Automobile Liability Insurance and will 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 will be determined by the railroad company(ies) involved. See Section 00 73 00 - 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 will be responsible for purchasing and maintaining applicable professional liability insurance. This insurance will 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 will 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 will 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 will assume responsibility for such insurance as will protect 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 will be not less than those specified in Section 00 73 00 - 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 will 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 will 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 will furnish to Owner complete "originally signed" copies of the Owner's Protective Liability Policy. The number of copies will 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 will 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 will be licensed or approved by the Insurance Bureau of the state in which the Project is located and will 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 will furnish to Owner an acknowledgment receipt from the insurance carrier for each damage claim against the Project. The receipt will include the insurance carrier’s assigned claim number.

B. Upon request, Contractor or Contractor's insurance carrier will also furnish to Owner a status report on all damage claims. This report will 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 will 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 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 will contain provisions to

B. 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.

C. 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 will 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 will 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 will 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 will 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 will 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 will adjust and settle the loss with the insurers.

ARTICLE 6 CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

A. Contractor will 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 will be solely responsible for the means, methods, techniques, sequences and procedures of construction. Contractor will 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 will 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 will assign and maintain a competent superintendent who will 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 will be removed from the Project. The superintendent will be Contractor's representative at the Site and will have authority to act on behalf of Contractor. All communications given to the superintendent will be as binding as if given to Contractor.

6.02 LABOR AND WORKING HOURS

A. Contractor will provide competent, suitably qualified personnel in their various duties. Contractor will 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 will 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 will 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 will 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 will expressly run to the benefit of Owner. If required by Engineer, Contractor will furnish satisfactory evidence, (including reports of required tests) as to the kind and quality of materials and equipment to be incorporated in the Work. Contractor will not use material in the Work until Shop Drawing or Submittals have been reviewed by 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, will be plainly marked and removed immediately from the Work.

C. All materials and equipment will 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"

A. 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 will 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 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 will 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.

4. 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 will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will 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 will 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 will be final and binding, may not be reversed through an appeal under any provisions of the Contract Documents, and no “or-equal” or substitute will 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 will 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 will 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 will 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 will 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 will submit an acceptable substitute and the Contract Price will be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate Change Order will be issued. Contractor will not be required to employ any Subcontractor, Supplier, other person or organization against whom Contractor has reasonable objection.

C. Contractor will not award Work to Subcontractor(s), in excess of 50% of the Contract Price, without prior written approval of Owner.

D. Contractor will be fully responsible for all acts and omissions of Contractor's 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 will 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

will 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. Contractor will 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 will require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with 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 Owner and Contractor jointly, Bonds in an amount proportioned to the amount of Subcontractor's subcontract, and for the same purpose and under the same specifications as those of the general Contract. The Surety on the general Contract will 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 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 will file a true copy of such agreement with Owner.

6.06 PATENT FEES AND ROYALTIES

A. Contractor will 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 will be disclosed by Owner in Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Contractor will 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 will defend all such claims in connection with any alleged infringement of such rights.

6.07 PERMITS AND LICENSES

A. Contractor will obtain and pay for all construction permits and licenses. Owner will assist Contractor, when necessary, in obtaining such permits and licenses. Contractor will 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 will pay all charges of utility owners for connections to the Work.

6.08 LAWS AND REGULATIONS

A. Contractor will give all notices and comply with all laws, ordinances, rules, and regulations applicable to furnishing and performance of the Work. Neither Owner nor Engineer will 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 will bear all claims, costs, losses, damages and expenses caused by, arising out of, or resulting therefrom. However, it will 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 will 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 will 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 will 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 will not unreasonably encumber the premises with construction equipment or other materials or equipment. Contractor will 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 will 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 will be applicable to any claim hereunder.

6.11 REMOVAL OF DEBRIS AND CLEANING

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

6.12 LOADING STRUCTURES

A. Contractor will not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor will 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 will 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 will cooperate to the fullest extent with the utility, and Contractor will see that Contractor's operations interfere as little as possible with these operations, and Contractor will assume the cost of any charge against Owner therefor. In cases where existing Utilities or Utility service connections are encountered, Contractor will perform Contractor's operations in such a manner that service will be uninterrupted, and the cost thereof will be at Contractor's expense, unless otherwise provided.

6.14 RECORD DOCUMENTS

A. Contractor will 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 will be available to Engineer for examination and will be delivered to Engineer for Owner upon completion of the Work.

6.15 SAFETY AND PROTECTION

A. Contractor will be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor will take all necessary precautions for the safety of, and will 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 will 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 will erect and maintain all necessary safeguards for such safety and protection. Contractor will notify owners of adjacent property, Utilities, and utility owners when prosecution of the Work may affect them.

C. Contractor will restore, at Contractor's own expense, any public or private property damaged or injured in consequence of any act or omission on Contractor's part, or on the part of Contractor's 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 will 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 will 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 will 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 will 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 will be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.17 HAZARD COMMUNICATION PROGRAM

A. Contractor will 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 will 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 will 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 will 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 will 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 will 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 be assigned a unique sequential integer corresponding to the order in which it was submitted.

D. Each Submittal will correspond to and reference one and only one Section. However, a single Section may have multiple Submittals.

E. 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.

F. At the time of each submission, Contractor will 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 will 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.

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

H. Contractor will 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 will 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.

I. If Contractor requests a change of a previously approved Submittal item, Contractor will 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 will be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and will 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 will 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 will any concurrence by Engineer relieve Contractor from responsibility for errors or omissions in the Shop Drawings. Engineer's review will 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 will be commenced until the Submittal has been reviewed by Engineer.

6.22 CONTINUING THE WORK

A. Contractor will carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will 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 will 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 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 will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned Contract.

D. Contractor will 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 will secure the material Supplier's or Subcontractor's consent to assign said warranties to Owner.

E. The warranties provided in this section will 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 will 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 will 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 paragraph 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 will 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 Contractor to provide indemnification.

F. The indemnification provisions under this Agreement will 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 will 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 will 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 will survive the termination of this Agreement.

I. Contractor and Subcontractors will compel their insurance company to waive subrogation against Owner, Engineer and Contractor 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 will 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 will 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 will 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, will bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer will 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 will 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, 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 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 will 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 will 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 will 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 will properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, Contractor will 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 will 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 will 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 will issue all communications to Contractor through Engineer.

8.02 REPLACEMENT OF ENGINEER

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

8.03 FURNISHING DATA

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

8.04 PAY WHEN DUE

A. Owner will 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 will 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 will 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 will 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. Resident Project Representative's dealings in matters pertaining to the on Site Work will in general be only with Engineer and Contractor, and dealings with Subcontractors will 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 will 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 will be binding on Owner, and also on Contractor who will 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 Engineer's preliminary determinations with Contractor 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, will 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 ENGINEERS 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, will 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 will 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 will 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 will 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 will 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 will 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 will 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 will be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph 10.02 will 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 will 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 will comply with the provisions of paragraph 10.06. Any Claim for an adjustment of Contract Price will 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, Contractor's fee for overhead and profit will 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, Contractor's fee will be 15 percent;

b. for costs incurred under paragraph 12.01.B.3, Contractor's fee will 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 Contractor's fee will 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;

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

d. no fee will 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 will 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 will comply with the provisions of paragraph 10.06. Any Claim for an adjustment in the Contract Times will comply with the provisions of paragraph 11.01.

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

10.06 CHANGE PROPOSALS

A. Contractor will 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 will 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 one issue, or a set of closely related issues.

1. Procedures: Contractor will 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 will 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 will 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 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 will 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 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 Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will 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 will 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 will 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 will 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 will 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 will also furnish a copy to Engineer, for its information only. The responsibility to substantiate a Claim will 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 will 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 will review it thoroughly, giving full consideration to its merits. The two parties will 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 will 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 will 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 will 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 will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor will 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 will 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 will 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 will 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 will be in amounts no higher than those prevailing in the locality of the Project, will not include any of the costs itemized in paragraph 12.01.C, and will 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 will 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 will be apportioned on the basis of their time spent on the Work. Payroll costs will include, but not be limited to, salaries and wages plus the cost of fringe benefits, which will 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, will 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 will accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor will 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 will obtain competitive bids from Subcontractors acceptable to Owner and Contractor and will 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 will 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 will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts will 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 will be reasonable, but not more than 5 percent of the current list price, or invoice, of the equipment. The base hourly rate will 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 will include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining:

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

2) 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 will 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 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 will 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 will 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 will 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 Engineer's preliminary determinations with Contractor 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 will 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 will 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 will 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 will 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 will 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 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 will 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 will 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.

F. Contractor will 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.

G. 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.

H. 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.

I. Contractor will 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.

J. 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.

K. 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 will be Contractor's sole and exclusive remedy for such delay. In no event will 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;

L. Nor will 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.

M. 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, Contractor will 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 will 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 will 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 will 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 will assume full responsibility therefor, pay all costs in connection therewith and furnish Engineer the required certificates of inspection, testing or approval.

C. Contractor will also be responsible for and will 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 will 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 will 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 will be paid for by Contractor.

G. Neither observations by Engineer nor inspections, tests or approvals by others will relieve Contractor from Contractor's 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 will, if requested by Engineer, be uncovered by Contractor for Engineer's observation. Such uncovering will be at Contractor's expense unless Contractor has given Engineer timely written notice of Contractor's 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, will 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 will be paid for as follows:

1. If it is found that such Work is defective, Contractor will 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 will 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 will 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 will 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 will 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 will 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 will 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 will 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) will be paid by Contractor.

C. Repair or replacements made under the guarantee will 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 will 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 will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and

Owner will be entitled to an appropriate reduction in the Contract Price. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 OWNER MAY CORRECT DEFECTIVE WORK

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with paragraph 13.06, 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 Contractor's Surety without prejudice to any other remedy Owner may have, correct and remedy any such deficiency.

B. In exercising Owner's rights and remedies under this paragraph 13.09, Owner will 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 will 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 Owner's 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 will be charged against Contractor and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work. Owner will 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 will 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 will submit to Engineer a final Schedule of Submittals, and, where applicable, a Schedule of Values for the Work. These schedules will be satisfactory in form and substance to Engineer as provided in Article 2.

B. The Schedule of Values will include quantities and unit prices aggregating the Contract Price and will subdivide the Work into component parts. Each unit cost so established will 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 will equal the total Contract Price established in the Proposal.

C. The Schedule of Values will 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 Engineer, it will become part of the Agreement and will 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 will 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 will 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 will be on the form provided in the Contract Documents or in a format acceptable to Engineer or Owner. On the second and all subsequent payments, partial Waivers of Lien and Sworn Statement will 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 will 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 will 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 will file with Owner the written consent of the Surety to such reduction and will 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 will 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 will 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,
2. adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
3. 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;
4. Contractor has failed to provide and maintain required bonds or insurance;
5. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
6. 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;
7. The Work is defective, requiring correction or replacement;

8. Owner has been required to correct defective Work in accordance with paragraph 13.09, or has accepted defective Work pursuant to paragraph 13.08;

9. The Contract Price has been reduced by Change Orders;

10. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

11. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

12. 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;

13. there are other items as set forth in the Contract Documents entitling Owner to a set off against the amount recommended; or

14. 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 will 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 will 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 will 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 will notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a Certificate of Substantial Completion. Contractor will 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 will 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 will fix the date of Substantial

Completion. Engineer will attach to the certificate a punch list of items to be completed or corrected before final payment. Owner will 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 will 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 Contractor will 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 will 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 will 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 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 will 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 will have otherwise agreed in writing and so informed Engineer.

3. Owner will have the right to exclude Contractor from any part of the Work which Engineer has so certified to be substantially complete, but Owner will 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 will 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 will 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 Owner's 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 Contractor's 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 will make the necessary corrections and resubmit the Application.

C. If the Application and accompanying documentation are appropriate as to form and substance, Owner will, 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 will 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 will, 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 will be submitted by Contractor to Engineer with the Application for such payment. Such payment will be made under the terms and conditions governing final payment, except that it will not constitute a waiver of Claims.

14.13 WAIVER OF CLAIMS

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.09, or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; and will 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. 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 Owner, will 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 will store all materials in such manner that they will not become an obstruction, nor become damaged in any way, and Contractor will 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 Contractor 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 will 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 will 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 will 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 will 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 will 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 will 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 will:

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 will not relieve Contractor of Contractor's 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 will be followed:

a. The parties will 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 will 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) will 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 will 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 will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday, or on a day made a legal holiday by the Law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 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 will 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 will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

B. All representations, warranties and guarantees made in the Contract Documents will 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 will 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. Contractor will agree not to discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to Contractor's 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 will be paid by Contractor to Owner prior to final payment authorization. However, Contractor will 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 will be made at such times and in such amounts as Engineer will invoice Owner, provided, however said charges will be in accordance with Engineer's current rate schedule at the time the costs are incurred. Engineering and inspection costs so incurred will 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 will 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 will not constitute a waiver of that provision, nor will 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 73 00
SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

A. These Supplementary Conditions amend and supplement Section 00 72 00 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.

B. The terms used in these Supplementary Conditions that are defined and have the meanings assigned to them in Section 00 72 00 - General Conditions.

1.02 MODIFICATIONS TO GENERAL CONDITIONS

A. **SGC-1.01 Defined Terms**

1. The definition for "As-Built Drawings" in Section 00 72 00 - General Conditions will be added as follows:

   As-Built Drawings -- Revised construction documents prepared by the Contractor that reflect all modifications made during the construction process. These include changes due to material availability, constructability issues, or design optimizations. These drawings serve as a contractual record to prove compliance with project requirements.

2. The definition for "As-Built Drawings" in Section 00 72 00 - General Conditions will be added as follows:

   Record Drawings -- Clean, finalized sets of drawings compiled by the Engineer using the Contractor’s as-built drawings and they incorporate all approved changes into the original design documents and represent the project’s final state as documented; these drawings may not be based on field verification.

3. The definition for “Substantial Completion” in Section 00 72 00 - General Conditions will be revised as follows:

   Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of the 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 the Engineer’s written recommendation of final payment in accordance with Article 14.11 of Section 00 72 00 - General Conditions. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

B. **SGC-4.02 Subsurface and Physical Conditions; Investigations and Reports**

1. In the preparation of Plans and Specifications, the 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: On Wick Road crossing Telegraph.

2. Copies of the following reports and/or tests are attached as Exhibits: Report on Geotechnical Investigation Trenchless Water Main Installation Wick Road at US-24/Telegraph Road, City of Taylor, Michigan Dated August 25, 2026

C. **SGC-4.05 Reference Points**

1. Delete Article 4.05 of Section 00 72 00 - General Conditions and replace it with the following:

   Contractor will be responsible for the preservation of established reference points and will make no changes or relocations without the prior written approval of Owner. Contractor will 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 Contractor as provided in Division 01 of the Specifications.

D. **SGC-5.03 Additional Insured**

1. Add the following language as a new Article 5.03.A.9 of Section 00 72 00 - General Conditions:

   City of Taylor, Wade Trim, Wade Trim 's Subconsultant(s), Wayne County Department of Public Services, and Michigan Department of Transportation, and any other person or entity required to be named as an additional insured under the Contract Documents, including each of the aforementioned’s respective parent companies, affiliates, subsidiaries, officers, directors, employees, and agents, are required to be designated as additional insureds on all policies of insurance required by Article 5.03 of the Section 00 72 00 - General Conditions and elsewhere in the Contract Documents (except for Worker’s Compensation insurance and Professional Liability insurance, unless otherwise specifically required by the Contract Documents).

E. **SGC-5.04 Limits of Liability**

1. The required limits of liability for insurance coverages requested in Article 5.03 of Section 00 72 00 - General Conditions will 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: $500,000

   Disease – Each Employee: $100,000

   SGC-5.04.B Comprehensive General Liability

   General Aggregate: $2,000,000

   Products – Com/Ops Aggregate: $1,000,000

   Personal and Advertising Injury: $500,000

Each Occurrence: $1,000,000

Fire Damage (any one fire): $100,000

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

General Aggregate:$2,000,000

Each Occurrence: $1,000,000

SGC-5.04.E Builder's Risk-Installation Floater

Cost to Replace at Time of Loss

SGC-5.04.F Umbrella or Excess Liability: $2,000,000

F. **SGC- 12.04 Lump Sum Work**

1. Add the following new paragraph after Article 12.03 of Section 00 72 00 - General Conditions, which is to read as follows:

12.04 LUMP SUM WORK

a. When additional work or deletion of work, which is covered by a lump sum item, is required due to a modification, not a normal overrun or underrun in estimated quantities, payment or credit for the work will be based upon apparent unit prices which will be derived by dividing the lump sum price by the estimated plan quantities.

b. Renumber subsequent paragraphs accordingly.

G. SGC-13

1. It shall be the Contractor's responsibility to determine the corrective action plan necessary to bring the work into compliance. This action plan shall be submitted to the Owner and his authorized representative for their review and concurrence that said corrective action will adequately address the deficiency. If you refute the initial findings, it is your responsibility to make your position known to the Owner and his representative with sufficient documentation that your position can be evaluated. All actions described above shall be done in writing as near to the date of the Notice as possible, but no later then ten (10) days after the issuance of said Notice.

H. **SGC-18 Liquidated Damages**

1. Liquidated damages, if applicable, are referenced in the Proposal and Agreement. The requirements for liquidated damages should be included herein.

ARTICLE 18 LIQUIDATED DAMAGES

a. If the Contractor fails to Substantially Complete the Work within the Contract Time, or extension of time granted by the Owner, then the Contractor will pay to the Owner the amount for liquidated damages as specified in the Agreement for each calendar day that the Contractor will be in default after the time stipulated in the Contract Documents. The liquidated damages charged will be deducted from the Contractor's progress payments.

b. Contractor will 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 the Contractor has given written notice of such delay within seven (7) calendar days to Owner or Engineer.

c. To any preference, priority or allocation order duly issued by the Owner.

d. 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

e. To any delays of subcontractors occasioned by any of the causes specified in paragraph "a" and "b" of this Article.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 91 13
ADDENDUM

To all prospective Bidders and others concerned, YOU ARE HEREBY ADVISED THAT the Contract Documents for the above referenced Project are revised in accordance with the following:

Section	Description of Change
Sheet	**Description of Change**

Attachments to this Addendum:

_____

This Addendum is hereby incorporated into the original Contract Documents for the bidding referred to above and is considered as binding as though originally appearing therein. Receipt of this Addendum must be noted in the place provided in Section 00 42 43 - Proposal, dated _____, 20_____.

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. This project includes Bids will be received for the following Work: This project includes the installation of approximately 42,000 LF of HDPE water main with sizes ranging from 8" to 16", 670 water services, 78 gate valves, 74 hydrants, and associated pavement repairs. The proposed work on Mary and Haskell Street must have final completion on or before Labor Day (Monday Spetember 6, 2027) in order to allow for paving those streets before the end of the construction season. The proposed work on Wick Road will be completed on or before Friday November 10, 2027. This road is on schedule to be paved throught MDOT LAP program in 2028. The remaining work will be completed on or before Friday Novemeber 15, 2028. .

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 50 00 - Temporary Facilities and Controls

1.03 WORK BY OTHERS

A. There is no other work in the Project area, known to the Owner, which would affect this Contract.

1.04 RIGHT-OF-WAY JURISDICTION/PERMITS

A. Ecorse Road, Pennsylvania, Allen Road(s) is under the jurisdiction of the Wayne County Department of Public Services.

B. Telegraph road(s) is under the jurisdiction of the Michigan Department of Transportation. To obtain the MDOT ROW permit the contractor will submit a settlement/heave monitoring plan. The plan will include monitoring locations, reading frequency during all aspects of drilling, and applicable action/stop work criteria. The plan will also include contingency plans for the following: return and bore failure, lose of drilling fluid, ground loss, excessive settlement/heave, unsuccessful bore, or any other conditions that could affect the US-24/Telegraph Roadway.

C. Other roads and streets in the vicinity of the Project are under the jurisdiction of the City of Taylor.

D. All Drain(s) are under the jurisdiction of Wayne County Department of Public Services.

E. Work in the Wayne County Department of Public Services right-of-way requires a permit from the Wayne County Department of Public Services. Contractor will obtain the permit and pay all fees in connection with obtaining the permit. The fees for the permit are based upon a permit fee, plan review fee, and an inspection deposit.

1. Cost of all inspection including any necessary soil compaction tests and concrete testing performed by Wayne County Department of Public Services on this Project will be deducted from the inspection deposit. A cash inspection deposit (along with the permit fee and the plan review fee) will be required to be paid by the Contractor prior to obtaining the permit.

2. Contractor is cautioned that the deposit is based upon the estimated cost. The actual cost of the inspection fee will be the actual costs incurred by Wayne County Department of Public Services for inspection on the Project. Contractor will be responsible for any additional costs over and above the fee calculated above and will be refunded any excess amounts.

3. Please see the attached chart to see the status of permts for the various areas included in this project.

F. Contractor will secure any permits required by the agency having jurisdiction, will abide by all rules and regulations of each, and will pay all costs in connection with the permits. Contractor will pay for all permit and inspection fees as the agencies may charge to ensure compliance with their requirements.

1.05 COORDINATION

A. A shutoff notice will be delivered by the Contractor to all affected residences and businesses a minimum of two days before any water main is shut off for construction.

B. Whenever an existing gate valve must be opened or closed, the City of Taylor Water Department will be notified. Valves will be opened or closed only by the City of Taylor Water Department.

C. While both existing and new fire hydrants are in place, the Contractor will clearly mark those hydrants not in service and notify the City of TaylorC Fire Department of hydrants not in service.

D. It will be the responsibility of the Contractor to coordinate Contractor's operations and those of the Contractor's subcontractors in such a manner so as to avoid interference and delays in the areas of common construction activities.

1.06 CONTRACTOR’S USE OF PREMISES

A. Contractor will maintain construction operations within the presently existing road rights-of-way and easements throughout the Project area. In the event that the Contractor deems it necessary or advisable to operate beyond the limits of the existing rights-of-way or easements, Contractor will be responsible for making special written agreements with the property owners and will furnish such copies of agreement to the Owner.

1.07 PHOTOGRAPHS

A. Photographs as specified in Section 01 33 00 - Submittal Procedures will be required for this Project.

1.08 AUDIO/VIDEO ROUTE SURVEY

A. An audio/video route survey as specified in Section 01 33 00 - Submittal Procedures will be required for this Project. Complete coverage will include the area the project area and 50 feet beyond the project limits shown on the plans in all applicable locations..

B. The audio/video route survey will be delivered on a USB Flash Drive.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Agency	Application Name	Permit Type	Reference Number	Approval Date	Expiration Date
Area 1/Ecorse					
Department of Environment, Great Lakes, and Energy - Drinking Water and Environmental Health Division	Act 399	Water	ACT-592605		
Wayne County Department of Public Services - Engineering Division	Wayne County Construction Permit	ROW/Drain	R26-0898		
Michigan Deprtment of Trasnportation (MDOT)	MDOT Construction Permit Application	ROW	122343		
Area 3					
Department of Environment, Great Lakes, and Energy - Drinking Water and Environmental Health Division	Act 399	Water	ACT-557187	10/20/2026	10/20/2028
Wayne County Department of Public Services - Engineering Division	Wayne County Construction Permit	ROW	R26-0335	5/4/2026	
Area 4 - Wick Rd					
Department of Environment, Great Lakes, and Energy - Drinking Water and Environmental Health Division	Act 399	Water	ACT-562010	9/9/2026	9/9/2028
Wayne County Department of Public Services - Engineering Division	Wayne County Construction Permit	Drain	R26-0603		
Michigan Deprtment of Trasnportation (MDOT)	MDOT Construction Permit Application	ROW	120028		
Mary & Haskell					
Department of Environment, Great Lakes, and Energy - Drinking Water and Environmental Health Division	Act 399	Water	ACT-568029	8/28/2026	8/28/2028
Michigan Deprtment of Trasnportation (MDOT)	MDOT Construction Permit Application	ROW	120034	8/6/2026	8/6/2027

Infrastructure Consulting Engineers

500 Woodward Avenue • Suite 2625 • Detroit • Michigan • 48226

REPORT ON GEOTECHNICAL INVESTIGATION

TRENCHLESS WATERMAIN INSTALLATION
WICK ROAD AT US-24/TELEGRAPH ROAD
CITY OF TAYLOR, MICHIGAN

Owner:

25605 Northline Road
Taylor, Michigan 48180

Prepared for:

WADE TRIM

25251 Northline Road
Taylor, Michigan 48180

August 25, 2026
2026070A

Somat Engineering, INCORPORATED

Somat Engineering, INCORPORATED

August 25, 2026
2026070A

Mr. Brian Frisk, P.E.
Wade Trim
25251 Northline Road
Taylor, Michigan 48180

RE: Report on Geotechnical Investigation
Trenchless Watermain Installation
Wick Road at US-24/Telegraph Road
City of Taylor, Michigan

Dear Mr. Frisk:

We have completed the geotechnical investigation for the proposed trenchless watermain installation along Wick Road at US-24 (Telegraph Road) in the City of Taylor, Michigan. This report presents the results of our field and laboratory testing, our interpretation of the subsurface conditions at this site, and geotechnical design and construction considerations based on the soil and groundwater conditions encountered.

The soil samples collected during our field investigation will be retained in our laboratory for 90 days from the date of this report, at which time they will be discarded unless otherwise directed by you.

It was a pleasure working with you on this project.

Sincerely,
Somat Engineering, Inc.

Jennifer S. Schmitzer
Project Manager

DB/JSS/CRH/as

REPORT ON GEOTECHNICAL INVESTIGATION
TRENCHLESS WATERMAIN INSTALLATION
WICK ROAD AT US-24/TELEGRAPH ROAD
CITY OF TAYLOR, MICHIGAN

REPORT SUMMARY

A general summary of the report conclusions and recommendations is provided below:

- Three (3) soil borings were drilled along the horizontal directional drilling (HDD) alignment. These soil borings were performed in grass areas along the north side of Wick Road. Two soil borings were performed near the HDD entry and exit points, and one soil boring was performed in the median of Telegraph Road, at about the midpoint of the HDD alignment. Each soil boring extended to a depth of 25 feet below existing grade.
- In general, the soil borings encountered sand fill to about 3 to 4 feet over predominantly lean clay. The clay extended to the termination depths of the borings. The consistency of the cohesive soils ranged from medium to very stiff. These soils are considered suitable to support the HDD installation method.
- We estimate the long-term groundwater table may be situated at about 8 to 9 feet below existing grades. Within the expected 8-foot± excavation depths, we anticipate that standard sump pit and pumping techniques should be adequate in controlling the groundwater in entry and exit pit excavations.

The summary presented above is general in nature and should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned therein. Details of our findings and recommendations are discussed in the following sections and in the appendices of this report.

REPORT PREPARED BY:

David Burby
Geotechnical Staff Engineer

Jennifer S. Schmitzer
Project Manager

REPORT REVIEWED BY:

Corey R. Hostetter, P.E., LEED A.P.
Senior Project Engineer

REPORT ON GEOTECHNICAL INVESTIGATION
TRENCHLESS WATERMAIN INSTALLATION
WICK ROAD AT US-24/TELEGRAPH ROAD
CITY OF TAYLOR, MICHIGAN

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REPORT ON GEOTECHNICAL INVESTIGATION
TRENCHLESS WATERMAIN INSTALLATION
WICK ROAD AT US-24/TELEGRAPH ROAD
CITY OF TAYLOR, MICHIGAN

1.0 INTRODUCTION

1.1 GENERAL

Upon authorization from Wade Trim, Somat Engineering, Inc. (Somat) has conducted a geotechnical investigation for the proposed trenchless installation of a section of new watermain along Wick Road at the US-24 (Telegraph Road) intersection in the City of Taylor, Michigan. This investigation was performed in accordance with Somat Proposal No. P260188A, dated June 26, 2026.

The following sections of this report provide our understanding of the project, a description of our field investigation, the results of the field and laboratory tests, the logs of test borings, our interpretation of subsoil and groundwater conditions, geotechnical design recommendations, and construction considerations regarding the subsurface conditions encountered.

1.2 PROJECT AND SITE INFORMATION

As we understand, a new watermain is planned for installation along the north side of Wick Road in the City of Taylor. The new watermain will replace an existing aging pipe and a section will be installed underneath US-24/Telegraph Road using a horizontal directional drilling (HDD) technique. The proposed trenchless crossing is about 350 feet in length and will extend underneath both bounds of Telegraph Road. The investigation was performed to support the Application Requirements for Trenchless Installations for the Michigan Department of Transportation (MDOT Form 3702).

The general project site consists of commercial properties in the immediate vicinity of the intersection, with residential properties along Wick Road to the east and west of Telegraph Road. Existing infrastructure near the proposed alignment consists of raised curbs, sidewalks, catch basins, signal/sign posts, and numerous existing utilities. Traffic in this area is generally heavy.

2.0 SUBSURFACE INVESTIGATION

2.1 FIELD EXPLORATION

Based on the MDOT Form 3702, Application Requirements for Trenchless Installations, soil borings are required to be performed within 10 feet of the proposed utility alignment. Because this section of Telegraph Road is divided, three soil borings were required along the HDD alignment. These soil borings were performed along the Wick Road alignment, in the grass areas just north of the pavement. Two soil borings were performed near the HDD entry/exit points, and one soil boring was performed in the median of Telegraph Road, at about the midpoint of the HDD alignment.

Wade Trim provided the approximate soil boring locations in a drawing of the proposed alignment. Somat staked the borings in the field using offsets measured from the provided drawing, taking into account drill rig access and observed underground and overhead utilities. Borings were adjusted as necessary once all utilities were marked through MDOT and the MISS DIG one-call system. As-drilled soil boring locations were estimated using a Trimble R580 GPS device (sub-meter accuracy). Elevations at each location were estimated from the design drawing provided. A soil boring location diagram is provided in Appendix A for reference.

2.1.1 Drilling Operations

The drilling operations were performed on August 3, 2026. A truck mounted drill rig (equipped with an automatic SPT hammer) was used to advance 3¼-inch inside diameter hollow stem augers to the explored depths of the soil borings, or about 25 feet. The boreholes were backfilled with non-shrink grout and the cuttings were dispersed on site.

2.1.2 Sampling

Soil samples were recovered from the soil borings using split-spoon sampling procedures in accordance with ASTM Standard D1586 (“Standard Method for Penetration Tests and Split Barrel Sampling of Soils”). Samples were taken semi-continuously (at approximate intervals of 2.5 feet)

to the termination depths of the borings. The samples obtained during drilling were sealed in glass jars in the field to protect the soil and maintain the soil's natural moisture content.

Soil samples collected during the field portion of the subsoil exploration were labeled with the soil boring designation and a unique sample number. All soil samples were transported to Somat's Romulus laboratory for further analysis and testing. They will be retained in our laboratory for a period of 90 days from the date of the final report, after which time they will be discarded, unless we are notified otherwise.

2.1.3 Standard Penetration Test (SPT)

Soil samples were obtained by Standard Penetration Tests in accordance with ASTM D1586 procedures, whereby a conventional 2-inch O.D. split-spoon sampler is driven into the soil with a 140-pound hammer repeatedly dropped through a free-fall distance of 30 inches. The sampler is generally driven three successive 6-inch increments, with the blows for each 6-inch increment being recorded. The number of blows required to advance the sampler through 12 inches, after an initial penetration of 6 inches, is termed the Standard Penetration Test resistance (N-value) and is presented graphically on the individual Logs of Test Borings. As added information, the number of blows for each 6-inch increment is also presented on the boring logs.

The N-values reported on the Logs of Test Borings are the direct blow counts from the field and are uncorrected. The efficiency of each specific hammer is dependent on many factors, including type (auto vs. manual), material quality, regularity of maintenance, drill rig mechanics, etc., and can change with time. As such, auto hammers are required to be calibrated every two years. For this project, DLZ American Drilling used a CME-75 truck mounted drill rig (Serial No. 363487) with an energy transfer ratio (ER) of 82.8%.

2.1.4 Groundwater Level Observation Procedures

Whenever possible, groundwater level observations were made during the drilling operations and immediately after completion of drilling, and are shown on the individual Logs of Test Borings. During drilling, the depth at which free water was observed, where drill cuttings became saturated

or where saturated samples were collected, was indicated as the groundwater level during drilling. In granular, pervious soils, the indicated water levels are considered relatively reliable when solid or hollow-stem augers are used for drilling. However, in cohesive soils, groundwater observations are not necessarily indicative of the static water table due to the low permeability rates of the soils, and due to the sealing off of natural paths of groundwater flow during drilling operations.

It should be noted that seasonal variations and recent precipitation conditions may influence the level of the groundwater table significantly. Groundwater observation wells are generally used if precise groundwater table information is needed, however the installation of groundwater monitoring wells was not included in the scope of the investigation. Therefore, the discussion and recommendations provided within the report are based on our knowledge of the soil and groundwater conditions in this area, which should provide for a reasonable approximation of the groundwater level.

2.2 LABORATORY TESTING

All soil samples were classified in accordance with the Unified Soil Classification System (USCS, ASTM 2487). Moisture content tests were performed on all cohesive soil samples. Additionally, Atterberg Limits tests (ASTM D4318) were performed on selected cohesive samples.

All laboratory tests were performed in accordance with their applicable ASTM procedures. The results of the laboratory classification and testing are included in Appendix B on the respective logs of test borings. Graphical results of laboratory testing with brief descriptions of each test are included in Appendix C.

2.3 LIMITATIONS

The scope of our services was strictly geotechnical and did not include any environmental assessment, or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site.

Some soils have been identified on the Logs of Test Borings as "fill" if a soil deposit is suspected to have been placed by human activity, versus having been deposited by natural means. These designations were based on our professional engineering judgment considering factors such as our visual classification, the presence of foreign materials (i.e. bricks, concrete, plastic, etc.), and/or site topography, among many other possibilities. As such, the "fill" descriptions should be considered as secondary information to the standardized soil classification. Due to the large variation of types of fill, methods of fill placement, potential changes of historical use of the site, and soil sample size, it is difficult to discern whether the subject soil sample is native to this site, or fill material based on visual classification alone. As such, the designation of "fill" may not be reliable and hence should be considered as informational only. Conversely, where a soil is not designated as "fill" on the boring logs, it does not necessarily mean it is not a fill soil, only that there were no apparent observations indicating a fill material. Therefore, we cannot guarantee that our description of "fill" soils is accurate, or that we have identified all types of fill material encountered with our sampling on the site.

3.0 SUBSURFACE CONDITIONS

3.1 SOIL STRATIFICATION

Soil conditions encountered at the soil boring locations have been evaluated and are presented in the form of Logs of Test Borings. The Logs of Test Borings presented in Appendix B include approximate soil stratification with detailed soil descriptions and selected physical properties for each stratum encountered in the test borings. In addition to the observed subsoil stratigraphy, the boring logs present information relating to sample data, Standard Penetration Test results, groundwater level conditions observed in the boring, personnel involved, and other pertinent data. For information, and to aid in understanding the data as presented on the boring logs, General Notes defining nomenclature used in soil descriptions are presented immediately following the Logs of Test Borings in Appendix B. It should be noted that the Logs of Test Borings included with this report have been prepared on the basis of laboratory classification and testing as well as field logs and observations made during drilling.

A generalized description of the soil encountered in the soil borings is provided below:

Topsoil. About 3 inches of topsoil was encountered at the surface of all of the soil borings.

Sand Fill. Below the topsoil in all borings, layers of presumed fill sand were encountered. These soils consisted of poorly graded sand, silty sand, and silty clayey sand in borings B-01, B-02, and B-03, respectively. The sand layers extended to depths ranging from about 3 to 4 feet below existing grades (EL. 613 to 612 feet±). The apparent density of the granular soils was medium dense.

Clay. Below the sand, the soils were predominantly lean clay. The clay extended to the termination depths of the borings at about 25 feet below existing grades. The consistency of the cohesive soils ranged from medium to very stiff. The lean clay layers were mottled brown and gray to depths ranging from about 8 to 9 feet below existing grades (EL 607 feet±), before becoming gray to the termination depths.

Please refer to the individual boring logs for the soil conditions at the specific boring locations. It is emphasized that the stratification lines shown on the Logs of Test Borings are approximate indications of change from one soil type to another at the borehole locations. The actual transition from one stratum to the next may be gradual, and may vary within the area represented by the test boring.

3.2 GROUNDWATER LEVEL OBSERVATIONS

Free groundwater was only observed in boring B-03, at a depth of about 18 feet below existing grade (EL. 598 feet±). Upon completion of drilling boring B-03, the groundwater level was about 20 feet below existing grade before initiating the grouting procedure.

Often times in clay soils, a change in color from brown or mottled to gray indicates the long-term groundwater level due to oxidation above the saturated soils. Based on the transition from mottled brown to gray, we estimate the long-term groundwater level is situated at about 8 to 9 feet below existing grades (EL. 607± feet).

It should be noted that the elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation and percolation in the area,

as well as on the water level of surface water bodies in the vicinity affecting the groundwater flow pattern.

4.0 TRENCHLESS WATERMAIN INSTALLATION

A new 12-inch diameter water main will be installed beneath both bounds of US-24 (Telegraph Road), parallel to and just north of Wick Road. The length of the new HDD installation is about 350 feet.

4.1 HORIZONTAL DIRECTIONAL DRILLING CONSIDERATIONS

HDD excavations are typically drilled (reamed) from the existing ground surface or excavated launch pits to open a hole to a slightly larger diameter than the planned pipe installation. The reaming tool will advance through the proposed layout, from the beginning to end of the conduit alignment. A drilling fluid ("slurry") will be injected into the boring during the reaming, to maintain the hole opening. Following the completion of boring, a pullback procedure will be conducted to pull the segments of the watermain back through the bored hole.

This method of pipe installation requires less excavation, produces minimal construction waste, and is advantageous for use in avoiding utilities or obstructions within the planned alignment. We anticipate that the directional drilling will be conducted from pits excavated near the tie-ins to existing watermain to the west and the new pipe segments (installed into open cut excavations) to the east. Based on the plans provided, the water main will be installed with the invert of deepest segment at about elevation 604 feet± (maximum depth of about 12 feet±) below Telegraph Road.

In general, the soils encountered in the investigation borings within the HDD zone consisted of medium to very stiff lean clay. These soils are considered suitable to support the HDD installation method.

The table below presents recommended geotechnical parameters for the predominantly clay layers encountered in the vicinity of the proposed installation. The average values for total and effective

friction angle and cohesion are based on our experience with similar soils in the area as well as field and laboratory testing.

Geotechnical Parameters for HDD Stability Analysis Medium to Very Stiff Lean Clay	
Total Unit Weight, γ	130 pcf
Friction Angle, φ	0°
Effective Friction Angle, φ '	20º
Cohesion, c	1,500 psf (average)
Effective Cohesion, c'	400 psf

It may be more difficult to maintain line and grade within softer soils, so the contractor should be prepared to control the installation. An appropriate drilling fluid should be selected for clay soils with varying degrees of consistency.

Identifying obstructions is one of the most critical aspects of planning for directional drilling. While cobbles and boulders were not specifically encountered in these soil borings at the anticipated directional drilling depths, they are known to be present within Detroit area clay soils, though more so prevalent at depths approaching bedrock (significantly deeper than the borings drilled for this project).

Similarly, existing utilities and tunnels should be identified prior to the installation to avoid damaging them and redirecting the conduit installation. The contractor should be made aware of the possibility of these issues and be prepared to deal with the occurrence of underground utilities.

4.2 GROUNDWATER CONSIDERATIONS

We estimate the long-term groundwater table may be situated at about 8 to 9 feet below existing grades (EL. 607± feet). With the predominantly clay soil profile underlying surficial granular fill soils, we anticipate that standard sump pit and pumping techniques should be adequate in controlling the groundwater in entry and exit pit excavations. Water may be able to flow into the excavations from surficial granular layers as well as any granular seams, layers, or strata that may

be present but were not encountered in our investigation. Infiltration through granular backfill of utility trenches that are adjacent to the proposed launch pit excavations should also be anticipated.

If there are significant water-bearing granular layers present within the excavation, then the contractor should be prepared to handle the inflow of water. Using steel sheeting toed sufficiently into the clay may help reduce the flow of any perched water and surface water runoff into the excavations of the HDD entry/exit points.

It should be noted that the elevation of the natural groundwater table is likely to vary throughout the year depending on the amount of precipitation, runoff, evaporation and percolation in the area.

4.3 LATERAL EARTH PRESSURE RECOMMENDATIONS

Based on the provided drawing, we estimate that the entry/exit pit excavations will be situated at a depth of about 8 feet below existing grades (EL. 608 to 607 feet±). As such, we assume trench boxes, driven sheeting, or similar methods will be used to shore the excavations. Earth retaining structures with unbalanced grade levels on opposite sides should be designed to account for the recommended lateral earth pressures summarized in the following table. The required lateral movement of the top of the wall to reach the earth pressure conditions in granular soils is based on the AASHTO LRFD requirements summarized in Table C3.11.1-1 of the LRFD Manual. The lateral earth pressures provided in the following table resulting from the soft to hard clay soils are assumed to be in-situ (native) clay soils.

Recommended Lateral Earth Pressures [A,B,C]									
Soil		Granular [C]		Clay			Random Fill	MDOT Class II	MDOT 21AA
Consistency		Loose	Dense	Hard	Stiff	Soft	---	95% ASTM 1557	95% ASTM 1557
ACTIVE	Lateral Translation to Mobilize [1]	(0.004)H	(0.001)H	(0.01)H	(0.02)H	(0.05)H	(0.02)H	(0.002)H	(0.001)H
	Active Coefficient (K_a)	0.32	0.28	0.45	0.45	0.45	0.60	0.31	0.22
	Equivalent Fluid Active Earth Pressure [2]	40 psf	35 psf	65 psf	65 psf	65 psf	65 psf	40 psf	30 psf
	Lateral Surcharge (q) Effect [3]	0.32*q	0.28*q	0.45*q	0.45*q	0.45*q	0.60*q	0.31*q	0.22*q
AT-REST	At-Rest Coefficient (K_o)	0.48	0.44	0.63	0.67	0.75	0.75	0.47	0.36
	Equivalent Fluid At-Rest Earth Pressure [2]	60 psf	55 psf	90 psf	90 psf	95 psf	95 psf	55 psf	50 psf
	Lateral Surcharge (q) Effect [3]	0.48*q	0.44*q	0.63*q	0.67*q	0.75*q	0.75*q	0.47*q	0.36*q
PASSIVE	Passive Coefficient (K_p)	3.12	3.54	2.20	2.00	1.67	1.67	3.25	4.60
	Equivalent Fluid Passive Earth Pressure [2,]	375 psf	440 psf	320 psf	270 psf	210 psf	220 psf	405 psf	640 psf
	Lateral Bearing Capacity for Transient Loading [4]	---	---	6 x Clay Cohesion			---	---	---

Notes:
[1] For active earth pressures, the structure must rotate about the base, with the top of the structure laterally translating between 0.001 and 0.05 of the exposed height to fully mobilize the active earth pressures. Otherwise, the structure should be considered to be in an At-Rest condition.
[2] Equivalent Fluid Earth Pressures should be applied in a triangular distribution laterally against the structure.
[3] The lateral effect of a surcharge, q, on the ground surface at the top of the structure should be applied uniformly against the structure.
[4] Passive pressures for long term loading conditions. For transient loads, i.e., wind or traffic loading, short term lateral loads will mobilize the cohesion in the clay soils and may be resisted by the "lateral bearing capacity" of the clay soils. However, long term or permanent lateral loads applied to the stiff to soft clays will cause the soils to creep and lose the horizontal resistance. Therefore, the lateral resistance from the clay soils for the lifetime of the structure will shift from the cohesive "lateral bearing capacity" to the equivalent fluid pressures as the pore water pressure dissipates.
[A] All earth-pressures provided are for the drained condition. If drainage is not provided behind the structure or a soil strata is situated below the long term ground water table, then the equivalent earth pressures should be recalculated using the buoyant unit weight of the soil and include the hydrostatic pressure from the long-term groundwater table.
[B] The recommended lateral earth pressures are unfactored. It is anticipated that the appropriate factors of safety will be applied during the design of the structure.
[C] Granular soils include silt, sand and gravel.

The application of the earth pressures in the design of below grade structures will be influenced by the geometry of the structure, the fixity conditions imposed on the structure, the method and material used for construction and soil and groundwater conditions. Generally, the soil conditions acting on below grade structures can be assumed to be in one of the three conditions. Active earth pressure occurs when the top of the structure rotates away from the soil a sufficient amount to mobilize its shear strength (noted as the required lateral translation) so the soil mass stretches

horizontally and a condition of plastic equilibrium is reached. If the structure is rigidly restrained, so that it does not rotate sufficiently to reach the active earth pressure condition, at-rest earth pressure conditions will exist. If the structure is partially restrained, the actual lateral earth pressure may be somewhere between the active and at-rest pressure conditions. The actual pressure distribution will depend on the flexibility and stiffness of the structure. Also, any additional lateral structure loads resulting from surcharge loading, such as construction traffic loads, should be added to the above earth pressures. Passive earth pressure occurs when the wall or foundation moves into the soil and the soil mass is compressed horizontally, mobilizing its shear strength fully.

As noted, the recommended lateral earth pressures are all unfactored and do not include hydrostatic pressures or account for the long-term groundwater level. We anticipate that the relevant safety factors will be applied to these recommended pressures during the structural design. The recommended lateral earth pressures are applicable for the design of standard cantilevered retaining structures or below grade walls. The design of braced earth retention systems require further analysis as the earth pressures developed are different for these wall systems. If these types of retaining walls are anticipated for this project, we would be pleased to assist in the design and provide more specific lateral earth pressure recommendations.

4.4 ENGINEERED FILL REQUIREMENTS

Any fill placed within pavement areas should be an approved material, free of frozen soil, organics, or other deleterious materials. Also, fill should never be placed on a frozen base. It is recommended that all required earthwork operations be performed under strict compliance with the current MDOT Standard Specifications for Construction. The fill should be placed and compacted as required by current MDOT Construction Specifications.

5.0 GENERAL EXCAVATION RECOMMENDATIONS

Excavation is recognized as one of the most hazardous construction operations. An excavation is any man-made cut, cavity, trench, or depression in an earth surface formed by earth removal.

Trenching and excavation hazards are addressed in specific standards for the general industry in Occupational Safety and Health Administration (OSHA) Part 1926 Subpart P "Excavations", specifically 29 CFR 1926.650, .651, and .652. The project must comply with the most stringent trenching and excavation requirements of these standards, Michigan Occupational Safety and Health Administration (MIOSHA) Construction Safety Standard Part 9 "Excavation, Trenching, and Shoring", or other OSHA approved requirements.

We anticipate excavations in site fill and sand soils will be prone to caving and sloughing of the excavation sidewalls, especially in areas where the soil conditions are in a very loose or loose condition (N value of 9 or less). Appropriate measures will be required to maintain the stability of excavation sidewalls. The required measures will depend on the subsurface materials encountered for the full depth of the excavation, the depth and width of excavation, and groundwater conditions at specific locations. In general, excavation walls should be sloped back to a stable angle in accordance with published MIOSHA guidelines. The side of an excavation more than 5 feet deep shall be sloped as prescribed in the MIOSHA table (from Part 9), unless the excavation is made entirely in stable rock or supported by a protective system as prescribed in the referenced standards. An excavation less than 5 feet may also require protection if a competent person determines that hazardous earth movement is anticipated.

Sloping or benching systems for excavations less than 20 feet deep shall be in accordance with maximum allowable slopes and based on the soil or rock type encountered as prescribed in the standards. If sufficient room is not available for sloping the excavation walls, then shoring, by means such as trench boxes, sliding trench shields or sheeting, will be required to maintain the stability of the sidewalls. The design of support systems, shield systems, and other protective systems shall be in accordance with OSHA 29 CFR 1926.652. Excavations 20 feet deep or greater require that sloping or benching systems, or a protective system, be designed by a registered professional engineer (or approved by a registered professional engineer in accordance with OSHA 29 CFR 1926.652).

Construction traffic, stockpiles of soil and construction materials should be kept away from the edges of the excavations for a distance equal to the depth of the excavation. If such clearances cannot be maintained, the resulting surcharge loads should be considered in the design of the shoring system. However, no loads shall be placed within 2 feet of an excavation edge for any unsupported excavation in which a worker is required to enter (unless a proper shoring system is in place).

Proper testing for atmospheric hazards such as low oxygen, hazardous fumes, and toxic gases should occur prior to worker entry when excavations are greater than 4 feet deep. Daily inspections of an excavation, adjacent area, and any protective system should be made by a competentperson prior to the start of work, following a rainstorm or other water intrusion, or during/after any occurrence that could change the conditions of the trench. In all cases, MIOSHA and other applicable requirements must be followed and adequate protection provided for workers.

Care should be exercised when excavating near existing pavement, utilities, and structures that are to remain, to protect them from damage. Mechanical excavations near existing utilities may also pose a physical hazard to workers if the utility is damaged. The contractor should be aware of existing utility locations before excavating and be prepared to expose them for verification and to support or brace them, as required.

6.0 GENERAL QUALIFICATIONS

This report and the attached Logs of Test Borings are instruments of service, which have been prepared in accordance with generally accepted soil and foundation engineering practices. We make no warranties either expressed or implied as to the professional advice included in this report.

The contents of this report have been prepared in order to aid in the evaluation of expected subsoil properties to assist the engineer in the design of *this* project at the site specified herein. The contents of this report should not be relied upon for other projects or purposes. In the event that any changes are made in the geotechnically related aspects of this project, however slight, the

conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are modified in writing by our office.

Since the information obtained from the soil borings is specific to the exact test locations, soil and water conditions could be different from those occurring at other locations of the site. This report does not reflect variations which may occur between the soil borings. The nature and extent of these variations may not become evident until the time of construction. If significant variations become evident, it may be necessary for us to reevaluate the recommendations provided in this report.

This report and the associated Logs of Test Borings should be made available to bidders prior to submitting their proposals and to the successful contractor and subcontractors for their information only, and to supply them with facts relative to the subsurface investigation, laboratory tests, etc. Somat is not responsible for failure to provide services that other project participants, apart from our client, have assigned to Somat either directly or indirectly. Somat is not responsible for failing to comply with the requirements of design manuals or other documents specified by other project participants, that impart responsibilities to the geotechnical engineer without our knowledge and written consent. We are not liable for services related to this project that are not outlined in our scope of services, detailed in our project proposal.

The discussions and recommendations submitted in this report are based on the soil information contained in the Logs of Test Borings and test results appended to this report. We expect that the Logs of Test Borings included in this report along with our discussions and conclusions will assist you in the design of the proposed project. If you have any questions regarding this report, please contact us.

Please review the important information regarding geotechnical reports included in Appendix D.

APPENDIX A

SOIL BORING LOCATION DIAGRAM



Adapted from Google Earth satellite imagery

Drawing Scale as noted

Legend:

Approximate Soil Boring Locations

SOIL BORING LOCATION DIAGRAM

Trenchless Installation
Wick Road Watermain
City of Taylor, Michigan

Somat Project No.: *2026070A*

APPENDIX B

LOGS OF TEST BORINGS AND GENERAL NOTES

PROJECT NO. 2026070A **DATE STARTED:** 8/3/2026 **DATE COMPLETED:** 8/3/2026

LOG OF TEST BORING B-01

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation 615 ft	0											
614.7	3 inches of TOPSOIL 0.3												
612.0	FILL - Medium dense poorly graded fine sand, trace silt, occasional topsoil seams, brown, moist (SP) 3.0		SS1	6	6-6-5	11	2.5						
	Stiff LEAN CLAY, trace sand, trace gravel, frequent silt partings, mottled brown and gray (CL)	5	SS2	14	3-2-2	4	5.0	3000*	23.6				
			SS3	8	2-2-2	4	7.5	3000*	24.3				
607.0	8.0		SS4	18	1-2-2	4	10.0	3000*	29.4		47	25	
	Stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	10	SS5	13	0-2-2	4	12.5	2000*	34.6				
			SS6	18	0-1-1	2	15.0	1800#	36.7				
		15	SS7	15	0-1-2	3	17.5	1800#	23.9				
595.0	20.0		SS8	18	0-0-2	2	20.0	1600#	24.3				
	Medium to stiff LEAN CLAY, few sand, trace gravel, gray (CL)	20	SS9	17	1-1-2	3	22.5	1800#	23.9				
590.0	25.0		SS10	18	0-0-2	2	25.0	3000*	15.5				
	End of Boring at 25 feet	25											
		30											

▼ SPT N VALUE ▼ 10 20 30 40

● MOISTURE CONTENT (%) ● 10 20 30 40

■ UCS STRENGTH (psf) ■ 2000 4000 6000 8000

GROUNDWATER READINGS
First Encountered: none
Upon Completion: none

BORING LOCATION INFORMATION
Latitude: 42.241068
Longitude: -83.26914

Coordinates/GSE determined by: Trimble R580/Estimated from topo drawing

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 75 (SN: 363487; ER=82.8%)
Logged By: D. Burby
Drilling Method: 3 1/4 inch HSA
Method Notes: ----
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Water Main Replacement along Wick Road
Trenchless Installation
City of Taylor, Michigan

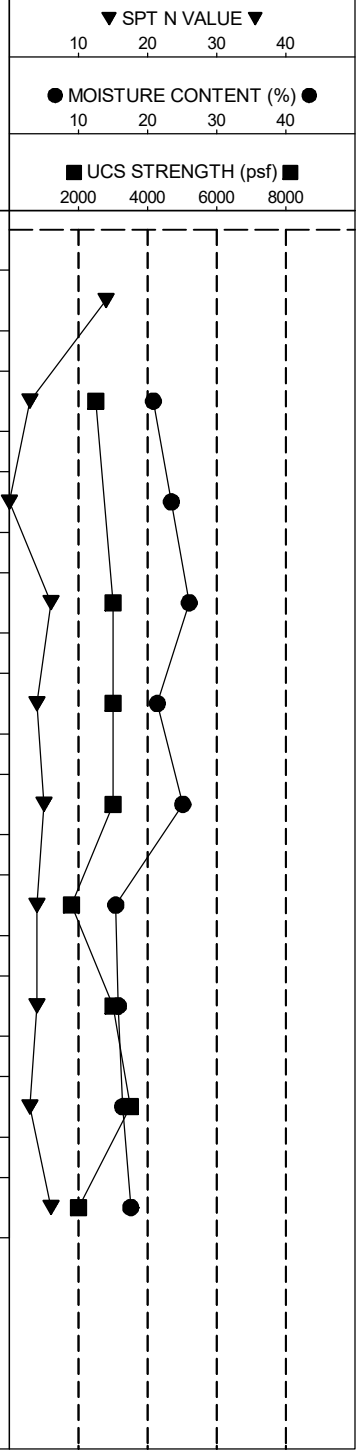
8/25/26

LOG OF TEST BORING WICK RD WATER MAIN REPLACEMENT.GPJ SOMAT.GDT 8/25/26

PROJECT NO. 2026070A **DATE STARTED:** 8/3/2026 **DATE COMPLETED:** 8/3/2026

LOG OF TEST BORING B-02

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation 616 ft	0											
615.7	3 inches of TOPSOIL 0.3												
	FILL - Medium dense silty fine sand, trace organics and roots, trace gravel, brown, moist (SM)		SS1	8	3-7-7	14	2.5						
612.0	4.0												
	Stiff to very soft LEAN CLAY, few sand, trace gravel, occasional organic seams/pockets, mottled dark brown and gray with pockets of black (CL) (organic content at 5 ft. = 1.8%) (organic content at 7.5 ft. = 1.8%)	5	SS2	13	3-1-2	3	5.0	2500*	20.8				
			SS3	7	0-0-0	0	7.5	<>	23.4				
607.0	9.0		SS4	18	1-2-4	6	10.0	3000*	26.0		36	17	
	Stiff LEAN CLAY, trace sand, trace gravel, gray (CL)	10	SS5	15	0-2-2	4	12.5	3000*	21.4				
			SS6	16	0-2-3	5	15.0	3000*	25.1				
600.0	16.0	15											
	Medium to stiff LEAN CLAY, few sand, trace gravel, gray (CL)		SS7	14	0-2-2	4	17.5	1800#	15.4				
		20	SS8	17	0-1-3	4	20.0	3000*	15.8				
			SS9	16	0-1-2	3	22.5	3500*	16.4				
591.0	25.0		SS10	18	3-3-3	6	25.0	2000*	17.6				
	End of Boring at 25 feet	25											
		30											



GROUNDWATER READINGS

First Encountered: none
Upon Completion: none

BORING LOCATION INFORMATION

Latitude: 42.241047
Longitude: -83.269708

Coordinates/GSE determined by: Trimble R580/Estimated from topo drawing

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 75 (SN: 363487; ER=82.8%)
Logged By: D. Burby
Drilling Method: 3 1/4 inch HSA
Method Notes: ----
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Water Main Replacement along Wick Road
Trenchless Installation
City of Taylor, Michigan

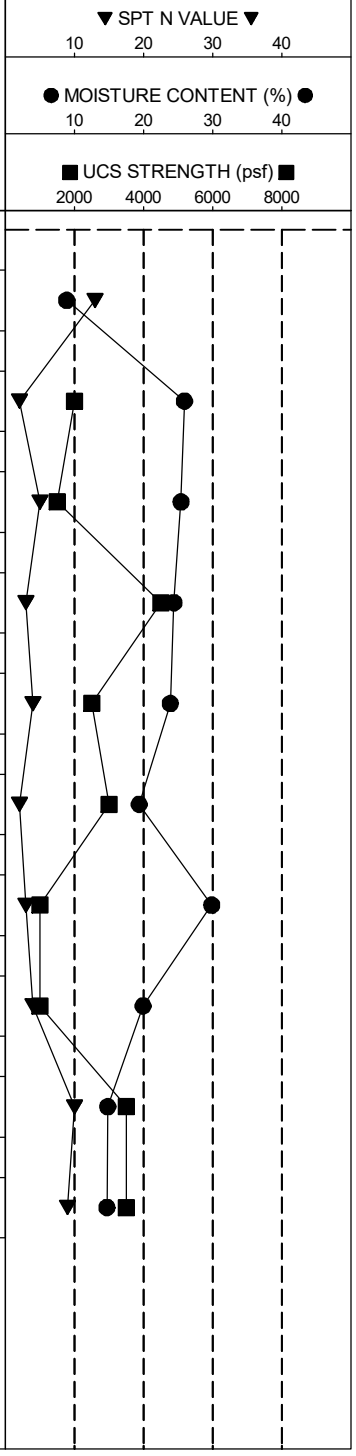
8/25/26

LOG OF TEST BORING WICK RD WATER MAIN REPLACEMENT.GPJ SOMAT.GDT 8/25/26

PROJECT NO. 2026070A **DATE STARTED:** 8/3/2026 **DATE COMPLETED:** 8/3/2026

LOG OF TEST BORING B-03

ELEVATION ft	LOG OF SOIL PROFILE	DEPTH (ft)	SAMPLE NO.	SAMPLE RECOVERY (in)	NO. OF BLOWS FOR 6-inch DRIVE	N VALUE	SAMPLE TIP DEPTH (ft)	UNCONFINED COMP STRENGTH (psf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	LIQUID LIMIT	PLASTICITY INDEX	% PASSING #200
	Ground Surface Elevation 616 ft												
615.7	3 inches of TOPSOIL (0.3)	0											
	FILL - Medium dense silty clayey fine sand, trace topsoil, trace gravel, dark brown, moist (SC-SM)		SS1	9	4-6-7	13	2.5		8.9				
613.0	(Organic content = 2.0%) (3.0)												
	Stiff to medium LEAN CLAY, trace sand, trace gravel, occasional fine sand partings, mottled brown and gray (CL)	5	SS2	15	1-1-1	2	5.0	2000*	25.9				
			SS3	14	0-2-3	5	7.5	1500*	25.4				
607.0	(9.0)		SS4	18	1-1-2	3	10.0	4500*	24.4		32	12	
	Very stiff to medium LEAN CLAY, trace sand, trace gravel, gray (CL)	10	SS5	18	1-2-2	4	12.5	2500*	23.9				
			SS6	18	0-1-1	2	15.0	3000*	19.4				
		15	SS7	18	0-1-2	3	17.5	1000#	29.9				
598.0	(18.0)												
	Medium to stiff LEAN CLAY with sand, trace gravel, gray (CL)	20	SS8	18	0-2-2	4	20.0	1000#	19.9				
			SS9	15	2-4-6	10	22.5	3500*	14.8				
591.0	(25.0)	25	SS10	18	2-4-5	9	25.0	3500*	14.7				
	End of Boring at 25 feet	30											



GROUNDWATER READINGS
First Encountered: 18 feet
Upon Completion: 20 feet

BORING LOCATION INFORMATION
Latitude: 42.241028
Longitude: -83.270252

Coordinates/GSE determined by: Trimble R580/Estimated from topo drawing

KEY
Torvane
* Penetrometer
<> Disturbed Sample

Drilling Company: DLZ American Drilling
Drill Rig: CME 75 (SN: 363487; ER=82.8%)
Logged By: D. Burby
Drilling Method: 3 1/4 inch HSA
Method Notes: ----
Hammer Type: Automatic
Backfilled With: Grout
Checked By: ALOG
QA/QC By: JSS
Remarks:

Somat Engineering

Water Main Replacement along Wick Road
Trenchless Installation
City of Taylor, Michigan

8/25/26

LOG OF TEST BORING WICK RD WATER MAIN REPLACEMENT.GPJ SOMAT.GDT 8/25/26

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2488 (Modified)

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1 3/8" I.D., 2" O.D. (standard)	BS:	Bulk Sample	RC:	Rock Core with diamond bit, NX size, (unless otherwise noted)
S:	Split Spoon – non-standard size, as noted	HSA:	Hollow Stem Auger		
ST:	Thin-Walled Tube – 3" O.D., (unless otherwise noted)	DP:	Direct Push	RB:	Rock Bit/Roller Bit
LS:	Liner Sample	PS:	Piston Sample	WR:	Wash Rotary
PA:	Power Auger	PT:	Pitcher Sample	NR:	No Recovery
HA:	Hand Auger	WS:	Wash Sample	VS:	Vane Shear Test
AU:	Auger Sample			ER:	Hammer Energy Ratio

Standard Penetration Test Resistance, N-Value: Sum of 2nd and 3rd 6-inch increments, in blows per foot of a 140-pound hammer falling 30 inches and driving an 18-inch to 30-inch long, 2-inch OD split spoon.

WATER LEVEL MEASUREMENT:
Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soils, the indicated levels may reflect the location of a groundwater table. In low permeability soils (clays and silts), the accurate determination of groundwater levels may not be possible with only short-term observations. Groundwater levels at times and locations other than when and where individual borings were performed could vary.

DESCRIPTIVE SOIL CLASSIFICATION:
Soil classification is based on the Unified Soil Classification (USC) System and ASTM Standards D-2487 and D-2488. Coarse-grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are generally described as: clays, if they are plastic, and silts, if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their apparent in-place density and fine-grained soils on the basis of their apparent in-place density (silty soils) or consistency (clayey soils).

CONSISTENCIES OF COHESIVE SOILS:
The pocket penetrometer, pocket torvane, and in-situ vane shear tests are converted into an estimated unconfined compressive strength, in pounds per square feet (psf), for presentation on the logs. The unconfined compressive strength is estimated to be about two time the shear strength.

DESCRIPTORS OF MINOR CONSTITUENTS

Primary Constituent	Fine-Grained (Silt & Clay)	Coarse-Grained (Sand & Gravel)	
Descriptor of Other Constituents	Relative Portion of Coarse Grained Soils as a % of Dry Weight	Relative Portion of Fine Grained Soils as a % of Dry Weight	Relative Portion of Coarse Grained Soils as a % of Dry Weight
Trace	<5%	<5%	<5%
Few	≥5% - <15%	N/A	≥5% - <15%
With	≥15% - <30%	≥5% - 12%	≥15%
Modifier	≥30%	>12%	N/A

FINE-GRAINED SOILS **COARSE-GRAINED SOILS**

Unconfined Compressive Strength Qu, psf	Consistency	N-Value	Apparent Density
< 500	Very Soft	0 – 4	Very Loose
500 - <1,000	Soft	5 – 9	Loose
1,000 - <2,000	Medium	10 – 29	Medium Dense
2,000 - <4,000	Stiff	30 – 49	Dense
4,000 - <8,000	Very Stiff	50 – 80	Very Dense
≥ 8,000	Hard	>80	Extremely Dense

DEFINITIONS OF PAVEMENT CONDITION

Condition		Description
Good	ACC	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks and transverse cracks (open ¼ inch). No patching or very few patches in excellent condition.
	PCC	Moderate scaling in several locations. A few isolated surface spalls. Shallow reinforcement causing cracks. Several corner cracks, tight or well sealed. Open (¼ inch wide) longitudinal or transverse joints.
Fair	ACC	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (½ inch deep or less).
	PCC	Severe polishing, scaling, map cracking, or spalling over 50% of the area. Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (½ inch with fair ride). Several slabs have multiple transverse or meander cracks with moderate spalling.
Poor	ACC	Alligator cracking (over 25% of surface). Severe distortions (over 2 inches deep) Extensive patching in poor condition. Potholes.
	PCC	Extensive slab cracking, severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlement or frost heaves.

DEFINITIONS OF STRUCTURAL AND DEPOSITIONAL FEATURES

Term	Definition
Parting	≤ 1/16 inch (1.6 mm) thick
Seam	> 1/16 inch (1.6 mm) → ½ inch (12.7 mm) thick
Layer	> ½ inch (12.7 mm) to ≤ 12 inches (305 mm) thick
Pocket	Small, erratic deposits of limited lateral extent
Lens	Lenticular deposit
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Varved	Alternating partings or seams (1 mm – 12 mm) of silt and/or clay and sometimes fine sand
Stratified	Alternating layers of varying material or color with layers ≥ 6 mm thick
Laminated	Alternating layers of varying material or color with layers < 6 mm thick
Fissured	Contains shears or separations along planes of weakness
Slickensided	Shear planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Homogeneous	Same color and appearance throughout
Occasional	One or less per foot (305 mm) of thickness
Frequent	More than one per foot (305 mm) of thickness
Interbedded	Applied to strata of soil lying between or alternating with other strata of a different nature

GRAIN SIZE TERMINOLOGY

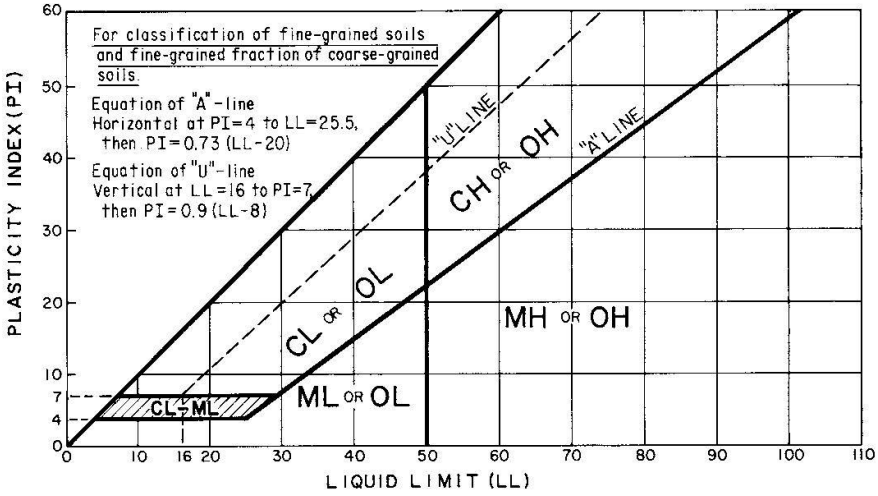
Major Component of Sample	Size Range
Boulders	≥ 12" (300 mm)
Cobbles	< 12" - 3" (300 mm – 75 mm)
Gravel - Coarse	< 3" - ¾" (75 mm – 19 mm)
Gravel – Fine	< ¾" - #4 (19 mm – 4.75 mm)
Sand – Coarse	< #4 - #10 (4.75 mm – 2 mm)
Sand – Medium	< #10 - #40 (2 mm - 0.425 mm)
Sand – Fine	< #40 - #200 (0.425 mm -0 .074 mm)
Silt	< 0.074 mm - 0.005 mm
Clay	<0 .005 mm

GENERAL NOTES

Unified Soil Classification System (USCS)
ASTM D2487

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
COARSE-GRAINED More than 50 % retained on No. 200 sieve	**Gravels** (More than 50 % of coarse fraction retained on No. 4 sieve)	**Clean Gravels**	Cu ≥ 4 and 1 ≤ Cc ≤ 3[D]	GW	Well-graded gravel [E]
		(Less than 5% fines [C])	Cu < 4 and/or [Cc < 1 or Cc > 3][D]	GP	Poorly graded gravel [E]
		Gravels with Fines	Fines classify as ML or MH	GM	Silty gravel [E,F,G]
		(More than 12 % fines [C])	Fines classify as CL or CH	GC	Clayey gravel [E,F,G]
	Sands (50 % or more of coarse fraction passes No. 4 sieve)	**Clean Sands**	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [D]	SW	Well-graded sand [I]
		(Less than 5 % fines [H])	Cu < 6 and/or [Cc < 1 or Cc > 3] [D]	SP	Poorly graded sand [I]
		Sands with Fines	Fines classify as ML or MH	SM	Silty sand [F,G,I]
		(More than 12 % fines [H])	Fines classify as CL or CH	SC	Clayey sand [F,G,I]
FINE-GRAINED SOILS 50 % or more passes the No. 200 sieve	**Silts and Clays** Liquid limit less than 50	**inorganic**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K,L,M]
		organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75	OL	Organic clay [K,L,M,N]
					Organic silt [K,L,M,O]
	Silts and Clays Liquid limit more than 50	**inorganic**	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic silt [K,L,M]
		organic	(Liquid Limit - oven dried) / (Liquid Limit - not dried) < 0.75	OH	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor			Pt	Peat

A Based on the material passing the 3-in. (75-mm) sieve.
B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
D $Cu = D_{60}/D_{10}$ $Cc = (D_{30})^2/(D_{10} \times D_{60})$
E If soil contains ≥15 % sand, add "with sand" to group name.
F If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
G If fines are organic, add "with organic fines" to group name.
H Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
I If soil contains ≥15 % gravel, add "with gravel" to group name.
J If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
K If soil contains 15 to <30 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.
L If soil contains ≥30 % plus No. 200, predominantly sand, add "sandy" to group name.
M If soil contains ≥30 % plus No. 200, predominantly gravel, add "gravelly" to group name.
N PI ≥ 4 and plots on or above "A" line.
O PI < 4 or plots below "A" line.
P PI plots on or above "A" line.
Q PI plots below "A" line.



Order of Classification: 1) Consistency or Apparent Density, 2) Type of Soil, 3) Minor Soil Type(s), 4) Inclusions, 5) Layered Soils, 6) Color, 7) Water Content, 8) USCS Symbol, 9) Geological Name

APPENDIX C

LABORATORY TEST RESULTS

Somat Engineering

Water Main Replacement along Wick Road
Trenchless Installation
City of Taylor, Michigan

SUMMARY OF LABORATORY RESULTS

PROJECT NO. 2026070A

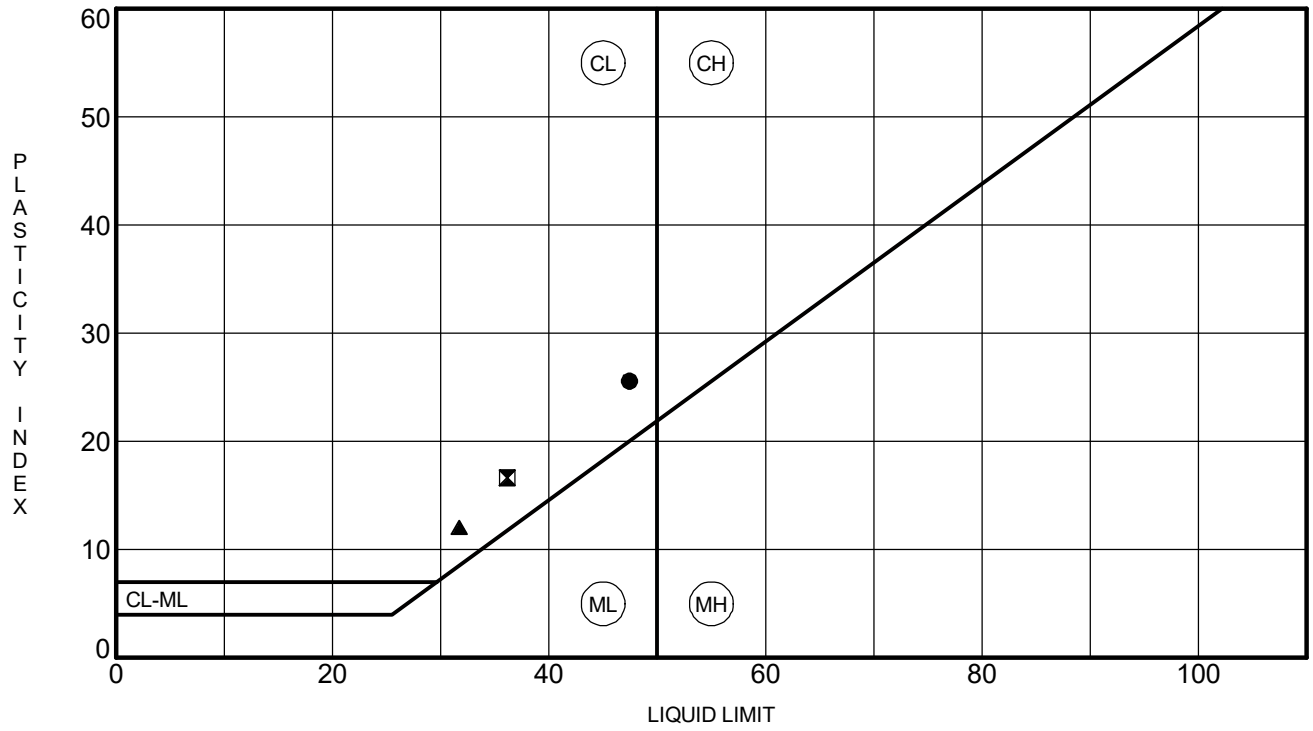
Borehole	Top Depth of Test Sample (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	UCS (psf)	Fine Sg
B-01	3.5							23.6		3000*	
B-01	6.0							24.3		3000*	
B-01	8.5	47	22	25				29.4		3000*	
B-01	11.0							34.6		2000*	
B-01	13.5							36.7		1800#	
B-01	16.0							23.9		1800#	
B-01	18.5							24.3		1600#	
B-01	21.0							23.9		1800#	
B-01	23.5							15.5		3000*	
B-02	3.5							20.8		2500*	
B-02	6.0							23.4		<>	
B-02	8.5	36	19	17				26.0		3000*	
B-02	11.0							21.4		3000*	
B-02	13.5							25.1		3000*	
B-02	16.0							15.4		1800#	
B-02	18.5							15.8		3000*	
B-02	21.0							16.4		3500*	
B-02	23.5							17.6		2000*	
B-03	1.0							8.9			
B-03	3.5							25.9		2000*	
B-03	6.0							25.4		1500*	
B-03	8.5	32	20	12				24.4		4500*	
B-03	11.0							23.9		2500*	
B-03	13.5							19.4		3000*	
B-03	16.0							29.9		1000#	
B-03	18.5							19.9		1000#	
B-03	21.0							14.8		3500*	
B-03	23.5							14.7		3500*	

Torvane
* Pocket Penetrometer
<> Disturbed Sample

Somat Engineering

Water Main Replacement along Wick Road
Trenchless Installation
City of Taylor, Michigan

ATTERBERG LIMITS RESULTS
ASTM D4318
PROJECT NO. 2026070A



Specimen Identification	Depth	LL	PL	PI	Fines	Remarks
● **B-01**	**8.5**	**47**	**22**	**25**		
⧓ **B-02**	**8.5**	**36**	**19**	**17**		
▲ **B-03**	**8.5**	**32**	**20**	**12**		

NP = Nonplastic

ATTERBERG LIMITS WICK RD WATER MAIN REPLACEMENT.GPJ SOMAT.GDT 8/25/26

Description of Frequently Used Laboratory Testing Procedures

Visual Engineering Classification

Visual classification was performed on all samples (though other means of refining the classification may also be used). The General Notes provided immediately following the Logs of Test Borings include a brief discussion of the general method used to visually classify the soil, which is based on the visual-manual procedure (ASTM D2488). The visual classification is used to assign an appropriate Unified Soil Classification System (USCS) group symbol. The USCS symbol is shown in parentheses following the textural description of the various strata on the boring logs. Where more laboratory testing is performed (requiring both grain size and Atterberg Limits tests), the classification may also be refined further based on USCS ASTM D2487.

Moisture Content (ASTM D2216)

Moisture content determination tests were performed in accordance with ASTM D2216. Samples were sealed in the field to retain the natural moisture content of the soil specimen. Samples were then dried at a constant temperature (approximately 110º C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample (and the loss in weight representing the water contained in the original sample). The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

Hand Penetrometer

A hand/pocket penetrometer was used to estimate the unconfined compressive strength of cohesive (clay) samples. In the hand penetrometer test, the shear strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small, calibrated spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square foot. The value is reported on the soil boring logs as an estimate of the unconfined compressive strength.

Torvane Shear Strength Test

Using a Torvane, the shear strength of weaker cohesive soils was estimated by pressing a small, calibrated spring-loaded vane into the sample and measuring the resistance in shear when twisting. The undrained shear strength is defined as the maximum torque required to fail the sample. The shear strength is doubled and reported on the soil boring logs as an estimate of the unconfined compressive strength.

Atterberg Limits Tests (ASTM D4318)

Determination of the Liquid Limit, Plastic Limit, and Plasticity Index of cohesive soils (known as Atterberg Limits) were performed in accordance with ASTM D4318. Fine-grained soils are tested to determine the Liquid Limit (LL) and Plastic Limits (PL), which are moisture contents that define boundaries between material consistency states. The LL and PL values define the transitional boundaries between non-plastic, plastic, and viscous fluid states. The plasticity index (PI) defines the complete range in water content for the plastic state.

Organic Content (Loss-On-Ignition) Tests (ASTM D2974)

The organic content of a soil is determined through a Loss-On-Ignition test performed in accordance with ASTM D2974 on soil samples suspected to contain significant organics. After the sample has been oven-dried, the soil sample is super-heated in a 440ºC muffle furnace as a means to burn off all present organic matter. The weight of the remaining ash is used to calculate the percentage of organic matter as compared to the dry weight of the sample.

APPENDIX D

GBA MESSAGE:
"IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL-ENGINEERING REPORT"

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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SECTION 01 21 00
ALLOWANCES

PART 1 GENERAL

1.01 GENERAL INFORMATION

A. Contractor will include Allowance(s) listed in the Bid Proposal that will 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 will be subject to Owner approval and under special terms described herein. Contractor will coordinate and cause the work covered by these Allowances.

C. It is understood that Contractor has included in the Contract Price Allowances so named in the Contract Documents and will 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 will be administered in accordance with the provisions of the General Conditions of the Contract. Contractor will be required to coordinate this work with the agency involved and pay 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 will be adjusted accordingly by Change Order. The adjustment in Contract Price will 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 will be responsible for all coordination with the agency involved and for the timely completion of the Work to fit his schedule. Contractor will not be allowed any additional compensation for the failure of the agency involved to meet any schedule.

1.03 RELATED REQUIREMENTS

A. The requirements of Section _____ and all Division 01 sections will also apply to this work.

1.04 DEFINITIONS

A. Lump Sum Allowance: A monetary sum that includes, as part of the Contract Price, the associated costs and requirements to complete the specified Allowance.

1.05 SUBMITTALS

A. Submit invoices or delivery slips to indicate actual quantities of materials delivered to the Site for use in fulfillment of each Allowance.

1.06 INSTRUCTIONS

A. At the earliest feasible date after Contract Award, Contractor will 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 will obtain Bids for each Allowance for use in making final selections; include recommendations that are relevant to performance of the Work.

C. Contractor will purchase products and systems as selected by Engineer from the designated Supplier.

D. Allowances will 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 will be adjusted accordingly by Change Order. The adjustment in Contract Price will 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.

1.07 SPECIFIC ALLOWANCES

Directional drill monitoring

Any and all costs accociated with ground mintoring while directional drilling undeer telegraph road will be incidental to the cost of completing this work.

Construction Layout and Staking

The cost associated with this work is incedental to the project.

A. Permits:

1. Contractor will pay for any outstanding or unpaid permit fees that have not been paid for by the commencement of construction.

2. This allowance will be payment in full for labor, materials, and equipment required the associated costs and requirements to complete and obtain outstanding or unpaid permits that are required for the Work specified herein.

3. Contractor will not be allowed mark ups from the amount invoiced by the permitting agencies.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

SECTION 01 22 00
UNIT PRICES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section describes the method of measurement and basis of payment for items of Work included in the Contract and specified in Section 00 42 43 - Proposal. Contractor will provide labor, material, tools, equipment and services required to complete the Work specified herein and indicated on the Plans.

B. The scope and quantity of Work estimated in the Proposal is the best estimate of the Engineer. It is anticipated that the quantity of Work to be completed will vary from the estimated quantities in Section 00 42 43 - Proposal.

C. City of Taylor will make no allowances for items not included in Section 00 42 43 - Proposal.

1.02 ITEMS OF THE PROPOSAL

Item 1, 201, 401, 501

Mobilization will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will 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 City of Taylor'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 will 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, 202, 402, 502

Traffic Maintenance and Control will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, and equipment required for maintaining traffic, and will include, but is not limited to, furnishing, installing, operating, and maintaining 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 other items necessary to complete the job, whether specifically mentioned or implied.

Item 3, 203, 403, 503

Audio-Video Route Survey will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material, equipment, and supplies necessary for furnishing an audio-video route survey in accordance with 01 33 00 - Submittal Procedures and Section 01 11 00 - Summary of Work.

Item 4, 204, 404, 504

Inspector Days will be paid for at the Contract unit price per Day as specified in the Proposal. Measurement for Inspector Days will be as follows:

a. An Inspector Day will be construed to mean any day when an operation by the Contractor's work crew (as determined by the Engineer), such as but not limited to construction of the project, restoration, cleanup and Project follow-up; will require the presence of a Resident Project Representative. An Inspector Day will also include any time when the presence of a Resident Project Representative is required to determine the status of completion of items identified on the project punch list, involvement with project complaints or other items related to closeout of the construction contract.

b. An Inspector Day will be computed by adding the total actual hours that each Resident Project Representative spent on the Project and dividing such total number of hours by eight (8) provided that the minimum show-up time when a Work crew elects to not Work will be four (4) hours. Show-up time will not be included when 12 hours notice of intent to not Work has been given by the Contractor to the Engineer. Cost of Inspector Days will be deducted from the monthly payments to the Contractor and paid to Engineer by the City of Taylor. Should the credited amount (number of days indicated by the Contractor in the Proposal) become depleted, the cost of Inspector Days will be deducted from the monthly payments to the Contractor. Upon completion of the Project, any surplus remaining in the Inspector Day bid item will be given to the Contractor.

Item 5, 205, 405, 505

Minor Traffic Devices and Flag Control will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid will be payment in full for labor, material and equipment necessary for furnishing and installing minor traffic devices and flag control, and will include, but is not limited to, portable signs, paddles, cones, channeling devices, flagmen, removing and replacing damaged devices, installing and removing temporary pavement markings, and other items necessary to complete the Work, whether specifically mentioned or implied.

Item 6, 206, 406, 506

Concrete Pavement, **Remove** will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment necessary for the removal of concrete pavement in excess of six (6) inches thick, or for the removal of concrete base course with asphalt surfacing in excess of six (6) inches thick, as shown on the Plans or as determined by Engineer. This work will include, but is not limited to saw cutting, removal and disposal of asphaltic surface courses and integral curbs, removal and disposal of unsuitable materials, furnishing, placing, and compacting backfill, protection of existing improvements, barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal of concrete pavement in excess of six (6) inches thick, and for concrete base course with asphalt surfacing will be determined by field measure of concrete pavement or concrete base course with asphalt surfacing removed.

Item 206A

Earth Excavation will be paid for at the Contract Unit Price per Cubic Yard (CYD) . Price paid will be payment in full for labor, material, and equipment necessary for excavation to the lines and grades shown on the plans, and will include, but is not limited to, excavation and disposal of unsuitable material including, but not limited to, asphalt pavement, removal of temporary roadway, asphalt approaches and asphalt drives, aggregate surfaces, concrete end headers, rocks, earth, large stones, culverts, sewers, abandoned utilities, structures, the excavation, removal, and stockpiling of topsoil, protecting existing improvements, filling holes and voids with compacted granular backfill, the excavation and disposal of other items exposed in excavating to the subgrade, also for fine grading and compacting the subgrade, barricading, and other items necessary to complete the job, whether specifically mentioned or implied.

Payment for earth excavation will be per cubic yard with the quantity of earth excavation calculated from existing and proposed grades. The quantity paid will be based on plan quantity unless there is a field change which affects the plan quantity. No field measurement for payment of this item will be done at the time of construction.

Item 7,8, 207, 208, 407, 408, 507, 508

Sidewalk, Sidewalk Ramp, and Drive Approach, Concrete, Remove and Replace of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per Square Foot (SFT). Price paid will be payment in full for labor, material, and equipment necessary for the removal and replacement of the sidewalk, sidewalk ramps, and driveway approaches and will include, but is not limited to, sawcutting, removal and disposal of unsuitable material, compacting and fine grading subgrade, furnishing, placing, and compacting backfill and subbase, construction of expansion joints, also forming, placing, jointing, finishing and curing the concrete, providing protection against rain and cold weather, backfilling, protection of existing improvements, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal and replacement of sidewalks, sidewalk ramps, and driveway approaches will be determined by field measure of sidewalks, sidewalk ramps and driveway approaches in place.

Item 9, 209, 406A, 506A

Bituminous Pavement, Remove regardless of thickness, will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material and equipment necessary for removing bituminous pavement, and will include, but is not limited to, sawcutting, excavation, protection of existing improvements, removal and disposal of unsuitable material, barricading, miscellaneous restoration or cleanup, and other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for removal of bituminous pavement will be determined by field measure of bituminous pavement removed.

Item 10, 210, 409, 509

Concrete Curb and Gutter, Remove will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for the removal of concrete curb and gutter, as shown on the Plans or as determined by Engineer, and will include, but is not limited to, saw cutting, removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements, barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal of concrete curb and gutter will be determined by field measure of concrete curb and gutter removed.

Item 211, 410

Storm Sewer, Remove of the size and type specified will be paid for at the Contract Unit Price on a per Linear Foot (LFT) basis. Price paid will be payment in full for labor, material and equipment necessary for removal of storm sewers and culverts, and will include, but is not limited to, excavation, sheeting, shoring, bracing and dewatering, protection of existing improvements, removal and disposal of unsuitable material and debris, removal and disposal of end sections and headwalls, backfill, backfilling, rebuilding and reconnecting live sewers, providing and maintaining a satisfactory sewer bypass service, maintaining drainage, and other items necessary to complete the job, whether specifically mentioned or implied.

Removing storm sewers will be determined by field measure of storm sewer and culverts removed.

Item 212, 410A

Catch Basin, Remove of the size, type, and material specified, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment required for removal of existing structure and will include, but is not limited to, excavation, sheeting, shoring, bracing, and dewatering; protection of existing improvements, removal of existing structures, removing and disposing of unsuitable material, backfill, backfilling, rebuilding and reconnecting live sewers or mains, providing and maintaining a satisfactory sewer bypass service, bulkheading of abandoned sewers, maintaining drainage, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 11, 213, 411, 510

Fire Hydrant, Remove will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for removing fire hydrant, and will include, but is not limited to, necessary excavation, sheeting, bracing, shoring, and dewatering, protection of existing improvements, removal of fire hydrant, valve, valve boxes, connecting piping, disconnection from existing water main, capping of existing water main, backfill, backfilling, disposal of excess excavated material, restoration, delivering hydrant, gate valve and valve box to Owner, cleanup, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Fire hydrant removal will be measured as units removed.

Item 12, 214, 412, 511

Gate Valve and Well, Remove, **of the size shown on the plans** will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, materials, and equipment required for removing existing gate valve and well, and will include, but is not limited to, excavation, removing the structure, removing and salvaging gate valve, salvaging well frame and cover, capping water main, backfilling with specified materials, cleanup, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Valve and well removal will be measured as units removed.

Item 13

Sign, Salvage will be paid for at the Contract Unit Price on a per Each basis. Price paid will be payment in full for labor, materials, and equipment required for salvaging signs, and will include, but is not limited to, removing and salvaging sign, post, and hardware, relocating and re-installing sign, cleanup, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 14, 15, 215, 215A, 413, 414, 512, 513

Soil Erosion and Sedimentation Control Devices will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material and equipment necessary to furnish and install soil erosion and sedimentation control devices, and will 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 other items necessary to complete the Work, whether specifically mentioned or implied.

Item 16, 216, 514

Structure, Adjust of the size, type, and material specified will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment required to raise the frame and cover on an otherwise sound structure. This work will include, but is not limited to, sawcutting, removal and disposal of pavement, excavation, construction, bricks, blocks, precast adjustment rings, PVC pipe, or other materials necessary to adjust the designated structure, masonry plaster coat, backfill, disposal of unsuitable or excess material, concrete, installation of frame and cover, cleanout of structure, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 17, 217, 415, 518

Water Main, Directionally Drill of the type, diameter, and class specified, will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for furnishing and installing directional bored water main and will include, but is not limited to, specials and fittings, excavation, sheeting and bracing, shoring, draining, dewatering, excavating utility crossings, potholing, boring water main, jointing, grouting, testing, disinfecting, backfilling boring pits (including backfill with special materials where specified), excavating and installing fittings, disposal of excess

excavated material, temporary blow-offs, thrust blocks, thrust restrainers, encasement, barricading, restoration, final cleanup, connections to existing mains and all other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for water main directional bored will be in linear feet along the centerline of the pipe taken from end-to-end with no reduction for fittings, boring pits, 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.

Item 18, 19, 218, 219, 219A, 416, 417, 515, 516, 517, 519

Water Main, Pipe Bursting Existing Water Main with the type, diameter, and class specified, will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for bursting the existing pipe and furnishing and installing new water main, and will include, but is not limited to, necessary excavation, sheeting, shoring and bracing, draining, dewatering, excavating and exposing bends, valves, fittings, connections and related items, disposal of excess excavated material, specials and fittings, potholing, excavating utility crossings, fusing pipe and fittings, thrust blocks, thrust restrainers, disinfecting, testing, backfilling pits and excavations, barricading, restoration, miscellaneous cleanup, connections to existing mains and all other items necessary to complete the job, whether specifically mentioned or implied.

Water main pipe burst will be field measured in linear feet from end to end with no reduction for fittings and valves.

Item 20, 220, 220A, 419, 521, 522, 522A

Gate Valve and Well, of the size specified on the plans, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for furnishing and installing valve and well, and will include, but is not limited to, valve, valve well foundation, steel reinforcing, bricks, blocks, valve well sections, adjusting rings, well frame and cover, cement mortar plaster coat, necessary excavation, sheeting and bracing, shoring, dewatering, connection to water main, backfilling, restraints, disposal of excess excavated material, thrust blocks, restoration, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Valve and well will be measured as units installed.

Item 21, 219B, 418, 520,

Water Main, Abandon with Flowable Fill, of the size and type specified will be paid for at the Contract Unit Price per Cubic Yard (CYD) of flowable fill pumped. Price paid will be payment in full for labor, material, and equipment necessary for abandoning water main, and will include, but is not limited to, specials and fittings, necessary excavation, capping ends of existing water main, sheeting, bracing, shoring, draining, dewatering, backfilling (including backfilling with special materials where specified), thrust blocks, filling with flowable fill, cleanup, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for abandoning water main will be by certified batch plant delivery tickets of flowable fill submitted to Engineer at time of placement.

Item 221

Water Main, Bored or Open Cut, in Steel Casing will be paid for at the Contract Unit Price per Linear Foot (LFT) of casing installed. Price paid will be payment in full for labor, material, and equipment necessary for furnishing and installing water main in bored or open-cut steel casing, and will include, but is not limited to, furnishing water main, casing pipe, boring pit, necessary excavation, sheeting, shoring and bracing, dewatering, disposal of excess excavated material, testing, disinfecting, grouting, backfilling, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied. Water main in bored or open-cut steel casing will be field measured in linear feet of casing placed.

Item 22, 23, 25, 222, 223, 225, 420, 421, 423, 523, 524, 526

Water Service, of the size, type and length specified, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for furnishing and installing water service lines and will include, but is not limited to, water service pipe, curb stops, curb box, special fittings, necessary excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling, disposal of excess backfill and fill material (including backfill with special materials where specified), connection to new water main (including service clamps where specified); restoration, cleanup and other items necessary to complete the job, whether specifically mentioned or implied.

Water service lines will be measured as units installed.

Item 24, 26, 224, 226, 422, 424, 525, 527

Curb Stop and Box, of the size and type will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment required for installation of new curb stop and new curb box on existing and/or new water service line and will include, but is not limited to, excavation, sheeting shoring and bracing, fittings, water service line, connection to existing water service line, protection of existing improvements, backfilling, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

This item will be used at the discretion of Engineer when an existing water service line cannot be connected to the existing curb stop or whenever determined by Engineer.

Item 27, 226A

Water Service (Beyond Property Line), of the size and type specified, will be paid for at the Contract Unit Price per Linear Feet. Price paid will be payment in full for labor, material, and equipment necessary for furnishing and installing water service lines and will include, but is not limited to, water service pipe, curb stops, curb box, special fittings, necessary excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, backfilling, disposal of excess backfill and fill material (including backfill with special materials where specified), connection to new water main (including

service clamps where specified); restoration, cleanup and other items necessary to complete the job, whether specifically mentioned or implied.

Water service lines will be measured as linear feet installed.

Item 27A, 226B, 424A, 527A

Water Service, from Property Line to Meter, K Copper, 1 inch, Directional Bored Water service lines, of the type specified, directional bored, from the curb stop to the meter inside the house, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and installing water service lines; and shall include, but is not limited to, any necessary excavation, sheeting, bracing, shoring, draining, dewatering, boring, grouting, jointing, testing, disinfecting, and backfilling; excavation of boring pits and exit pits; disposal of excess excavated material; furnishing and installing water service pipe and special fittings; connection to existing water service line; cleanup; and all other items necessary to complete the job, whether specifically mentioned or implied.

Water service lines will be field measured in each.

Item 27B, 226C, 424B, 527B

Water Service, Connection to Water Meter

Water service connection to water meter will be paid for at the Contract Unit Price per each. Price paid shall be payment in full for all labor, material, and equipment required for entering a building on a property and connecting a new water service line to an existing or proposed water meter; and shall include, but is not limited to, all excavation; sheeting, shoring and bracing; installation of water service through foundation, footings, or floors; all necessary piping, fittings, and connectors; obtaining permits and inspections; restoration of site furnishings, landscaping, and appurtenances; and all other items necessary to complete the Work, whether specifically mentioned or implied.

Water service connection to water meter will be measured as unit connected.

Item 28, 227, 425, 528

Fire Hydrant Assemblies will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for furnishing and installing fire hydrant assemblies, and will 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 other items necessary to complete the job, whether specifically mentioned or implied.

Hydrants will be measured as units installed.

Item 29, 30, 31, 228, 229, 230, 231, 232, 426, 429, 430, 431, 432, 530, 531, 532, 533, 534, 534A, 535

Connection to Existing Water Main, of the size, fitting, and material show on the plans, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for connecting new water main to existing water main and will include, but is not limited to, water main pipe, fittings, adapters, necessary

excavation, sheeting and bracing, shoring, draining, dewatering, laying, jointing, bedding, testing, disinfecting, filling, backfilling (including backfill with special materials where specified), disposal of excess backfill and fill material, connection to new water main, capping old water main, thrust blocks, restoration, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Connection to existing water main will be measured per connection made. Connection to existing water main is not paid for separately where a tapping sleeve, valve and well/valve box is being paid for.

Item 32, 33, 233, 234, 446, 447, 535A, 535B

Sanitary Sewer, Television Inspection, of the type and diameter specified, will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for televising, existing sanitary sewer, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 234A, 234B, 234C, 434,

Storm Sewers and Culverts, Open-Cut of the type and diameter specified on the Plans, in open cut trench will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for storm sewer pipe and culvert pipe in open cut trench and will include but is not limited to, excavation, sheeting, shoring, bracing, and dewatering, construction, protection of existing improvements, sand backfill, sand, stone or concrete pipe bedding, placing and removing of stoppers and bulkheads, final inspection which includes cleaning, stubs in drainage structures, connection to drainage structures and sewers, end sections, barricading, restoration, cleanup and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for storm sewers and culverts in open cut trench, will be in place, by length in linear feet, from center to center of end standard manholes, standard catch basins, standard inlets, headwalls, or other standard drainage structures, with no deduction in length for intermediate standard structures. However, where tee manholes or where special bid items, as indicated in Plans and Specifications, having a basis of payment of lump sum, are involved, the measurement will be from the end of the tee manhole or from the end of the special bid item nearest the adjoining drainage structure and the adjoining drainage structure.

Item 234D, 234E

1. **Storm Sewer, Standard Drainage Structures** of the type and diameter specified, for depths up to eight (8) feet and for the first eight (8) feet of deeper structures, will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for a complete standard storm drainage structure, and will include but is not limited to, excavation, dewatering, construction, frame, cover, bricks, blocks, cone section, riser sections, top section, bottom section, masonry plaster coat, steps, sand backfill, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

   Additional depth of drainage structures, more than eight (8) feet of the type and diameter specified will be measured by Vertical Foot (VFT), to the nearest tenth, for that portion of

drainage structures more than eight (8) feetin depth from the top of the base to the top of the cover.

Item 34, 235, 435, 536

Aggregate Base Course, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per Ton. Price paid will be payment in full for labor, material, and equipment necessary for the aggregate base course, compacted in place, and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing, and compacting backfill and subbase, also compacting and fine grading subgrade, also furnishing and applying chemical additives and water, also for barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for aggregate base course will be in tons, with the installed tonnage determined by certified delivery tickets submitted to Engineer or his duly authorized representative. Delivery tickets will indicate the scale weight of the material, including chemical additives and moisture content. For material having a moisture content in excess of six (6) percent, the excess over six (6) percent will be deducted from the scale weight of the material when the moisture content is six (6) percent. Material placed to conform to the cross section and width specified on the Plans or as determined by Engineer will be paid for at the tonnage basis. If the width of the base course is increased to accommodate Contractor in placing forms, etc., the additional material installed beyond the width specified on the Plans or as determined by Engineer, will be at Contractor's expense.

Item 35, 36, 236, 236A, 236B, 436, 438, 537, 538

Pavement, Concrete of the type and thickness specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment necessary for the concrete pavement and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing and compacting backfill and subbase, also compacting and fine grading subgrade, also the furnishing and installing of hook bolt assemblies, tie bar assemblies, dowel bar assemblies, contraction joint basket assemblies, expansion joint basket assemblies, polyethylene planks, polystyrene or other fillers, hot-poured elastic joint compound, mesh reinforcement, bar mat reinforcement, also forming, placing, jointing, finishing, texturing and curing the concrete, also providing protection against rain and cold weather, also for barricading, restoration, pavement gapping, part width construction, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete pavement will be determined by field measure of concrete in place.

Item 236C, 236D, 236F, 437

Pavement, Concrete with Integral Curb of the type and thickness specified will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid will be payment in full for labor, material, and equipment necessary for the concrete pavement and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing and compacting backfill and subbase, also compacting and fine grading subgrade, also the furnishing and installing of hook bolt assemblies, tie bar assemblies, dowel bar assemblies, contraction joint basket assemblies, expansion joint basket assemblies,

polyethylene planks, polystyrene or other fillers, hot-poured elastic joint compound, mesh reinforcement, bar mat reinforcement, also forming, placing, jointing, finishing, texturing and curing the concrete, also providing protection against rain and cold weather, also for barricading, restoration, pavement gapping, part width construction, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete pavement will be determined by field measure of concrete in place.

Item 37, 237, 439, 540

Curb and Gutter, Concrete of the type and width specified will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for the concrete curb and gutter section and will include, but is not limited to, excavation, construction, protection of existing improvements, furnishing, placing, and compacting backfill and subbase, compacting and fine grading subgrade, providing and installing hook bolt assemblies, tie bar assemblies, reinforcing steel, also forming, placing, jointing, finishing, texturing and curing the concrete, providing protection against rain and cold weather, backfilling, barricading, restoration, gapping, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete curb and gutter will be determined by field measure of curb and gutter in place.

Item 39, 40, 238, 239, 440, 441, 541, 542

Bituminous Pavement will be paid for at the Contract Unit Price per Ton. Price paid will be payment in full for labor, material, and equipment required for 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 bituminous pavement will be in tons, with the installed tonnage determined by certified batch plant delivery tickets submitted to Engineer or Engineer's duly authorized representative, at the time of placement.

Item 38, 236E, 242, 242A, 444,445, 539, 545, 546

Sidewalk, Sidewalk Ramp, and Drive Approach, Concrete, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per Square Foot (SFT). Price paid will be payment in full for labor, material, and equipment necessary for sidewalks, sidewalk ramps, and driveway approaches and will include, but is not limited to, excavation, construction, protection of existing improvements, undercutting and backfilling the subgrade, compacting and fine grading subgrade, furnishing, placing, and compacting backfill and subbase, construction of expansion joints, also forming, placing, jointing, finishing and curing the concrete, construction of detectable warning, providing protection against rain and cold weather, barricading, restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for sidewalks, sidewalk ramps, and driveway approaches will be determined by field measure of sidewalks, sidewalk ramps and driveway approaches in place.

Sidewalk ramps will be measured from back of curb to the key flag or to the end of the monolithic rolled curb, whichever is less.

Item 41, 240, 442, 543

Restoration with Topsoil, Seed and Mulch will be paid for at the Contract Unit Price per Square Yard (SYD) of the depth specified. Price paid will be payment in full for labor, material, and equipment necessary to construct the right-of-way to the cross section shown on the Plans or as determined by the Engineer, and will include, but is not limited to excavation, 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, and items necessary to complete the job, whether specifically mentioned or implied. Contractor will restore areas disturbed by Contractor's operations.

Measurement for restoration with topsoil, seed, and mulch will be determined by field measure.

Item 42, 241, 443, 544

Maintenance Aggregate will be paid for at the Contract Unit Price per Cubic Yard (CYD). The price paid shall be full compensation for all labor, materials, and equipment required to furnish and install maintenance aggregate as shown on the Plans or as directed by the Engineer, including, but not limited to, protection of existing improvements, excavation, compacting and fine grading the subgrade, furnishing, placing, and compacting aggregate, furnishing and applying water, barricading, and all incidental work necessary to complete the item, whether specifically mentioned or implied.

Measurement for maintenance aggregate shall be by the cubic yard in place, as determined by the dimensions shown on the Plans or as directed by the Engineer. Quantities shall be calculated based on the approved width, length, and compacted thickness of material installed and accepted by the Engineer.

Maintenance aggregate placed in excess of the limits shown on the Plans or directed by the Engineer, including any additional width or thickness required for the Contractor's convenience or operations, shall be at the Contractor's expense and will not be measured for payment.

Item 43, 244B, 446B, 544A

Allowance, Permit Fees to cover costs to complete and obtain outstanding permits that are required for the specified Work. Contractor will submit appropriate documentation to validate the actual cost of completing and obtaining the outstanding permit(s). The amount of the allowance will be adjusted accordingly by Change Order to recognize the allowable cost incurred by Contractor at direction of Owner.

Item 44, 244C, 446C, 544C

Exploratory Excavation will be paid for at the Contract Unit Price per EACH. Price paid will be payment in full for labor, material, and equipment necessary for excavation to expose utilities, and will include, but is not limited to, excavation and disposal of unsuitable material including, but not limited to, asphalt pavement, removal of temporary roadway, asphalt approaches and asphalt drives, aggregate surfaces, concrete end headers, rocks,

earth, large stones, culverts, sewers, abandoned utilities, structures, the excavation, removal, and stockpiling of topsoil, protecting existing improvements, filling holes and voids with compacted granular backfill, the excavation and disposal of other items exposed in excavating to the subgrade, also for fine grading and compacting the subgrade, barricading, and other items necessary to complete the job, whether specifically mentioned or implied.

Payment for exploratory excavation will be per each with the locations directed by the engineer.

Item 45, 244A, 446A, 544B

Irrigation System, Remove and Reinstall Existing will be paid for at the Contract Unit Price on a per Lump Sum basis. Price paid will be payment in full for labor, material, and equipment required for removal of existing irrigation system and replacing it in as good as or better condition and will include, but is not limited to, excavation, protection of remaining system, reinstalling valves, piping, connections, fittings, heads, boxes, and controllers; furnishing and installing new material for material that could not be salvaged; removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements; restoration, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 243

Sign, Remove and Replace will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for removing, storing and reinstalling the sign, as shown on the plans, or as determined by Engineer, and will include, but is not limited to, the removal of the sign including attached parts, connections, post, and hardware; securing and storing the sign and its attached parts, connections, post, and hardware until it can be re-installed; removal and disposal of unsuitable materials; protection of existing improvements; barricading; and items necessary to complete the job, whether specifically mentioned or implied.

Item 243A, 244, 547

Trees and Stumps, Remove will be paid for at the Contract Unit Price per Each. Price paid will be payment in full for labor, material, and equipment necessary for the complete removal and disposal of each tree or stump in accordance with the following schedule of sizes:

a. Remove Stump.....6-inch diameter or larger

b. Remove Tree.....6 - 12 inches in diameter

c. Remove Tree.....13 - 24 inches in diameter

d. Remove Tree.....25 inches or larger

The size of trees will be determined by the average diameter of each tree trunk measured at a point four (4) feet above the ground. The size of stumps will be determined by the average diameter of each stump measured at the top of the stump. Removal and disposal of stumps, hedges, brush, shrubs, roots, and trees having a diameter of less than six (6)

inches will be considered incidental to the Project. Removal of trees in clearing and grubbing areas will not be paid for separately.

Item 245

Guardrail, Remove will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid will be payment in full for labor, material, and equipment necessary for the removal of guardrail as shown on the Plans or as determined by Engineer, and will include, but is not limited to, the removal of attached parts and connections, removal and disposal of unsuitable materials, furnishing, placing and compacting backfill, protection of existing improvements, barricading, and for other items necessary to complete the job, whether specifically mentioned or implied.

1. Measurement for removal of guardrail will be determined by field measure of guardrail removed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 PRECONSTRUCTION MEETING

A. Prior to the delivery of materials or the start of any construction, the Contractor will request a Preconstruction Meeting from the Engineer. A minimum three (3) working days' notification to meeting participants will be required.

B. Schedule:

1. Engineer will establish the meeting place, time and date, distribute agenda, notify participants, and administer the meeting. Contractor will notify major Subcontractors.

C. Attendance:

1. Owner
2. Engineer
3. Contractor
    a. Major Subcontractors
4. Utility Companies
5. Safety Representatives
6. Governmental Agencies

D. Agenda:

1. Distribution by the 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 will 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 will 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 the Owner within seven (7) days of meeting for review at the next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 32 16
CONSTRUCTION PROJECT SCHEDULE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor will be responsible for the Project construction schedule for the full Contract Time, including without limitation the following:

1. Contractor's construction schedule updates will be submitted on a monthly basis, or as requested by Owner.

2. Contractor's short-term look-ahead schedule submitted at each progress meeting and as required by the Owner.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

1.03 DEFINITIONS

A. Activity: A discrete part of a project that is identified in the Contractor's planning, scheduling, executing, monitoring, and controlling of the construction Project. Activities included in a construction schedule consume time and resources.

B. Critical Activity: An activity on the critical path of the construction schedule.

C. Predecessor Activity: An activity that precedes another activity in the network.

D. Successor Activity: An activity that follows another activity in the network.

E. Cost Loading: The allocation to each activity within the Critical Path Method (CPM) Schedule of the portion of the Contract Price reflecting the Contractor's anticipated costs to perform that portion of the Work, including a proportional share of overheads and profit. The sum of costs for all activities must equal the total Contract Sum. The cost loaded CPM Schedule will be referenced to the contract, purchase order line item, and bid breakdown item.

F. Critical Path Method (CPM): Scheduling method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path to complete the Work of the Project within the specified Contract Times and interim completion milestones.

G. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

H. Event: The starting or ending point of an activity.

I. Free Float: is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

J. Total Float: is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

K. Contract Float: is the measure, in calendar days, of leeway between the Contractor's anticipated date for completion of all or any part of the Work and the corresponding specified Contract Time regardless of the float values calculated by the software used to produce the CPM Schedule.

L. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

M. Work Breakdown Structure (WBS): A deliverable-oriented breakdown of a project into smaller components. A work breakdown structure is a key project deliverable that organizes the team's work into manageable sections.

N. Detailed Cost Breakdown (DCB): An itemized breakdown of the Work and Contract Amount detailing quantities and dollar amounts for each pay item, developed by summarizing the cost-loaded CPM schedule to a level of detail appropriate for use in progress payment estimates. The sum of all pay items will equal the Contract Price.

O. Milestone: The date of a significant event, used to monitor schedule performance and define Contract deadlines.

P. Data Date: The reporting cut-off date through which progress is incorporated into a schedule.

Q. The term “day” as used in these Contract Documents will mean calendar day unless otherwise specifically designated. Contract Time computations will be made in Days. Total Float and Contract Float values computed in Working Days will be converted to Days when such computations are made for the purpose of calculating changes in Contract Time.

1.04 CPM SCHEDULE

A. Contractor's approach to prosecution of the Work will be disclosed by submission of computerized, cost-and-resource loaded CPM Schedules as required herein. These requirements are in addition to, and not in limitation of, those imposed elsewhere in the Contract Documents.

B. CPM Schedule Submittals are intended to show:

1. the priority and sequencing by which the Contractor intends to execute the Work (or Work remaining) to comply with the Contract Times, those sequences of Work indicated in or required by the Contract Documents and any other requirements of the Contract Documents;

2. how the Contractor anticipates foreseeable events, site conditions and all other general, local and prevailing conditions that may in any manner affect cost, progress, schedule, performance and furnishing of the Work;

3. how the Means and Methods chosen by the Contractor translate into Activities and sequencing;

4. the actual timing and sequencing of completed Work; and

5. the allocation of the Contract Price and construction craft labor hours to the Activities.

C. CPM Schedule will clearly define the prosecution of the Work from Date of Commencement of the Contract Time to Final Completion by using separate CPM Activities for, but not limited to:

Notice to Proceed, submittal, resubmittal, review and approval of basis of design, preliminary design and final design (applicable for design/build contracts); construction/installation; permitting (by the Contractor and Owner); workshops (instrumentation, software, and controls), submittal preparation; submittal review and return, resubmission and re-review; mechanical, electrical, controls systems and information systems layout drawings; procurement and fabrication; deliveries to the site or storage; Owner-furnished items or _____; interfaces with other work (other contractors, public utilities, etc.); planned shutdowns or other impacts to Owner's operating equipment or facilities; start-up and testing of the equipment/system; Field Acceptance Test (FAT); Site Acceptance Test (SAT) for controls; Substantial Completion, final inspection; Owner training; O&M and Training Manuals; punch list; final clean-up; submittal of as-built drawings and other record documents; close-out; and Final Completion.

D. The CPM Schedule will detail CPM Activities and logic ties as required to demonstrate the Contractor's approach to all the Work. CPM Activity durations will equate to the days required to complete the associated Work. Activities will not combine:

1. separate items of Unit Price or lump sum Work;
2. distinct classes of Work (e.g., CSI Divisions or equivalent);
3. Work in separate areas, structures or facilities and, if requested by Engineer, Work in separate locations or elevations within an area, structure or facility; or
4. rough-in and finish Work.

E. Start-to-finish relationships and negative lags will not be utilized unless approved in advance by the Engineer. Activities will be cost and resource loaded.

F. The activities will form a complete network wherein all activities (except for the start and completion milestones) will have at least one predecessor and one successor. Each activity will have as many predecessor or successor activities as is necessary to accurately reflect the requirements to complete the work. The number of activities and level of detail in the schedule will be subject to the Engineer's review.

G. Schedule calendars must be developed to accurately reflect the working times for each activity based on the specific requirements of the project. If not specified, assume 5 calendar days and 40 hours per week. Observed federal, state and non-work holidays should be included, as appropriate.

H. Installation CPM Activities will last from 15 to 45 days unless a shorter or longer duration is required to properly depict the Work. The schedule will provide not less than 30 days for each submittal review or re-review activity and for each submittal will include separate activities for review, re-submittal, and re-review. Submittal, delivery and start-up CPM Activities may combine materials and equipment in the same class of Work, based on the detail of related installation CPM Activities. Furnish, install, and test will be separate activities. Contractor will include weather contingencies and other anticipated/foreseeable events/conditions in the schedule and the schedule narrative.

I. Contractor will refrain from constraining activity dates in the schedule other than Contract milestones. If the Contractor feels constraints are necessary, the Contractor will detail the reasons for the constraints to the Engineer and in the schedule narrative and will require approval of their use.

J. Activities will be assigned consistent descriptions, activity identification, Work Breakdown Structure, and activity codes consistent with schemes provided by the Engineer or, if none is provided, with the Engineer's approval. For each activity, separate activity codes will be provided for work location, phase of work, responsible firm (Contractor, a Subcontractor or a Supplier), system, specification section, and DCB item. Constraint dates/basis will be explained.

K. The CPM Schedule will be prepared using the latest version of Oracle Corporation Primavera P6 Project Management Software unless the Contractor proposes a similar software that can be used for scheduling that is acceptable to the Engineer or _____.

L. Unless otherwise approved by the Engineer, CPM schedule calculations will be performed:

1. utilizing retained logic in lieu of progress override;
2. using expected finish dates;
3. with critical activities defined as the longest path;
4. with total float defined as the smallest of start float or finish float; and
5. with the predecessor calendar used for lags.

M. In preparing CPM Schedules, it is the Contractor's responsibility to:

1. request interpretations from the Engineer, as warranted
2. point out to the Engineer, by specific, separate notation, any aspects of the CPM Schedule that may reflect variations from the Contract Documents
3. work with Subcontractors and Suppliers in finalizing Activities and logic ties.

N. Early Dates in the CPM Schedule will be based on proceeding with all or part of the Work exactly on the date when the corresponding Contract Time commences to run. Late Dates will be based on completing all or part of the Work exactly on the corresponding Contract Time, regardless of whether the Contractor anticipates early completion or not. If sequences of Work are indicated in or required by the Contract Documents, the CPM Schedule will show in detail the Contractor's approach to conforming with those sequences.

O. A narrative will accompany all CPM Schedule submittals which will:

1. Discuss the Contractor's planning and approach to the Project and any changes therein;
2. Identify planned staffing, resources, and work hours;
3. Identify the basis for any constraints incorporated into the CPM schedule;
4. Itemize shifts, non-Working Days and any multiple calendars applied to the CPM Activities;
5. Compare current activity dates and the Contract Times;
6. Recap progress and days gained or lost vs. the As-Planned Schedule;
7. Provide activity reporting based on the CPM Schedule discussing progress by CPM Activity;

8. Detail Contractor's Site Management Plan, Construction Equipment Usage, Labor Buildup over first three months and de-staffing plans (when applicable);
9. Describe all changes in resources to be used on remaining Work;
10. Identify delays and causes and any actions taken to mitigate impact;
11. Explain the basis for any logic ties other than finish-to-start (FS), and for each lag incorporated into the schedule;
12. Define abbreviations used in the schedule;
13. Itemize any revisions made in the activities or Work sequences, and
14. Identify all approved logic changes.

P. The narrative will include monthly and cumulative plots of planned and actual manpower and payments, in a form acceptable to the Engineer, comparing the Contractor’s anticipated rate of progress in the most current CPM Schedule Submittal and that anticipated in the As-Planned Schedule.

Q. CPM Schedule submittals will include:

1. Electronic copies of the Contractor's native P6 schedule files (.xer);
2. A narrative;
3. Activity report/Gantt charts including CPM Activity code, description, duration, calendar, Early and Late Dates (calendar dates), Total Float, labor man-hours, cost, and sort codes. The Late Finish Date (or the Early Start Date) of any CPM Activity highlighting a Contract Time (or commencement of all or any part of the Work) will equal the corresponding Contract Time (or Contract date). Provide PDF file (11-inch x 17-inch printable, with headers and footers).
4. S-curves showing projected early and late earnings and earnings to date;
5. Total contract earnings report detailing contract value to date, total contract earnings to date and current period earnings by activity, sorted and subtotaled by responsibility, with actual, early start, early finish, late start and late finish dates;
6. Total Float report
7. Critical path
8. Other reports and Gantt charts as designated by the Engineer
9. Three (3) color copies and an electronic pdf copy of all of the above items.
10. Critical paths with zero or negative Total Float will be shown in red. If the Contractor plans to finish the work earlier than the Substantial Completion Date and Final Completion Date, then the activities with minimum Total Float will be identified in red color as the near critical path.
11. Schedule update reports will include the prior update baseline.

R. Each CPM Schedule Submittal will bear the Contractor's stamp or written indication of approval as representation to the Owner that the Contractor has determined or verified all data on that CPM Schedule, and that the Contractor and the Subcontractors and Suppliers have reviewed and coordinated the sequences in that CPM Schedule with the requirements of the Work. CPM Schedule Submittals are not Contract Documents.

S. Owner’s review of CPM Schedule Submittals may result in comments relating to conformance with:

1. the Contract Times,

2. those sequences of Work indicated in or required by the Contract Documents

3. any other Contract Document requirements that may have a significant bearing on the use of CPM Schedule Submittals to resolve issues affecting Contract Price and/or Contract Time. The review of CPM Schedule Updates may, in addition result in comments as to whether the Contractor’s scheduling of Work remaining continues to conform with the Contract Times and those sequences of Work indicated in or required by the Contract Documents. Review comments may also respond to Contractor’s proposed schedule recovery plans, when and as appropriate, and to Contractor requests for extensions in Contract Time. CPM Schedule review comments may also result in the selection of Targets and recording of Target Times.

T. The review of CPM Schedule Updates may, in addition result in comments as to whether the Contractor’s scheduling of Work remaining continues to conform with the Contract Times and those sequences of Work indicated in or required by the Contract Documents. Review comments may also respond to Contractor’s proposed schedule recovery plans, when and as appropriate, and to Contractor requests for extensions in Contract Time. CPM Schedule review comments may also result in the selection of Targets and recording of Target Times.

U. No CPM Schedule review by the Engineer will relieve the Contractor from the responsibility to:

1. comply with the Contract Times and any sequences of Work indicated in or required by the Contract Documents

2. complete omitted Work within the Contract Times.

Nor will any such CPM Schedule review by the Engineer lead to approval of, or consent to, any variation from the Contract Documents.

V. CPM Schedule reviews will not impose on the Owner any responsibility for:

1. the means, methods, sequences or techniques by which the Contractor plans and executes the Work;

2. verifying whether Work is omitted;

3. Activity durations are reasonable;

4. the adequacy of the level of labor, materials and construction equipment;

5. the reasonableness of the Contractor’s chosen Means and Methods; or

6. whether Work sequences and Activity timing are practicable.

Even if any comments or objections are noted from the reviews of CPM Schedule Submittals, no such reviews or objections noted will be effective or construed to create or impose on the Owner or Engineer any responsibility for the timing, planning, scheduling or execution of the Work or for the correctness of any such CPM Schedule details. The correctness of the CPM Schedule will remain the sole responsibility of the Contractor.

W. The initial CPM Schedule is known as Revision 0 (Rev. 0) and, once approved by the Engineer, becomes the As-Planned Schedule and the initial Record Baseline Schedule. Within 30 days following the Contract Start Work Date, Contractor will provide the Rev. 0 cost-loaded CPM Schedule Submittal and a list of all project submittals for Engineer's review and approval.

1. The Rev. 0 Submittal will reflect Contractor's plan for the Work as awarded in full accordance with the Contract, and will not include any delays, changes, Change Orders, Construction Change Directives or substitutions, or "or-equals". Activity durations and Work sequences in the CPM Schedule Rev. 0 Submittal will be based on furnishing named or specified materials/equipment nominated in the Contract and the means and methods indicated in or required by the Contract Documents. No activity durations or Work sequences in the Rev. 0 CPM Schedule will be based on or-equals or substitutions even if the Contractor intends to pursue such under the provisions of the Specifications. Any additional modifications to the contract dates, scope, or costs are managed through approval of subsequent CPM Schedule Submittals.

2. Contractor will cause Work covered by Allowances as well as specified Unit Price Work and contingent Unit Price Work to be done within the Contract Times. Contractor will be responsible for completing, within the Contract Time for Substantial Completion, up to one hundred twenty-five percent (125%) of the estimated quantities for each specified item of Unit Price Work. The CPM Schedule will incorporate within the limits of the Contract Times:

    a. Contractor's best estimate of the activities and logic ties required by Cash Allowances and Work to be authorized under any Provisionary Allowances and under any contingent Unit Price Work; and,

    b. Activities relating to requisite tasks of Owner, and to interfaces with other work, based on the information given in the Contract Documents, and if not given, as indicated by the Engineer. Provisionary Allowance activity will be for the entire duration of the Contract. In any case, Contractor will allow not less than the times indicated in the Contract, or if no times are indicated, 15 days or such greater time as is reasonable under the circumstances for each required action by Engineer, Owner or other contractors.

    c. The Rev. 0 schedule will allow sufficient time to accommodate Owner activities as well as time for facility operational constraints that may affect the ability to obtain equipment shutdowns. Required durations for Owner submittal review will be not less than those referenced in Section 01 33 00 - Submittal Procedures.

    d. Planned durations for weather-exposed activities will include sufficient time allowances to accommodate without delay the loss, within each calendar month, of not less than the number of work-days specified below due solely to adverse weather.

Monthly Required Allowance for Workdays Lost Due to Adverse Weather											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

5	5	5	6	6	6	8	5	8	4	5	4

No extension in Contract Time will be justified due to adverse weather except to the extent that the number of work days lost in a calendar month due solely to adverse weather exceeds the number of days specified in the table above.

3. Contractor will cost and resource load the activities within the CPM schedule by allocating to each activity the applicable portion of the Contract Price proportionate to the Work required to perform the activity. The cost-loaded CPM Schedule will tabulate schedule activity number, quantities (for Unit Price Items), required craft labor hours, and activity cost value for each activity. Contractor may add non-work activities to the CPM schedule as necessary to account for all elements within the total Contract price. Activities for submittals and other non-construction activities (excluding mobilization and design deliverables under design/build delivery) will not be cost-loaded within the CPM Schedule. Activities for bonds, builders risk insurance and stored materials will be cost loaded at invoiced cost (excluding any general conditions, overheads or profit). The cost-loaded schedule will include activities and costs for specific deliverables within the following categories:

    a. CPM schedules; (b) testing, start-up, commissioning; (c) operation and maintenance manuals; (d) training; (e) delivery of updated as-built record documents; (f) clean-up, and (g) punch list work for each trade or subcontractor in an amount not less than 1% of the total Work of that trade or subcontractor. The aggregate total of all activity costs within the cost-loaded schedule will equal the Contract Price. Delivery activities will be cost loaded if the Contractor intends to request payment for materials properly stored on-site. Costs shown for each activity in the cost-loaded CPM Schedule will reflect a share of the Contract Price that is proportionate to the estimated costs to perform the associated Work, including a proportional share of Contractor's and subcontractor’s mark-ups, and will be an accurate and correct allocation of the Contract Price.

    b. testing, start-up, commissioning;

    c. operation and maintenance manuals;

    d. training;

    e. delivery of updated as-built record documents;

    f. clean-up, and

    g. punch list work for each trade or subcontractor in an amount not less than 1% of the total Work of that trade or subcontractor.

4. The aggregate total of all activity costs within the cost-loaded schedule will equal the Contract Price. Delivery activities will be cost loaded if the Contractor intends to request payment for materials properly stored on-site. Costs shown for each activity in the cost-loaded CPM Schedule will reflect a share of the Contract Price that is proportionate to the estimated costs to perform the associated Work, including a proportional share of Contractor's and subcontractor’s mark-ups, and will be an accurate and correct allocation of the Contract Price.

5. Unless otherwise approved by the Engineer activity cost amounts within the cost-loaded schedule will be summarized into payment items comprising a Detailed Cost Breakdown

(DCB) to be used to prepare Progress Payment Estimates. In such case each schedule activity will be cross-referenced to one and only one summary payment item through assignment of a payment item code. A single DCB payment item may include one or more schedule activities. The aggregate total of all DCB payment items will equal the Contract Price. Separate DCB items and cost-loaded schedule activities will be provided for furnishing, installing and testing of equipment.

6. The cost-loaded CPM Schedule and DCB will be submitted for Engineer's review and approval in accordance with the requirements of the General Conditions and will:

    a. show the allocation of the Contract Price among activities representing the various components of the Work, in sufficient detail as the Engineer may require;

    b. divide the Work into activities by significant Sections of the Specifications within areas, structures and Facilities, or Work Breakdowns, or vice versa;

    c. identify total amounts for each Work activity;

    d. segregate work by the various subcontractors and identify the subcontractor performing each element of the work; and

    e. for Unit Price Items only, tabulate quantities and unit prices.

7. Contractor will hold a baseline schedule presentation meeting for the Owner and Engineer. This meeting is meant for the Contractor to present, in detail, the schedule plan.

    a. Examples of items for presentation include but are not limited to work breakdown structure, a description of each activity name, basis for durations, general work sequence, the critical path, and weather assumptions. This meeting could also take place during schedule updates, if requested.

8. **The first Progress Payment will not be finalized until the Engineer returns to the Contractor the Rev. 0 CPM Schedule Submittal (including the DCB) as "Approved" or "Approved As Noted."** Once the Rev. 0, or Rev. 0A, etc. CPM Schedule Submittal is returned by the Engineer as "Approved" or "Approved As Noted", it will represent the As-Planned Schedule, and will be used for Payment Submittals until revisions to the CPM Schedule are approved by the Engineer. If Engineer does not approve the cost-loaded CPM Schedule or the DCB, Contractor will address Engineer's comments, revise and resubmit until approved by the Engineer. The cost-loaded CPM Schedule report and the DCB will include spaces for signatures of Engineer and Contractor to confirm the approval of each party. Once the Rev. 0 cost-loaded CPM Schedule and DCB are approved, the Contractor will not modify any activity value or pay item, unless otherwise authorized by the Engineer in writing. Engineer may require reallocation of costs for uninstalled material, amounts not expended for bonds or insurances, or to properly reflect authorized Change Directives or Change Orders. Contractor represents and warrants to Owner that the final cost-loaded CPM Schedule and DCB provide an accurate and correct allocation of the Contract Price.

9. CPM Schedule Updates. After approval of the Rev. 0 CPM Schedule Contractor will update the CPM Schedule monthly (or at shorter intervals if deemed necessary by the Engineer) using as a data date the first day of each calendar month. Each CPM Schedule Update will show the actual status of the Project as of the date of the updated CPM Schedule. CPM

Schedule Updates will progress the Record Schedule, and will be due five (5) days after the closing of each Progress Payment period, whether the As-Planned Schedule has been established or not. Each CPM Schedule Update submittal will be accompanied by the following power point slides in a format acceptable to the Engineer: (1) Project milestone date trending; (2) Summary schedule; (3) Project activity progress (number of activities earlier or later than scheduled last month); (4) Project total float (mean and median total float trend each month); (5) Labor hour resources planned loading each month; and Actual Labor Count weekly history (from daily reports).

a. Each update will include the actual dates each activity is commenced and the date that the activity is completed sufficiently to allow subsequent activities to commence, delays and other significant events occurring since the previous Payment Submittal.

b. Contractor may revise schedule logic in each CPM Schedule Update provided that such revisions comply with Contract requirements, are identified in the accompanying narrative, and are acceptable to Engineer. Schedule logic and/or activities will be revised as necessary to accurately address out-of-sequence progress (e.g., successor activities started before completion of predecessor).

c. Subject to review and approval of Engineer, Contractor will update the physical percent complete for each activity started or in progress, based on realistic assessment of earned value and work remaining. Contractor will revise percent complete as required by Engineer. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete. Punch list activities may be declared 100 percent complete upon completion and correction of punch list work identified during Owner’s pre-final inspection.

d. Contractor will include the CPM Schedule Update with its monthly Payment Submittal, which will also include Contractor’s certification that it has not been delayed or adversely impacted, as of the cut-off date, by any acts or omissions of Owner or Engineer, except as otherwise specifically stated.

e. The most recent CPM Schedule “Approved” or “Approved as Noted” by the Engineer will be the current Record Schedule and will be used by the Owner and Contractor to monitor progress against Contract Times and resolve issues affecting Contract Prices and Contract Times and the assessment of liquidated damages.

f. If the Early Dates in any CPM Schedule update submittal forecast any slippage in the Contract Times, the Contractor will indicate such overrun(s) by reporting negative Total Floats. Owner reserves the right not to approve schedules that do not reflect completion within the Contract Time.

10. Short-term look-ahead Schedules will subdivide CPM Activities into detailed tasks and cover the prior two (2) weeks and the next four (4) weeks. Each installation task will be cross- referenced to a CPM Activity and will not combine the Work for more than one crew.

11. Submittals will segregate preparation from review and will not combine items furnished by separate Suppliers.

1.05 CONTRACTOR’S SCHEDULER

A. Contractor will appoint a project scheduler with the following minimum qualifications (unless otherwise modified by the Owner or Engineer): At least 5 years of experience using a recent version of Primavera P6 Professional Project Management software, and scheduling for at least three construction projects with cost and responsibility loaded CPM schedules. If the appointed project scheduler fails to perform to an adequate professional and technical standard or if Engineer, in the reasonable exercise of its discretion, objects to the appointed project scheduler, the Contractor will use a replacement project scheduler having the required qualifications, at no increase in Contract Price and/or Contract Time. Submit the scheduler qualifications and experience for Engineer review and approval.

B. Contractor's scheduler will prepare the Baseline schedule, all schedule updates, look ahead schedules, time impact analysis, and recovery schedules required by the Contract Documents. Contractor's scheduler will attend all project meetings where scheduling input is necessary, as well as attend the meetings and perform the duties set out in the other Contract Documents. Owner and Engineer will be invited to all Contractor Scheduling meetings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROGRESS AND COMPLETION

A. Time limits stated in the Contract Documents are of the essence of the Agreement. Contractor will begin the Work on the date of commencement indicated in the Notice to Proceed. It will carry the Work forward expeditiously with adequate resources, will at all times adhere to the CPM Schedule, and will achieve Substantial Completion and Final Completion within the time limits set forth in Project Calendar stated in the Contract Documents, as extended by change orders.

B. The construction and completion of the Project will be undertaken and completed in accordance with the cost loaded CPM Schedule described in the Contract Documents. The parties will use the CPM Schedule for planning and monitoring the progress of the Work. If the Contractor will fail to adhere to the CPM Schedule, as revised pursuant to the Contract, it must promptly request Engineer's approval to work outside of normal working hours and will work such additional time over regular hours, including Saturdays, Sundays and holidays and/or supply such additional workmen as may be required to bring the Work on schedule, without additional cost or expense to Owner, including claims for inefficiency due to the use of overtime. In the event of such failure of Contractor to adhere to the CPM Schedule, Contractor may alternatively propose revisions to the CPM schedule to recover the delay for Engineer 's review and approval. If Engineer agrees that such revisions are feasible and likely to recover the delay, Contractor will promptly implement the measures necessary to recover the delay.

C. If Contractor is late in achieving Substantial Completion, Final Completion, or if Contractor fails to adhere to the approved CPM Schedule or submits a CPM Schedule update which forecasts delay in achieving any of the Contract Times, or if Engineer reasonably determines based on an evaluation of Contractor's rate of progress that there is a substantial probability of delay in achieving any of the Contract Times, Engineer may provide Contractor a notice to cure, request that Contractor submit a schedule recovery plan, and withhold liquidated damages in accordance with the applicable provisions of the Agreement.

D. Upon receipt of a request for a schedule recovery plan:

1. To the extent that Contractor believes that it is entitled to an increase in Contract Time under the terms of the Contract, Contractor will comply with paragraphs 3.02 and 3.03 in providing notice, demonstration of entitlement, delay analysis, and supporting documentation demonstrating the number of days of Contract Time extension to which Contractor believes it is entitled.

2. To the extent that delay exceeds any time extension to which Contractor is entitled, Contractor will submit a schedule recovery plan and immediately take measures necessary to recover delay. Contractor's schedule recovery plan will describe the cause of schedule slippage or delayed progress and the actions proposed and taken by the Contractor to recover schedule. Contractor will meet with the Engineer and present the Contractor's written schedule recovery plan. If, upon evaluation of the Contractor's schedule recovery plan, the Engineer determines that there is sufficient cause to withhold liquidated damages, the Owner may deduct from Requests for Payment the Owner's estimate of the liquidated damages then due using the Engineer's estimate of late completion of the Work.

E. Contractor will carry on the Work with due diligence during all disputes or disagreements with the Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements. Contractor will exercise reasonable precautions, efforts and measures to avoid or mitigate situations that would cause Delays.

3.02 SUSPENSIONS AND DELAYS

A. In accordance with the General Conditions the Engineer may order the Contractor in writing to suspend, defer, stop, delay, interrupt, slow down, or extend all or any part of the Work for such period as it may determine to be appropriate for the convenience of Owner.

1. To the extent practical, the Contractor will consult with Engineer and will mitigate the cost of suspensions and delays by reducing the size of its Project staff and demobilizing equipment to the extent practicable upon notice from the Engineer of any Owner caused delay or interruption which is likely to exceed seven (7) days. Upon the termination of the delay or as otherwise directed by Owner, the Contractor will restore the Project staff to the appropriate size.

B. Contractor will provide Owner the opportunity to prevent or mitigate delays by Contractor's promptly furnishing of written notice of potential delay to Engineer before Contractor incurs actual delay or additional costs, and in any case not later than three (3) days after the occurrence of any of the following that Contractor believes: (a) to be within the responsibility of the Owner, and (b) may result in critical path delay to any of the Contract Times required by the Project Calendar included in the Contract Documents:

1. (i) Construction Change Directives or Change Orders issued by Owner; (ii) the Contractor receives a notice of a change in the Agreement or extra work to be performed; (iii) the Engineer provides a clarification or notice of a no-cost change or minor change as provided in the General Conditions; or (iv) Owner or Engineer directs a change in the Work in accordance with the changes provisions of the General Conditions that Contractor believes will result in critical path delay to any Contract Time;

2. Contractor encounters concealed conditions in accordance with the provisions of the General Conditions that it believes will result in critical path delay to any Contract Time;

3. Contractor believes that any act or failure to act by Owner or Engineer or any of Owner's other contractors or consultants, or any variation in quantities for unit price work, will cause performance of all or any part of the Work to be delayed, deferred, stopped, slowed down, suspended or interrupted beyond the reasonable time for such actions as allowed under the Contract Documents and the CPM schedule, resulting in potential critical path delay to any Contract Time.

C. Contractor will promptly provide written notice to Engineer before Contractor incurs actual delay or additional costs, and in any case not later than three (3) days after the occurrence of any event that (a) is not within the responsibility of either the Owner or the Contractor, and (b) may result in critical path delay to any Contract Time including without limitation:

1. Uncontrollable Circumstance as provided in the General Conditions

2. Adverse weather within a calendar month that causes the loss of more work-days than specified herein.

3. Conditions affecting Owner's facilities, that result in constraints to Contractor's work or impede shutdowns of Owner's systems at the times requested by Contractor, including without limitation operational effects of weather, plant conditions, ongoing maintenance, other work affecting available facilities, equipment failures or outages, requirements to maintain sufficient processing capacity, or other regulatory or operational issues affecting Owner's facilities, provided that such conditions are outside the reasonable control and reasonable advance planning of both Owner and Contractor.

4. Delays caused by regulatory authorities, governmental agencies, public utilities, and other third parties.

D. Contractor will promptly provide written notice to Engineer, in any case not later than three (3) days, after the start of any delay that is within the responsibility of the Contractor and will immediately take such action as is necessary to mitigate and recover the delay.

1. Contractor will provide notice and promptly take appropriate action to recover schedule whenever the Contractor anticipates, or any CPM Schedule Submittal demonstrates, that the scheduled early completion date for any required CPM Activity has slipped, due to acts or omissions within the control of the Contractor, beyond any Contract Time. If the Contractor is not responsible for such schedule slippage, the Contractor will give prompt written notice of a delay justifying a Contract Time extension in accordance with paragraph 3.02.B or 3.02.C.

2. If schedule recovery is required, the Contractor will enclose with the next Schedule Update Submittal a schedule recovery plan consisting of (a) a narrative describing the cause of schedule slippage and the actions taken to recover schedule within the shortest reasonable time, and (b) a Recovery Schedule with the corresponding revisions in Activities and logic ties and other adjustments intended to recover the schedule. Appropriate schedule recovery actions may include: assignment of additional labor, Subcontractors or construction equipment; Work during other than normal working hours; resequencing of the Work; increasing the concurrency of sequential Work activities; expediting of Submittals and deliveries; and any combination of any of these or other similar actions. Activity shortening and overlapping will be explained as to their basis (and be supported by increases in resources).

3. Contractor's failure, refusal or neglect to take appropriate schedule recovery action or, in the alternative, give written notice of a delay with a timely and properly supported Time extension request, and, in either case, to follow up with a timely CPM Schedule will be reasonable evidence that the Contractor is not prosecuting the Work with due diligence. Any such Contractor failure, refusal or neglect will give sufficient basis to the Owner, to elect any of the following:

    a. demand adequate, written assurance of due performance, as provided in the General Conditions,

    b. withhold liquidated damages, and

    c. in the Owner's sole discretion, direct alternate schedule recovery actions.

E. Each Subcontractor will be bound by the foregoing provisions.

3.03 DELAYS AND EXTENSIONS OF TIME

A. Extensions of the Contract Time will not be granted except as expressly provided for in the General Conditions and this Specification Section.

B. If the Contractor determines that critical path delay will occur to any Contract Time due to the events identified in paragraphs 3.02.A, 3.02.B or 3.02.C, Contractor may request a commensurate adjustment in the affected Contract Times (but only to the minimum extent reasonably forced on the parties by the event) by submitting to the Engineer a properly supported written request for extension of Time no more than three (3) days after Contractor provides notice of a concealed condition as provided in the General Conditions, or the extent of the delay becomes known, or the Engineer requests such submittal, whichever is sooner, or if the delay continues for more than 30 days, submit requests for Time extension at 30 day intervals until the delay has ended. Requests for Time extension in connection with weather delays will be made on a monthly basis within three (3) days from the end of each month. Claims for adjustment in any of the Contract Times or Contract Price will be waived if not properly submitted in accordance with all requirements of the General Conditions and this Specification Section within the time limit required or if timely notice of delay was not submitted in accordance with paragraphs 3.02.A, 3.02.B or 3.02.C.

C. No extension in Contract Time will be justified unless the Contractor demonstrates, through a detailed analysis of the CPM Schedule using the procedures specified in this paragraph 3.03, the occurrence of Delay which (a) is not reasonably foreseeable under the circumstances, (b) arises from unforeseeable causes, (c) is not caused in whole or in part by any act or omission within the control of the Contractor, and (d) necessarily extends the Work beyond the overall Contract Time (or a portion of the Work beyond a pertinent Contract Time).

D. Properly supported requests for extension of Time will include:

1. Explanation of the cause and duration of the delay together with identification of which schedule activities were affected.

2. Justification for entitlement to a time extension under the Contract Documents.

3. Identification of all concurrent delays with an explanation of their causes and which party is responsible for each.

4. Critical path analysis, using the latest Record Schedule approved by the Engineer before the start of the delay, demonstrating the number of calendar days by which each of the Contract Times has been delayed due to each cause. Analysis will be accompanied by native electronic XER files and will be verifiable by an independent, objective evaluation by the Engineer, using the electronic files and data furnished by the Contractor. Unless otherwise required by the Engineer, prospective analysis wil be prepared in accordance with AACEI Recommended Protocol RP-29, method implementation protocol MIP-3.6 (“Modeled / Additive / Single Base”) and as specified herein, by using the most recent Engineer approved Record Schedule prior to the date that the delay commenced, incorporating any schedule review comments provided by Engineer, then updating the schedule with actual progress to the start of the delay and noting the updated dates calculated for achievement of each of the Contract Times before commencement of the delay.

    a. Modeling of each delay will be accomplished by inserting into the updated pre- delay Record Schedule appropriate activities for each delay, with duration, constraints and logic accurately reflecting the actual delay and its impact on other activities.

    b. If more than one delay is concurrently in progress at any time after the start of the delay the analysis will be conducted in the following sequential steps:

        1) Delays under paragraph 3.02.C will be incorporated into the schedule that also includes the delays under paragraph 3.02.D, a copy of the schedule preserved, and resulting dates calculated for achievement of each of the Contract Times will be noted to determine the extent of delays that are not within the responsibility of the Owner.

        2) Using the same schedule containing all delays that are not within the responsibility of the Owner, all delays under paragraphs 3.02.A and 3.02.B will then be incorporated into the schedule, a copy of the schedule preserved, and the resulting further extension evaluated based on the dates calculated for achievement of each of the Contract Times.

    c. Reasonable delay mitigation to the extent commercially practicable will be incorporated into the schedule containing all delays by revising or deleting non- mandatory schedule logic, and increasing activity concurrency where practicable, and noting the resulting dates calculated for achievement of each of the Contract Times reflecting the effects of all schedule delays and commercially practicable mitigation.

    d. Extensions for each of the Contract Times will not exceed the difference in time between the dates calculated under paragraph 3.03.D.4.c and those calculated under paragraph 3.03.D.4.b.1.

    e. Unless otherwise required by the Engineer, retrospective delay analysis will be prepared in accordance with AACEI Recommended Protocol RP-29, method implementation protocol MIP-3.9 (“Modeled / Subtractive / Multiple Base”)

E. Engineer may perform or obtain an independent evaluation of delays. Engineer will review timely submitted, properly supported, requests for extension of Time and will determine the extent to which each of the Contract Times is to be revised by Change Order.

F. Minor Delays: No adjustment in any of the Contract Times will be justified as a result of (a) any delay of less than twenty-four (24) hours duration, or (b) delays to activities that are not on the critical path controlling the calculated date for achievement of any of the Contract Times, or (c) Contractor's failure to allow sufficient time in schedules in accordance with contract requirements.

G. No adjustments to the Contract Price or Contract Time will be made under the provisions of the General Conditions or this paragraph 3.03 for any suspension, delay or interruption (i) to the extent that performance would have been so suspended, delayed or interrupted by any other cause, including the fault or negligence of the Contractor; or (ii) for which an equitable adjustment is provided or excluded under any other provision of the Agreement. Further, no suspension of Work or delay will justify an increase in Contract Price or Contract Time unless the resulting Delay exceeds the time allowed in the Contract Documents for the act or failure to act.

H. To the extent that compensation for delays is permitted under the General Conditions, for critical path delays to any of the Contract Times due solely to the causes specified under paragraph 3.02.A or 3.02.B, and to the extent that the Work would not have been delayed due to any cause not within the responsibility of the Owner, Contractor may include in its timely properly supported requests for extension of time a Request for Change Order in accordance with the applicable provisions of the Contract General Conditions requesting compensation for additional costs incurred solely due to such critical path delays. However, no request or claim by the Contractor under this paragraph 3.03.H for an adjustment in Contract Time or for compensation for additional costs will be allowed (a) for any Delay or costs incurred more than three (3) Days before the Contractor gives written notice (except for Engineer's written orders to Contractor provided under the provisions of the General Conditions), or (b) if made after final payment. Delay for which compensation may be requested will be calculated as the difference between the dates for achievement of the Contract Times for Substantial Completion and for Final Completion calculated under paragraph 3.03.D.4.c and those calculated under paragraph 3.03.D.4.b.2. Compensation for such delays will be calculated in accordance with the General Conditions and applicable Specification Sections.

I. Owner's exercise of any of its rights under the Agreement and its Contract Documents, including requirement of correction or re-execution of the Work, regardless of the extent, number or frequency of Owner's exercise of such rights or remedies, will not under any circumstances be construed as interference with the Contractor's performance of the Work or as providing grounds for the Contractor to seek extensions of Contract Time or damages for delay of the Project.

J. Extension of the Contract Time will be the Contractor's sole remedy for any delay due to any of the causes identified under paragraph 3.02.C. In no event will the Contractor be entitled to any compensation or recovery of any damages in connection with any delay under paragraph 3.02.C, including, without limitation, extended overheads, extended general conditions, consequential damages, lost opportunity costs, impact damages or other similar remuneration.

K. For delays due to any of the causes identified under paragraph 3.02.D, or for acceleration to overcome such delays, Contractor will not be entitled to any increase in Contract Price and/or Contract Time, and the Contractor will assume all resulting direct, indirect and consequential costs, of both the Owner and Contractor.

L. If Contractor fails to complete the Work within any of the Contract Times due to delays within the responsibility of the Contractor, Owner may in its sole discretion (a) proceed to terminate the Contract for cause in accordance with the provisions of the General Conditions or (b) unilaterally issue a Change Order that both increases the Contract Time to the extent that Engineer determines necessary for completion of the Work, and provides a commensurate reduction in the Contract Price calculated as the cumulative total of the product of the number of days by which each Contract Time is extended due to delay within the responsibility of the Contractor times the daily liquidated damage rate that would have been applicable under the Contract had the Contract Time not been extended; or (c) execute a bilateral Change Order mutually agreed upon between Owner and the Contractor, to extend the Contract Time and compensate Owner for its damages; or (d) exercise any other rights available to the Owner under the Contract or by law or equity. If a Change Order or Construction Change Directive results in reduction of the Contract Price to an amount less than the cumulative total paid by Owner, Contractor will provide to the Owner a cash refund of the excess amount paid.

M. To the extent that the Owner authorizes (a) changes in the Work or (b) agrees to changes in Contract-required constraints or sequences, or (c) takes other actions that result in critical path reductions in the Time required to perform the Work, Owner will be entitled to commensurate reductions in the Contract Time and the Contract Price, or alternatively, if so directed by the Engineer, a period of Owner's float may be incorporated into the CPM Schedule for the Owner's exclusive use to mitigate delays within the responsibility of the Owner. Owner will provide notice to Contractor together with a critical path schedule analysis demonstrating the extent of reduction in any of the Contract Times, or the quantum of Owner's float created.

N. Notwithstanding anything contained herein to the contrary, Contractor acknowledges that no extensions of the Contract Time or increase to the Contract Price will be permitted except as approved in advance by Owner's execution of a Change Order in accordance with the executed Contract.

O. Each Subcontractor and supplier/vendor will be bound by the foregoing provisions.

3.04 ACCELERATION OF PERFORMANCE

A. Owner may direct acceleration of performance in accordance with the provisions of the General Conditions. Upon receipt of a written order from the Engineer directing acceleration of performance for the Owner's convenience, Contractor will consult with the Engineer regarding measures available to accelerate the work and will take such measures as the Engineer will direct, including for example resequencing of the CPM schedule, increasing concurrency of activities, increasing staff, accelerating submittals and material deliveries, and employing overtime work as so ordered.

B. If Contractor believes that schedule recovery is necessary due to delays that are not within the responsibility of the Contractor, the Contractor will provide prompt notice and a request for Time extension in accordance with paragraphs 3.02 and 3.03. Before acting to accelerate the work, Contractor will furnish to Engineer a written notice of planned acceleration specifying the actions that Contractor intends to take and the reasons therefor. Owner will bear no responsibility for costs incurred by the Contractor for schedule recovery efforts:

1. before providing such notice to the Engineer; or

2. to the extent of delays that are within the responsibility of the Contractor.

In any case, when performing efforts to recover delays that Contractor believes are the responsibility of the Owner, Contractor will maintain cost records in accordance with applicable requirements of the General Conditions and will submit for Engineer's signature daily time sheets showing overtime premiums paid. To the extent that Contractor demonstrates to Engineer's satisfaction that

1. Contractor had timely submitted a request for Contract Time extension justifying an extension of Time;
2. an extension of Time was justified under the Contract but not granted by Owner;
3. that the cause of the delay was not mitigated;
4. Contractor provided notice as specified before undertaking acceleration; and
5. that Contractor incurred additional overtime costs to accelerate its Work solely to recover such delay, Owner will reimburse as additional compensation only the premium cost of such overtime work, as shown on the time slips checked and approved each day by the Engineer, and no overhead, profits, costs, commissions, claims for inefficiencies or otherwise, or other costs or claims will be charged or due with respect to use of overtime work or the acceleration of performance.

C. Each Subcontractor will be bound by the foregoing provisions.

3.05 USE OF FLOAT

A. Total Float and Contract Float, whether expressly disclosed or implied by the use of float suppression techniques, are not for the exclusive benefit of the Contractor or Owner and will be available to both the Contractor and Owner.

B. The amount of Total Float available for sharing by the Owner will not be artificially reduced through the Contractor's unreasonable use of float suppression techniques. Total Float hidden using such techniques as preferential sequencing, late starts of follow-up trades, small crews, extended durations, imposed dates, scheduling Work not required for a Contract Time as if it were required Work, and so forth will be Total Float otherwise available for sharing with the Owner.

C. If the Engineer determines that the Contractor is utilizing unreasonable float suppression techniques and preferential sequencing (including, but not limited to late starts of follow-on trades, unreasonably small crews, extended durations, imposed dates, or scheduling Work not required) in violation of the float sharing provisions of the Contract Documents, the Contractor will not be entitled to any changes in Contract Price or Contract Time.

D. Early Completion Schedules: Contractor's bid and the Contract Price will be premised upon completion exactly on the Contract Time, without any contemplation of early completion. Contractor will not have a right to finish early. Submittal of a CPM Schedule having an early completion date for any Contract Milestone that is before the corresponding Contract Time will constitute Contractor's agreement that all days between the scheduled early completion date and the Contract Time constitute contract float available to both parties to absorb delays that occur due to any cause. Delays that do not extend the Work beyond the Contract Time will not justify an extension of Contract Time nor will the Owner have any liability under any circumstances for any delay from a planned early completion date.

END OF SECTION

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SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

A. Contractor will submit Shop Drawings, product data, and samples, as required by the individual Specification sections, to the Engineer for review in accordance with the provisions of Section 00 72 00 - General Conditions.

1.02 PROGRESS SCHEDULES

A. Contractor will 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 the Engineer.

1. Submit proposed Progress Schedules to the Engineer prior to the Pre-Construction Meeting.

2. Distribute hard copies of the Progress Schedules to attendees during the Pre-Construction Meeting for discussion.

3. Update the Progress Schedule submit electronically (in PDF format) to the 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. Submit one (1) electronic copy in PDF format of the Shop Drawing Schedule indicating the individual items and submission dates to the Engineer.

1. Submit a preliminary Shop Drawing Schedule in accordance with the requirements in Section 00 72 00 prior to the Pre-Construction Meeting.

2. Distribute hard copies of the Shop Drawing Schedule during the Pre-Construction Meeting for discussion.

3. Submit a final electronic copy of the Shop Drawing Schedule (in PDF format) at least 10 calendar days prior to submitting the first Application for a Payment.

1.04 SCHEDULE OF VALUES

A. Submit one (1) electronic copy in PDF format Schedule of Values of the Work to the Engineer.

1. Submit a preliminary Schedule of Values prior to the Pre-Construction Meeting.

2. Distribute hard copies of the Schedule of Values during the Pre-Construction Meeting or discussion.

3. Prepare a final Schedule of Values (in PDF format) in accordance with the Section 00 72 00 in sufficient detail to serve as the basis for payments during construction. Submit the Schedule of Values to the Engineer for review at least 10 calendar days prior to submitting the first Application for Payment.

1.05 APPLICATIONS FOR PAYMENT

A. Submit one (1) electronic copy in PDF format Applications for Payment to the Engineer in accordance with the provisions of Article 14 of Section 00 72 00.

B. Applications for Payment will be made on forms provided by or approved by the Engineer.

1. Samples of the 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 the Engineer.

2. Copies of these forms, with Project specific information completed by the Engineer, will be given to the Contractor at the preconstruction meeting or, if applicable, after approval of the final Schedule of Values.

C. Submit a completed Payment Schedule with an executed Contractor's Application for Payment and Contractor's Declaration to the Engineer not more than once per month.

D. Engineer will certify payments with the use of Engineer's Certificate for Payment.

1.06 SHOP DRAWINGS

A. Shop Drawings will be presented in a clear and thorough manner. Details will be identified by reference to plan sheet number, detail number if applicable, and specification Section number, and article number.

1.07 PRODUCT DATA

A. Present Product Data in a clear and thorough manner identified the same as the Shop Drawings. Included with the information will be performance characteristics and capacities depicting dimensions and clearances required.

B. Manufacturer's standard schematic drawings and diagrams will be modified to delete information which is not applicable to the Work. Manufacturer's standard information will be supplemented to provide information specifically applicable to the Work.

1.08 SAMPLES

A. Samples will 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.

1.09 SUBMISSION REQUIREMENTS

A. Make Submittals in accordance with the approved Submittal 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. Submit an entire package of Shop Drawings and Product Data information for major items of Work so that the Engineer can review the package as a unit.

C. 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 must initial or sign Shop Drawings and Product Data submittals, certifying the Contractor's review and approval of Submittal per Section 00 72 00; 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 will initial or sign Shop Drawings and Product Data submittal and will indicate the status of the Submittal, or requirements for resubmittal. Engineer will return to the Contractor one (1) electronic copy of the Shop Drawing and/or Product Data submittal (in PDF format) for distribution or for resubmission.

1.10 ENGINEER'S REVIEW

A. Upon receipt of any Submittal defined above, the 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 Section 00 72 00.
3. Respond to the submittal within 15 calendar days of receipt from Contractor.
    a. Contractor to allow for increased time for large or complex submittals; up to 30 calendar days may be required for major equipment and materials or Submittals which require review by more than one engineering discipline.

B. After review of any Submittal, the 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:
    a. Approved
    b. Approved as Noted
    c. Revise and Resubmit
    d. Rejected - See Remarks
    e. For Record Only
2. Notations for Response Required by Contractor:

a. None

b. Confirm

c. Resubmit

D. Notation Meanings:

1. Elements marked "Approved” indicate that the Contractor may commence with construction, fabrication or purchase of such items.

2. Elements marked "Approved as Noted" may require further action by the Contractor before commencing with construction, fabrication or purchase:

a. Contractor proceeds in strict accordance with the Engineer’s notes and/or required corrections/deletions/additions indicated thereon;

b. Contractor provides an appropriate response as may be noted by the Engineer.

3. Elements marked “Revise and Resubmit” indicate that further comments or explanations have been affixed to the Submittal, which may require action(s) by the Contractor before Engineer will mark the Submittal "Approved" or "Approved as Noted."

4. Elements marked "Rejected - See Remarks" indicate that the Contractor must make the required corrections as shown or noted and resubmit such items to the Engineer for further review.

5. Elements marked "For Record Only" indicate that the Engineer has not reviewed the Submittal and will maintain the information submitted as part of the project record.

6. Elements marked “None” indicate that the Submittal requires no further action by the Contractor.

7. Elements marked “Confirm” requires the Contractor to provide affirmation to the Engineer regarding comments, notes, markings, etc. made by the Engineer, and to affirm that the Contractor will comply with the comments, notes, markings, etc.

8. Elements marked “Resubmit” indicate that the Contractor may not commence with construction, fabrication or purchase of such items, and that the 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 the Engineer.

1.11 RESUBMISSION REQUIREMENTS

A. Contractor will make corrections or changes in the Submittals required by Engineer and resubmit. Contractor will indicate any changes which have been made other than those requested by the Engineer.

1.12 MANUFACTURER'S OPERATION AND MAINTENANCE DATA

A. 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 will have submitted one (1) acceptable copy to the Engineer for review.

B. Final copies of the operation and maintenance data will be bound in a suitable number of 3-inch or 4-inch, 3-ring hard cover binders. Permanently imprinted on the cover will be the words "Manufacturer's Operation and Maintenance Data", Project title, location of the Project, and the date. A table of contents will 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 will include, but not be limited to, detailed equipment drawings; sections cut through all of the major equipment and sub-assemblies; 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 will be provided for each piece of equipment in the section.

1. The schedule will 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.

1.13 AUDIO/VIDEO ROUTE SURVEY

A. When required in Section 00 42 43 - Proposal or Section 01 11 00 - Summary of Work, furnish the 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, review with Engineer the Project requirements to ensure that the audio/video is adequate for its intended purpose. Owner will have the authority to designate areas for which coverage may be added or omitted. The audio/video recording will be done prior to placement of materials or equipment on the construction area and furnished one (1) week prior to the pre-construction meeting.

C. Format:

1. Audio/Video route survey will be submitted in the format(s) as specified in Section 01 11 00.

a. Audio/video route survey submission will be on USB media

b. Format: USB – Video

c. Video Encoding: Highest available bit rate (6-9 Megabit), 60 fields per second interlaced video

d. Audio Encoding: Uncompressed stereo wave or stereo Dolby Digital (256 kilobit or better)

e. Aspect Ratio: 4x3 (720x480 pixels)

f. No Macrovision or other copy protection encoding. No region code or region code 1.

D. Complete coverage will include 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 will include, but not be limited to, existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culvert, headwalls, retaining walls, and buildings located within such zone of influence. Video coverage will be clear enough to identify cracks, depressions, holes and other defects in existing surfaces.

E. Houses and buildings will 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 will be identified by audio or visual means at intervals not-to-exceed 100 linear feet (30 m) in the general direction of travel.

F. When conventional wheeled vehicles are used, the distance from the camera lens to the ground will 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 will not exceed 30 feet/minute (10 m/min). Panning rates and zoom-in, zoom-out rates will be controlled sufficiently such that stop action during play-back will produce clarity of detail of the object viewed.

G. 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 will consist of hours, minutes, and seconds, separated by colons. For example, hh:mm:ss.

H. 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.

I. Recording will be done during times of good visibility. No recording will 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 the Owner.

J. In some instances, audio/video coverage may not be suitable for recording necessary details. In such instances, the Owner may specify still photographs to provide coverage. One (1) color photograph will be provided in accordance with this Section with a suitable description of the photograph’s location.

K. Any portion of the Audio/Video Route Survey of insufficient quality as determined by the Engineer will be redone by the Contractor at no additional cost to the Owner.

L. Each USB will be properly identified with the Project Title, location, time, and date in a manner acceptable to the Owner.

1.14 PHOTOGRAPHS

A. When required in Section 00 42 43 - Proposal or Section 01 11 00 - Summary of Work, furnish the 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 Section 01 11 00 - Summary of Work.

B. Photos will be in digital format (i.e., JPEG, TIFF, GIF, PNG or PDF) and will have a minimum resolution of 300 dpi.

C. The following information will 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. Submit photographs monthly along with the Application for Payment as described in Article 14 of Section 00 72 00.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01 45 00
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 individual specification Sections and the Contract Documents. Contractor will furnish such facilities as Engineer may require for collecting, storing, and forwarding samples to the designated laboratory. Contractor will furnish the required samples to the Owner without charge.

1.02 TESTS OF MATERIALS

A. Materials in the Work will meet the requirements of the Contract Documents.

B. Tests of materials will be made as specified herein. Engineer will at all times 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.

C. Materials will 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.

D. The standards for testing materials unless otherwise specified, will 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.

E. The sampling and testing of all materials not specifically mentioned will be done by generally accepted methods, unless otherwise specified by Engineer.

1.03 INSPECTING AND TESTING LABORATORY SERVICES

A. Contractorwill appoint, employ, and pay for specified services of an independent firm (to be approved by Engineer) to perform inspecting and testing, as required. Included is concrete testing for all structural concrete, inspection and testing for pile foundations, all soil compaction testing, concrete pavement testing and bituminous pavement density testing.

B. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by Engineer or Owner.

C. 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.

D. 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.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify Engineer and independent firm 48 hours prior to expected time for operations requiring services.

2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing or inspecting does not relieve Contractor of performing Work to contract requirements.

G. 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 paid for by Contractor.

1.04 CERTIFICATION OF MATERIALS

A. At the request of the Engineer, the Contractor will provide the 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 Contract Documents for quality control, which is required to establish quality of materials, equipment or fabricated items, will be paid for by the Contractor unless otherwise noted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SITE ACCESS AND PARKING

A. Contractor will 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 will be hard surfaced unless otherwise approved by the Engineer.

B. Contractor will maintain driveways a minimum of 15 feet (5 meters) wide between and around combustible materials in storage and mobilization areas.

C. Contractor will maintain traffic areas as free as possible of excavated materials, construction equipment, products, snow, ice, and debris.

D. Contractor will 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, the Contractor will submit for review a schedule and list indicating the streets and roads within the municipality that Contractor's equipment will use off the Project site.

B. Contractor will comply with safety requirements, weight restrictions and speed limits.

C. Gravel and dirt roads or streets used will be maintained by grading, placing dust palliatives and maintenance gravel in sufficient quantities to eliminate dust and maintain traffic.

D. Paved streets will be maintained in a reasonable state of cleanliness and the Contractor will remove accumulations of debris, dirt or mud caused by Contractor's operations. Removal will be done in such a manner as to prevent the release of dust. This will be done at least every day at the close of each day's operation or additionally when requested by the Engineer.

E. Roads or streets damaged by the Contractor’s operations, will 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, the Contractor may be required to deposit with the agency having jurisdictiona cash Road Protection Bond. This Bond, if required, will be held in escrow until final release is given by the agency having jurisdiction.

1. In the event the Contractor fails or neglects to maintain or restore the streets to the satisfaction of the agency having jurisdiction, the agency having jurisdiction will have the required maintenance or restoration work done and the cost incurred will be deducted from the Road Protection Bond.

2. At the completion of the Project, the agency having jurisdiction will return the Road Protection Bond less any monies expended by the agency having jurisdiction and will render to the Contractor an accounting of all monies so expended.

G. Contractor will not store any equipment, supplies, construction material or excess excavated material on any roads or streets unless otherwise approved by the Engineer.

1.03 EMERGENCY ACCESS

A. Contractor will at all times 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. Areas damaged by emergency vehicles will be restored by the Contractor at no additional cost to the 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, the Contractor will 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 the Engineer, the public safety is in danger or the necessity exists for maintaining traffic, the 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 will be backfilled with native material to provide for the necessary maintenance of traffic and safety; however, the native material will be removed within 48 hours and the trench properly backfilled as specified.

B. Contractor will provide written notice to residences and businesses of driveway access interruption 72 hours in advance of interruptions.

1. Written notices require approval for distribution from the Engineer.

2. Contractor will provide the Engineer with copies of notices at least five (5) working days in advance of their distribution for review and approval.

C. Where private roads are encountered throughout the community, the Contractor will maintain those portions affected by its construction operations in a passable condition. These roads will be maintained by the use of 21A road maintenance gravel, stone or slag.

1. In the event the original subbase has been destroyed, the Contractor will furnish and install1-inch to 2-inch aggregate to stabilize the existing subbase.

D. Upon completion of the construction activities, the Contractor will 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 will be responsible for complying with the requirements of the Railroad Company for all Work of the Project and/or temporary crossings for trucking routes. Unless otherwise provided by an item of these Specifications, the Contractor will 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 will 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, the Contractor will provide the 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, the Contractor will 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 will designate one responsible employee to carry out the requirements of this condition.

C. During the time that the road is closed, the Contractor will make provision for trash, leaf, and rubbish (garbage) pickup.

1.07 MAINTAINING TRAFFIC

A. Contractor will provide access for local traffic to property along the Project by means of temporary roads, drives, culverts or other means approved by the Engineer. Contractor will 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 will be graded, surfaced, treated for dust, constructed, or reconstructed, as specified herein or as shown on the Plans.

C. If the construction work is suspended due to weather conditions, winter shut down or for any other reason, sufficient labor, materials and equipment will be ready for immediate use at all times for the proper maintenance of traffic. Surfacing materials and dust palliatives will be applied at such times and locations and in such amounts as necessary to safely maintain traffic and as determined by the Engineer.

D. Where shoulders are low, high, soft or rough, adequate provisions will be taken to inform and protect the traveling public by means such as construction warning signs, barricades, lighted devices, etc. Such shoulder hazards will be eliminated as soon as practicable.

E. Contractor will 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".

1. Furnish all flagmen and watchmen as are necessary to maintain and safeguard traffic along the entire Project. Failure to comply with these requirements may be cause for the Owner to issue a stop Work order, which will remain in effect until all necessary devices are in place and operational. The issuance of a stop Work order will not be reason for granting additional compensation or an extension to the Contract Time.

2. Furnishing, installing, and maintaining traffic control devices will 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 will be taken down until the agency having jurisdiction over the roads has been notified and arrangements for the immediate reinstallation has been made. Contractor will provide temporary signs, traffic control devices,

warning devices, or watchmen continuously from the time the item is removed until it is reinstalled. Signs removed will be replaced with signs meeting requirements of the agency having jurisdiction over the roads.

1.09 TEMPORARY ELECTRICITY AND LIGHTING

A. Contractor will 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 will pay all costs of electrical power used.

B. Electrical wiring and distribution will 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 will also be available for the use of the 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 will pay all costs for installation, maintenance and removal, and service charges for local calls to provide service for Contractor's construction site office as well as for the Engineer's field office. Toll charges for calls relating to Project business will be at the Contractor's expense.

1.11 USE OF WATER

A. Contractor will acquire permits, post bonds and pay fees required by the local agency having jurisdiction prior to using any hydrant or any other source of water.

B. Contractor will reimburse the local community for all water consumed during course of the Project at the current rate as set by the agency having jurisdiction.

1.12 SANITARY PROVISIONS

A. Contractor will be responsible for installation, maintenance and removal of temporary sanitary facilities per MIOSHA regulations for use of construction personnel including the Owner and Engineer. Rules and regulations of the State and local health officials will be observed, with precautions taken to avoid creating unsanitary conditions.

1.13 POTABLE WATER

A. Contractor will furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including the Owner and Engineer.

1.14 MEDICAL SERVICES AND FIRST AID

A. Contractor will 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 the Owner and Engineer. Contractor will also furnish a communication system for contacting emergency services. The telephone numbers of the physician, hospital, or emergency services will be conspicuously posted at the job site.

1.15 POSTAL SERVICE

A. Residents in 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, the Contractor will 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, the Contractor will furnish new posts for the mailboxes if the existing posts are broken or rotted to the extent that they cannot be reused.

C. Any mailbox damaged by the Contractor's operations or by anyone else while the box is down due to the Contractor's operation, will be replaced by the 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.

D. The cost for relocating mailboxes will be incidental to the Project unless otherwise specified in Section 00 42 43 - Proposal.

1.16 NEWSPAPER DELIVERY

A. Residents in this Project area may receive their newspapers at roadside tubes. Since the resident arranges for newspaper delivery, the Contractor will notify the resident 24 hours prior to removal of any newspaper tube.

B. Newspaper tubes damaged by the Contractor while carrying out Contractor's operations or by anyone else while the tube is down due to the Contractor's operation, will be replaced as agreed between the Contractor and the newspaper who owns the damaged tube. The cost will be incidental to the Project.

1.17 BUS STOPS AND SHELTERS

A. Prior to the start of any construction, the Contractor will notify the transit authority that has bus stops within the area of the Work. Removal, relocation and/or replacement of signs and/or benches will be the responsibility of the Contractor in accordance with any requirements of the transit authority. The cost will be incidental to the Project.

1.18 ENGINEER'S FIELD OFFICE

A. When called for in the Summary of Work, Section 01 11 00 - Summary of Work, the Contractor will furnish and maintain, for the exclusive use of the Engineer, an approved weatherproof building as a field office. The building will be located as directed by the Engineer, in full view of the Work and with at least one (1) window facing construction operations.

B. Engineer’s field office will meet the following minimum requirements:

1. securely fixed to foundation
2. structurally sound and watertight
3. stairs and landings for doors as necessary
4. three hundred (300) square feet (28 m2)
5. three operable and locking windows with screens and storms.
6. two locking, standard sized, entrance/exit doors
7. two telephone lines

8. two telephone jacks for each line
9. one telephone
10. one facsimile machine
11. 120 volt electrical service per NEC, complete
12. one 36" x 42" (1m x 1.1m) drafting table
13. one drafting stool
14. one 30" x 60" (.75m x 1.5m) desk
15. one four drawer locking file cabinet
16. two desk chairs
17. one plan rack (minimum capacity eight plan sets)
18. one first aid kit
19. one 10A:80-B:C fire extinguisher
20. automatically controlled heating, ventilating, air conditioning system to maintain temperature between 68 and 76 degrees Fahrenheit, year round.

C. Contractor will furnish and maintain bottled water and sanitary facilities for the field office. Contractor will clean the office at least once per week. Contractor will provide and pay for all utility service throughout the duration of the Project, including telephone service and long distance telephone service.

D. A trailer having equal facilities and floor space may be used in place of the above described field office if so desired.

E. The field office will be furnished with a minimum of an aggregate surfaced driveway and parking area, for the exclusive use of the Engineer, for at least three (3) vehicles. Contractor will maintain parking area including snow removal.

F. The cost for furnishing and installing the field office, for furnishing utilities and utility service, and for maintenance of the field office and facilities, unless otherwise specified in the Proposal, will not be paid for separately but will be included in the price bid for various items of Work under the Contract. The building will be removed by the Contractor upon completion of the Contract and will become Contractor's property.

1.19 BY-PASS PUMPING

A. Contractor will maintain flow in existing sanitary and storm sewers by pumping, bypassing, or fluming, as necessary. During wet weather events, the flow in the sewer will rise rapidly and may become surcharged. Contractor will maintain flow in such a manner as the existing flow can be adequately transported including wet weather flow. Contractor will 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 will be PVC Schedule 80, ABS truss pipe, equivalent with solvent welded joints, HDPE with butt fused joints, or approved equivalent. Flexible hoses

of whatever types are not acceptable. Bypassed flow will be discharged to a sanitary sewer of acceptable size to handle the bypassed and existing flows. Contractor will plan construction operations such that there will be no backups, leaks, or discharges of pollutants.

C. Contractor will furnish and have available on-site, redundant pumping facilities in case of any failure of the pumping system including pumps, piping, electrical, connections, etc. Redundant pumping facilities also include having a backup power generator in case the primary power source fails. Contractor will 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 by-passing flow will be included in the unit price bid for other items of Work unless otherwise specified in the Proposal.

E. Contractor will submit a by-pass pumping/diversion scheme to the Engineer for approval not less than 15 calendar days prior to any anticipated by-pass pumping/diversion. The by-pass pumping plan will 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 will 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

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SECTION 01 51 18
TEMPORARY WATER MAIN

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes construction of temporary water main and water service connections to existing homes to supply water while the existing water main is out of service.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 89 00 - Site Construction Performance Requirements

B. Section 31 23 33 - Trenching and Backfilling

C. Section 33 14 00 - Water Utility Distribution Piping

1.03 REFERENCE STANDARDS

A. ASTM B88 - Standard Specification for Seamless Copper Water Tube

B. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

C. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

D. ASTM F477 - Standard Specification For Elastomeric Seals (Gaskets) For Joining Plastic Pipe

E. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing

F. AWWA C651 - Disinfecting Water Mains

G. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

H. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service

I. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 65 In. (100 mm through 1650 mm), for Waterworks

J. NSF/ANSI 14 - Certification of Plastic Piping Products

K. NSF 61 - Drinking Water System Components - Health Effects

1.04 SUBMITTALS

A. Submit shop drawings, catalog data, and manufacturer’s technical data showing complete information on the materials, specifications, composition, physical properties, and dimensions of pipe and fittings.

B. Submit detailed drawings showing detail and written descriptions of methods of connections of temporary water main to fire hydrants and connection temporary water services to houses.

Include entire construction process, disinfecting, testing, protection of piping, timing sequence, and related Work.

1.05 QUALITY ASSURANCE

A. Polyethylene pipe jointing will be performed by personnel trained in the use of butt-fusion or electro-fusion equipment and recommended methods for new pipe connections.

1.06 COORDINATION

A. Owner will locate and mark water service curb stops along the route of the temporary water main.

B. Verify operation of each curb stop prior to beginning work. When authorized by Engineer, remove and replace, or repair, existing curb stops and/or curb boxes as necessary to complete the Work. This work will be paid for as specified in the Proposal.

1. If curb boxes are plugged with dirt, broken, or misaligned in such away that the curb stop can not be accessed and turned, remove curb box and reset.

2. If curb stops are inoperable, remove and replace existing curb stop with a new curb stop.

C. Coordinate with Owner, Engineer, and local Fire Department at least 24 hours prior to shutting down existing water main.

1.07 DESIGN REQUIREMENTS

A. Temporary water main will be PVC or Polyethylene pipe unless otherwise approved by Engineer.

B. Temporary water main will be of the minimum diameter as specified below:

1. 2-inch diameter for systems with 10 or less residential connections (3/4-inch).

2. 4-inch diameter for systems with 50 or less residential connections (3/4-inch).

3. 6-inch diameter for systems with 51 or more residential connections (3/4-inch) but not more than 80 connections.

4. Minimum size of the temporary water main will be upsized as appropriate for services larger than 3/4-inch or more than the maximum allowed number of connections.

1.08 NOTIFICATION

A. Notify Owner and water users affected by the work a minimum of seven days prior to beginning work. Notification will be by means of a written notice on Owner letterhead, delivered to each user by Contractor, and will advise user as to when water service will be interrupted and to minimize water usage during this period. Ensure that every user is so notified. Notification will include telephone number(s) for contacting Contractor at any time, day or night.

B. A second written notice to the water users affected will be provided by Contractor one working day prior to the actual switch over from the existing water main to the temporary water main.

C. Provide a completion notice to each user within 12 hours of restoring water service to the re-lined water main.

PART 2 PRODUCTS

2.01 POLYETHYLENE PIPE

A. Polyethylene pipe will be AWWA C906 high-density polyethylene pipe, minimum Pressure Class 160 (SDR 11). Pipe will be clean and approved for potable water, and meet the requirements of NSF/ANSI 14 and NSF 61.

1. Fittings: Tees, crosses, bends, plugs and corporation stops will be Butt Heat Fusion Type, SDR 11, per ASTM D3261 or Electrofusion Type, per ASTM F1055. Fittings for joining HDPE pipe to Ductile Iron pipe or PVC C900 pipe will be fully restrained, Mechanical Joint Adapters.

2. Pipe Joints: Butt Fusion Welded or Electrofusion Welded. Joints will meet the leakage test requirements of Section 33 14 00 - Water Utility Distribution Piping.

3. Water Service Taps: Electrofusion corporation saddles with 1-inch brass outlet threads and brass corporation stop.

2.02 PVC PIPE

A. PVC pipe will be AWWA C900, restrained joint, PVC plastic, minimum Class 200 (DR 14) or ASTM D2241, SDR 17, restrained joint PVC meeting the requirements of NSF/ANSI 14 and NSF 61. Pipe will be clean and approved for potable water.

B. Pipe Joints: Non-Metallic, restrained joint couplings with high-strength, flexible, thermoplastic spline retainers. Retainers will be inserted into mating precision machined grooves in the pipe and coupling to provide full 360-degree restraint. Couplings will be designed for use at the rated pressures of the pipe and will incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints will meet the leakage test requirements of Section 33 14 00 - Water Utility Distribution Piping.

C. Fittings: PVC, AWWA C900, Pressure Class 200 (DR 14).

D. Water Service Taps: Bronze corporation stops with AWWA corporation stop inlet thread and thread outlet compatible with the water service pipe used.

2.03 WATER SERVICE PIPE

A. Water service pipe connecting houses to the temporary water main will be minimum 3/4-inch diameter.

B. Polyethylene, AWWA C901, Pressure Class 125, minimum 1-inch diameter with mechanical restrained fitting.

C. Soft Copper, ASTM B88, Type K, with flared fittings.

D. 1-inch NSF 61 approved hose with brass couplings.

2.04 CURB STOPS AND CURB BOXES

A. Curb stops and curb boxes will be as specified in Section 33 14 00 - Water Utility Distribution Piping.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install temporary water main either above grade or below grade except as outlined below. Above grade pipe including services will be appropriately protected from abuse, damage, vandalism, etc.

B. Temporary water main and services will be covered with a minimum of 6-inches of compacted aggregate at driveways and sidewalks.

C. Temporary water main at road crossings and commercial driveways will be buried.

3.02 CLEANING, FLUSHING AND CHLORINATING

A. After installation and prior to connection to any water supply, temporary water main thoroughly clean and flush until the water runs clear. This includes water service piping.

B. After flushing, provide necessary disinfection of the temporary water main using the slug method:

1. Slowly add chlorine at a concentration of at least 100 mg/L so that mains and appurtenances are exposed to the highly chlorinated water for at least 3 hours.

2. Residual is to be measured at regular intervals at a point no more than 10-feet downstream from the injection point to assure 100 mg/L of free Cl_2 is being fed.

3. Free residual chlorine must be measured as the slug moves throughout the piping and the residual should not drop below 50 mg/L at any time.

C. After the acceptable contact time (3 hours for the slug method) flush out the highly chlorinated until the residual is no higher than that is normally detected within the general distribution system.

D. After two consecutive bacteriological samples are drawn, 24 hours apart, with negative results as outlined above, the water main will be allowed to be put into service.

E. Contractor is responsible for paying fees for bacteriological testing until satisfactory bacteriological sampling and testing is completed.

1. Draw samples of the water from the water main, with Engineer as a witness. Transport the samples for testing, and provide written confirmation of the sample results to Engineer.

2. Sampling will be in accordance with Section 5.1 of AWWA C651.

3.03 CONNECTION TO WATER SUPPLY

A. After successfully chlorinating the water main, connect the water main to the water supply. The temporary water main will be connected to the water supply with a double check backflow preventer.

B. Water service piping will be connected to the existing houses either at the existing curb stop or to a hose bibb. Contractor will be completely responsible for ork required to ensure that each water service has satisfactory water service from the temporary water main prior to removing the existing water main from service.

3.04 SYSTEM MONITORING AND MAINTENANCE

A. Monitor the temporary water main and services and will ensure that the system is functioning as intended and will remedy any defects in water delivery within 3 hours of being notified.

B. Monitor system pressure and ensure that pressure is not lowered due to defects in temporary water main system.

3.05 PROJECT COMPLETION

A. At project completion, after the new water main has been installed, tested, accepted and connected to the water supply and after water services have been connected/reconnected to the new main, the temporary water main and appurtenances will be removed and become the property of Contractor.

END OF SECTION

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SECTION 01 57 13
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 012200 - Unit Prices

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 23 13 - Subgrade Preparation

D. Section 31 23 19 - Dewatering

E. Section 31 23 33 - Trenching and Backfilling

F. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus

B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity

C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles

D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile

F. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Contractor will secure permits, and post 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 US std Sieve , maximum; ASTM D4751.

2. Permittivity: 0.05 sec-1, minimum; ASTM D4491/D4491M.

3. Ultraviolet Resistance: Retaining at least 70% of tensile strength; ASTM D4355/D4355M after 500 hours exposure.

4. Tensile Strength: 100 lb - f minimum, in cross-machine direction;124 lb - f minimum in machine direction; ASTM D4632/D4632M.

5. Elongation: 15 to 30%; ASTM D4632/D4632M.
6. Tear Strength: 55 lb - f minimum; ASTM D4533/D4533M.

B. Posts will be 2 inch cross section hardwood stakes, minimum 3 feet 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 must meet the following minimum requirements unless otherwise specified on the plans.

1. Consist of vinyl laminate on 1000 denier polyester fabric weighing 18 oz per sq yard, minimum.
2. Tensile strength of fabric will be 220 lb - f, minimum.
3. Edges of fabric to be reinforced with minimum 5/8 inch diameter polypropylene rope.
4. Ballast chain minimum 5/16 inch galvanized steel.
5. Buoyancy blocks providing buoyancy of 18 lb - f.
6. Length of curtain (water depth) 5 feet.

2.03 DEWATERING DISCHARGE FILTER BAG

A. UV-stabilized, non-woven geotextile bag to filter sediment from water prior to discharging. Geotextile fabric must meet the following minimum average roll requirements:

1. Tensile Strength: 180 lb - f minimum; ASTM D4632/D4632M
2. Elongation: 50 percent minimum; ASTM D4632/D4632M
3. CBR Puncture Strength: 300 lb f; ASTM D6241
4. Trapezoidal Tear: 70 lb - f; ASTM D4533/D4533M
5. Flow Rate: 80 gal/min/sft Minimum; ASTM D4491/D4491M
6. Permittivity: 1.4 sec -1 minimum; ASTM D4491/D4491M
7. Apparent Opening Size: 80 US std Sieve; ASTM D4751
8. UV-Stability: 70% retained strength; ASTM D4355 after 500 hours.

2.04 EROSION CONTROL BLANKETS

A. Erosion control blankets will not be used on this project. In lieu of these blankets, the Contractor will stabilize the seeded areas using straw crimped into the ground using a mulch anchoring tool (disc with vertical coulters) or by hydroseeding with a cellulose or wood fiber mulch.

2.05 BONDED FIBER MATRIX

A. Bonded fiber matrix (BFM) will consist of long strand, residual, softwood fibers joined together by a high-strength, nontoxic adhesive. BFM will be 100% biodegradable, and be non-toxic to fish, wildlife, and humans. Upon drying the matrix will form a high strength, porous and erosion

resistant mat that will not inhibit the germination and growth of plants. BFM will retain its form despite re-wetting.

B. Bonded fiber matrix will consist of:

1. Seed and Fertilizer per Section 32 92 19.

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 will be mixed at the rate of 80 lbs per acre of PAM binder and 2500 lbs per acre of wood fiber mulch.

2.06 INLET FILTER FABRIC

A. Filter fabric will be constructed of 100% continuous polyester needle-punched non-woven engineering fabric. Filter fabric will be fabricated to provide a direct fit with the drainage structure cover. Filter fabric will have the following minimum physical properties.

B. Tensile Strength:80 lb - f minimum; ASTM D4632/D4632M

C. Elongation: 50 percent minimum; ASTM D4632/D4632M

D. CBR Puncture Strength: 300 lb - f minimum; ASTM D6241

E. Trapezoidal Tear: 70 lb - f minimum; ASTM D4533/D4533M

F. Flow Rate: 80 gal/min/sft minimum; ASTM D4491/D4491M

G. Permittivity: 1.4 sec -1 minimum; ASTM D4491/D4491M

H. Apparent Opening Size: 100 US std Sieve maximum; ASTM D4751

I. UV-Stability: 70% retained strength; ASTM D4355/D4355M 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 will provide erosion protection of surrounding soils.

B. Sedimentation control devices will be installed prior to Contractor beginning Work. Soil erosion and sedimentation control devices must 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 side slopes 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 must be corrected or implemented as site conditions change. Changes during construction must 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 will 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 will 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 APPLICATION OF BONDED FIBER MATRIX

A. The slope will be prepared and graded prior to application of Bonded Fiber Matrix (BFM). Mixture of wood fiber mulch and polyacrylamide binder will be blended, with the appropriate amount of seed and fertilizer per Section 32 92 19, according to manufacturer's recommendations.

B. BFM will be hydraulically applied to the soil as a viscous mixture, crating a continuous, three-dimensional blanket that adheres to the soil surface. BFM will be mixed and applied at the rate as specified in this Section unless otherwise indicated on the Plans.

C. The resulting coverage must be at least 1/8 inch thick over the entire surface area. BFM will be applied in two applications from alternate directions to eliminate shadowing and will be applied when no rain is expected for 12 hours.

3.07 DEWATERING DISCHARGE

A. Should it be necessary for Contractor to do any dewatering during the course of construction, Contractor will filter discharge through a discharge filter bag or other sediment control device that will filter all discharge water.

B. No dewatering discharge will be allowed to flow unfiltered from the construction site.

3.08 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 must 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.

3.09 INSPECTION

A. General:

1. Contractor is responsible to obtain and/or serve as the Certified Operator.

    a. Weekly inspections are to be conducted by Contractor as a minimum, and after every rainfall event. A copy of the inspection report will be submitted to the agency having jurisdiction, as well as Owner and Engineer.

2. Inspections will 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.

3. 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.

4. Inspector must be certified as a “Storm Water Professional” through the EGLE storm water training program. Additionally, the inspector will 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.

1) Situation: waiting for grass to grow, but grass is dormant.

c. Ground is frozen and/or snow covered.

C. Weekly Storm Water Meeting:

1. 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.

2. Contractor will maintain a log of weekly meetings and document the issues addressed in the meetings on site.

D. Agency Storm Water Inspections:

1. A log of inspections by federal, state, or local storm water or other environmental agencies will be kept in Contractor’s SWPPP.

2. 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.

3. Any reports issued will be sent to Engineer within 24 hours.

3.10 PROJECT COMPLETION

A. Remove temporary soil erosion and sedimentation control devices as soon as permanent measures have been established.

END OF SECTION

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SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 TRANSPORTATION AND HANDLING

A. Contractor will 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 will be delivered in original containers or packaging with identifying labels intact and legible.

B. Contractor will provide equipment and personnel at the site to unload and handle materials and equipment in a manner to avoid damage. Materials and equipment must be handled only at designated lifting points by methods to prevent bending or overstressing.

1.02 STORAGE AND PROTECTION

A. Store materials and equipment immediately on delivery, and protect it until installed in the Work.

B. Store products subject to damage by elements in weather-tight enclosures with temperature and humidity ranges as required by manufacturer's instructions.

C. Store loose granular materials on solid surfaces to prevent mixing with foreign matter.

D. Locate the place of storage so as to minimize interference with traffic and to provide easy access for inspection. Do not store materials closer than 5 feet (1.5 meters) to the edge of pavement or traveled way open to the public.

E. Materials that have been stored are subject to retest and must meet the requirements of their respective specifications at the time they are to be used in the Work.

F. 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. Obtain and distribute copies of manufacturer's instructions when the Contract Documents require that installation of Work to comply with manufacturer's instructions. Distribute copies of such instructions to parties involved in the installation, as well as at least 1 copy to the Engineer.

B. 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. Submit a complete list of major products to be used within 4 days, if requested by Engineer. The list will include the name of the manufacturer and the installing subcontractor, if applicable.

1.05 CONTRACTOR'S PRODUCT OPTIONS

A. Select any product meeting the standard for products specified only by reference standard.

B. For products specified by naming several products or manufacturer's, 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," submit a Substitution Request Form for any product or manufacturer not specifically named, in accordance with Section 00 72 00 - General Conditions.

D. For products specified by naming only one product and manufacturer, there is no option.

1.06 EQUIPMENT STARTUP AND TESTING

A. 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 will 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 will be operated both by itself and automatically as a system to verify its proper operation.

C. Contractor is to provide to the Engineer, in advance of startup, a schedule and listing of startup and testing procedures for review by the 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 will make adjustments necessary to ensure correct operation. When required, equipment installation and operation is to be witnessed and checked by manufacturer.

E. When required, the Contractor will train the 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 the Owner and the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 71 23
CONSTRUCTION LAYOUT

PART 1 GENERAL

1.01 RESPONSIBILITY FOR STAKING

A. Owner will set stakes and markers showing the locations on the surface of various parts of the Work as outlined herein. Additional stakes will be provided at the expense of the Contractor. Contractor will furnish such labor and assistance as the Owner may require in setting the same.

B. It will be the responsibility of the 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 will utilize lasers, or surveying instruments run by qualified competent personnel to control the construction installation Work. If the method being used by the Contractor fails to give proper alignment and grade control to the Work, the Owner will be empowered to order the Contractor to use such other method(s) as will provide adequate control.

D. Engineer may require the Contractor, at the 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.

E. In the event the Contractor presumes a staking inconsistency, the Contractor will notify the Engineer immediately to assist in resolving the concern.

1.02 STAKING SCHEDULE

A. Contractor will submit a completed staking schedule on the form provided by the Engineer showing the order in which the Contractor proposes to conduct the construction operation prior to the preconstruction meeting. The schedule will be submitted to the Engineer a minimum of three (3) working days prior to the start of construction.

B. During construction, the Contractor will to the extent possible, limit unnecessary staking requests and coordinate the construction schedule to provide for the efficient and effective use of the survey crew and eliminate excessive survey crew trips to the site.

1.03 LINE AND GRADE

A. Contractor will request, three (3) working days in advance, from the Engineer additional line and grade stakes as the Contractor may reasonably protect and preserve. Such request by the Contractor will 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 the Contractor, or where the Contractor fails to properly preserve construction survey stakes, such resetting or relocations of stakes will be done by the Engineer and paid for by the Contractor on the basis of time and materials for such re-staking.

B. Survey Control Points:

1. Contractor will bear all expense involved in re-establishing and/or resetting any survey control point, land survey point or monument lost or disturbed during Contractor's construction operation. Such Work will be done under the direct supervision of a licensed land surveyor. Such survey control points will be marked and flagged by the Engineer prior to construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 CLEANING

A. Contractor will 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 will be periodically removed from the site and disposed of at legal disposal areas away from the site.

C. Prior to Owner acceptance, Contractor will conduct an inspection of sight-exposed interior and exterior surfaces, and Work areas, to verify that the entire Work is clean.

D. Contractor will broom clean exterior paved surfaces and rake clean other exterior surfaces of the site.

1.02 PROJECT RECORD DOCUMENTS

A. Contractor will deliver one (1) copy of all Specifications, Plans, Addenda, Shop Drawings and Samples, annotated to show changes made during the construction process, to Engineer upon completion of the Work as record documents. Submittal of the record documents will be made with a transmittal letter containing:

1. Date
2. Project Title and Number
3. Contractors Name and Address
4. Title and Number of each Record Document
5. Certification that each Document as submitted is complete and accurate

B. Record Documents will include:

1. Annotations, including changes during the execution of the work resulting from Requests of Information, Field Orders, Change Directives, and the as-built conditions which differ from the proposed plans.
    a. Annotations will include dimensional changes from the proposed plans. Where different from the proposed plans, strike through the proposed dimension and provide the as-built dimension. Changes will be clouded.
    b. Annotations may also be accompanied by sketches, photos, etc., as appropriate, to demonstrate as-built information or conditions.
2. Underground utilities installed as part of the Project and utilities exposed during execution of the Work. Underground utilities will be surveyed to record their location and elevation. Utiliity locations will be based upon available Project data (i.e., coordinate system, benchmarks, etc.).

a. The utility information will include:

1) Straight run data every 100-feet.

2) Bends, valves, fittings, wyes/tees, hydrants, etc.

3) Crossings of other utilities.

C. Record documents will be in Portable Document Format (pdf), full size (i.e., 22" x 34"), in good order and in a legible condition.

D. Prior to delivery of the project record documents, Contractor will submit draft updates on a monthly basis to Engineer for review.

1.03 OPERATION AND MAINTENANCE DATA

A. Prior to final inspection or acceptance, Contractor will fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of products, equipment and systems specified in the Contract Documents.

B. Operation and maintenance data required by the individual Specification sections and the manufacturer's operation and maintenance data required in Section 01 33 00 - Submittal Procedures, will constitute the basis of such instruction.

1.04 START UP

A. Contractor will coordinate efforts between Owner, Engineer, any equipment manufacturers, subcontractors and governing agencies in the start up of applicable portions of the Work.

1.05 WARRANTIES

A. Provide written warranties from the manufacturerfor major equipment supplied under this Contract. The manufacturer’s warranty period will be concurrent with the Contractor’s warranty period. The warranty from the manufacturer will not relieve the Contractor of the one-year warranty starting at the time of Project Substantial Completion. Owner can request written warranties for equipment not classified as major.

1.06 SUBSTANTIAL COMPLETION

A. Certification that the Work is substantially complete will be in accordance with the General Conditions.

1.07 FINAL PAYMENT AND ACCEPTANCE

A. The final inspection, final application for payment and acceptance will be in accordance with the General Conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 89 00
SITE CONSTRUCTION PERFORMANCE REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes general performance requirements for earthwork complete with, 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 57 13 - Temporary Erosion and Sediment Control

B. Section 31 23 13 - Subgrade Preparation

C. Section 31 23 16 - Structural Excavation and Backfill

D. Section 31 23 19 - Dewatering

E. Section 31 23 33 - Trenching and Backfilling

F. Section 32 12 16 - Bituminous Paving

G. Section 32 13 13 - Concrete Paving

H. Section 32 13 15 - Sidewalks and Driveways

I. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. Unless otherwise specified, the Work for this Section will conform to the applicable portions of the following Standard Specifications:

1. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition.

2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with Section 01 57 13 - Temporary Erosion and Sediment Control. Contractor, at Contractor's expense, will 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. Comply with all requirements of theNational Pollutant Discharge Elimination System (NPDES) Storm Water Program for Construction Activities, Part 31 of PA 451 of 1994 as amended.

C. Provide, maintain and remove such temporary and/or permanent Soil Erosion and Sedimentation Control (SESC) measures as specified on the Plans or as determined by the Engineer.

1. Measures will prevent surface runoff from carrying excavated materials into the waterways, reduce erosion of the slopes, and prevent silting in of waterways downstream of the Work.

2. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

1.05 SUBMITTALS

A. Written permission for the use of disposal and borrow sites must be obtained and copies will be furnished to the 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 the Engineer to be removed, will be carefully protected from damage or injury during the various construction operations.

B. Trees, shrubs or other types of vegetation not designated to be removed but which is damaged by the Contractor's operation will be repaired or replaced by the Contractor, at Contractor's expense, as determined by the Engineer.

1.07 PROTECTION OF EXISTING STRUCTURES AND IMPROVEMENTS

A. Carefully protect 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 from damage during the construction operations.

B. Repair or replace existing structure or improvement not designated to be removed that are damaged by the Contractor's operations to the satisfaction of the structure owner, at Contractor's expense.

C. Deposits of dirt or debris in sewers, culverts, tiles, drainage structures, manholes, gate wells, etc. caused by the Contractor at the Contractor’s expense.

1.08 MAINTAINING DRAINAGE

A. Maintain 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 to for continued free discharge during construction. Costs incurred will be incidental to the excavating, backfilling and compacting or grading operations.

B. Repair or replace drainage facilities not designated to be abandoned, but which are damaged, or interrupted by the Contractor's operation immediately at Contractor's expense.

PART 2 PRODUCTS

2.01 GRANULAR MATERIAL

A. Bank run sand must meet 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 msut meet the requirements MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

A. Dewater the area within the vicinity of the new Work prior to commencing any construction activities. The depth of the dewatering will be sufficient to allow the Work area to remain in a dry condition during the various construction operations.

B. The costs incurred for furnishing, installing, maintaining and removing the dewatering equipment will be at the Contractor's expense unless otherwise specified.

C. Refer to Section 31 23 19 - Dewatering for additional requirements.

3.02 GENERAL

A. Construction operations will be restricted to the existing right-of-way or the areas indicated on the Plans. If the Contractor requires additional area, the Contractor must furnish the Engineer with written permission obtained from the property owner for any part of the operation the Contractor plans to conduct outside of the right-of-way or limits indicated.

1. Permission must be granted by the property owner prior to commencing any construction activities or operations outside of the existing right-of-way or designated areas.

3.03 EXISTING IMPROVEMENTS

A. Expose existing sewers and structures to which the new Work is to be connected and notify the Engineer once exposed. Engineer will verify the vertical and horizontal locations of the existing system and will inform the 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, must contact 811 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, the Contractor, at Contractor's expense, will perform construction operations in such a manner that the service will be uninterrupted.

C. Expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. Contractor is 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, the Contractor will make all arrangements with the owner of the utility for the moving. Costs incurred for such moving will be at the Contractor's expense unless indicated otherwise.

1. Before disturbing a utility line, structure or pole, furnish the Engineer with satisfactory evidence, in writing, that proper arrangements have been made with the owner of the utility.

3.05 UTILITY POLES

A. Contractor is responsible for removal or relocation of existing utility poles (including street light poles, guy poles, telephone poles, etc.) required as a result of any conflict with proposed improvements.

B. Arrangements for removing or relocating utility poles with the owner of the utility pole will be the Contractor's responsibility.

C. Prior to disturbing any utility pole, the Contractor will provide the Engineer with written evidence that proper arrangements have been made with the owner of the utility pole.

D. When required by the Work, Contractor will temporarily support poles in the vicinity of the Work, or make arrangement for the utility power owner to temporary support the poles, at no additional cost to the Owner.

1. Support provided by the Contractor will be in accordance with and to the satisfaction of the utility company.

3.06 EXISTING SEWERS, TILE, AND MAINS

A. Restore 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 with new materials equal in quality and type to the materials encountered.

B. Installation of new materials will be as specified in the Contract Documents or in accordance with the agency having jurisdiction. Bedding and backfill material, unless otherwise specified, will be Class II granular material, compacted to 95% of its maximum unit weight, and approved by the Engineer.

C. Seepage bed tile and water mains will be replaced in accordance with the requirement of the agency having jurisdiction.

D. The relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads will be at the 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 will be protected, preserved or restored by the 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 will be employed by the Contractor, at Contractor's expense, to protect the structures.

B. When it becomes necessary for the Contractor to move one of these buildings or structures in order to proceed with construction, the Contractor, at Contractor's expense, will exercise all due care in moving the building or structure to prevent undue damage.

C. Prior to moving an existing building or structure, the Contractor will furnish the 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 will 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, the Contractor, at Contractor's expense, will remove 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, the Contractor will install a masonry bulkhead in the structure.

C. Removal of a culvert or sewer also includes the removal and disposal of any end treatments or headwalls.

3.10 REMOVAL OF STRUCTURES

A. The removal of existing structures will consist of removing and salvaging the existing frame and cover by the Contractor. The ends of the existing pipe will be plugged and braced. The complete structure will be removed entirely and disposed of. The excavation will be backfilled with sand and compacted to 95% of its maximum unit weight. Maximum unit weight will 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 the Engineer, will be installed and maintained by the Contractor, during the rebuilding period.

3.11 ABANDONING STRUCTURES

A. Demolish Break the structure down to at least 30 inches below the subgrade.

B. Pipes connected to the structure will be plugged with a brick, masonry or concrete bulkhead approved by the Engineer.

C. Backfill the structure with flowable fill to 12 inches 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 12 inches below finished grade.

D. Backfill the remainder of the excavation with a granular material, compacted to 95% of its unit weight, and will meet with the approval of the Engineer. Maximum unit weight will be determined by ASTM D698, Method B.

3.12 SALVAGED MATERIAL

A. Salvaged materials will become the property of the Contractor unless otherwise specified in the Contract Documents, and will be disposed of by the Contractor, at Contractor's expense.

3.13 CROP DAMAGE

A. In areas where crops are encountered along the route of the construction, the Contractor will prepare a written agreement between the Contractor and the crop owner as to the type and nature of the crop that may be damaged during construction activities prior to the start of any construction activities within the area.

B. Contractor will be responsible for making full reimbursement to the owner of the crop damage on the basis of the following procedure:

1. The area of the crop damage will be determined by measurements taken by the Engineer, and this area will include those portions of the crop which may extend into the public right-of-way.

2. The County Office of the U.S. Agricultural Extension Service will establish the average yield of the crop.

3. The cost of the crop will be determined by using the prevailing price at the time of harvest as furnished by the U.S. Agricultural Extension Service.

C. Contractor will furnish the Engineer with satisfactory evidence that payment for crop damage was made, prior to receiving final payment on the Project.

3.14 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, the Contractor will plant new trees, in approximately the same location as the existing trees, of size and species per the landscaping plans included in the Plans.

2. Contractor may remove and preserve the existing trees.

a. Trees will 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 wll be replanted in approximately the same location.

c. Any trees damaged, destroyed or which die, will be replaced at no additional cost.

B. Trees, whether replanted or planted new, will be guaranteed for a period of one year(s) from the date of Substantial Completion.

3.15 REMOVING PAVEMENT

A. Removal of concrete and bituminous pavement, as called for on the Plans, consists of removing and disposing of pavement and will include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.

B. Remove pavement to an existing joint or cut parallel to existing pavement joints.

C. Use a power-driven concrete saw, approved by the Engineer, to make cuts. The depth of the saw cut will be a minimum of 6 inches to ensure that the removal of the old pavement will not disturb or damage the section of pavement remaining in place.

D. Residual concrete pavement will not be less than 5 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, cut the full depth of the bituminous surface with a power-driven saw, approved by the Engineer, along a line parallel to and at least 12 inches from either side of the base course removal.

F. Old pavement with a concrete cap will 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.

G. Removal of Curb for Curb Drop:

1. Where curb is to be removed for a curb drop, the operation will be performed either by saw cutting or by cold milling that has been approved by the Engineer, so as to leave a neat surface with a maximum 1 inch lip, without damage to the underlying pavement.

H. Removal of Curb and Gutter:

1. Where curb and gutter are to be removed, the operation will be performed by saw cutting. The limits of the removal will be as shown on the Plans or as approved by the Engineer. However, in no case will the width of removal be less than 18 inches for sections with rolled or straight curb or less than 24 inches for mountable curbs.

I. 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 will be removed and replaced at the Contractor's expense.

J. Earth removed during the pavement removal operation will be replaced by backfilling to the proposed subgrade with a suitable material, approved by the Engineer, at the Contractor's expense.

3.16 GUARDRAIL

A. Relocate or remove beam guardrail as specified on the Plans or as determined by the Engineer. If the existing material is damaged or destroyed, the Contractor will replace the material at Contractor's expense.

B. Where guardrail is encountered during construction and is removed by the Contractor when its removal was not called for on the Plans, the guardrail will be replaced or restored, at the Contractor's expense, to a condition comparable to that prior to construction.

C. After the guardrail removal or relocation operations are complete, surplus material will be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.

D. Backfill holes or voids resulting from the guardrail removal operation with a Class II granular material that has been approved by the Engineer.

3.17 FENCES

A. Remove and replace fences as indicated on the Plans. If any of the existing material is damaged or destroyed during the Contractor's activities, the Contractor will replace the damaged material at Contractor's expense.

B. Where fencing is encountered during construction and removed by the Contractor when its removal was not called for on the Plans, the fenceing will be replaced or restored, at the Contractor's expense, to a condition comparable to that prior to construction.

C. After the fence removal or relocation operations are complete, surplus material will be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.

D. Backfill holes or voids resulting from the fence removal operation with a suitable material that has been approved by the Engineer.

E. Where fences are encountered that are being used to confine livestock or to provide security, the fence must be immediately replaced following construction. During construction, the Contractor, at Contractor's expense, must provide, install and maintain a temporary fence that has been approved by the Engineer.

3.18 HOLES

A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, will be replaced by backfilling to the proposed subgrade with a suitable granular material. The material will be placed by the controlled density method or other effective means having the approval of the Engineer and will be compacted to 95% of maximum unit weight.

B. Furnishing, placing and compacting of the backfill material will be at the Contractor's expense.

3.19 RESTORATION IN RIGHT-OF-WAY AND YARD AREAS

A. Restore right-of-way and yard areas not paved or aggregate surfaced 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 the Engineer to achieve the cross section, line and grade shown on the Plans. Areas where slopes are 1 on 4 or flatter will be restored with topsoil, seed and mulch. Slopes steeper than 1 on 4 will be restored with sod.

B. Excess material from the restoration operation will be disposed of by the Contractor at Contractor's expense.

C. Grade disturbed areas to receive either topsoil and seed or topsoil and sod. Topsoil, seed, sod, fertilizer and mulch must conform to the requirements specified on the Plans and in Section 32 92 19 - Seeding.

D. Contractor, at Contractor's expense, will furnish, place, and compact any additional fill, meeting the approval of the Engineer, needed to restore the disturbed areas to the cross sections called for on the Plans or as determined by the Engineer.

3.20 RESTORATION OF AGGREGATE SURFACES

A. Shoulders:

1. Shoulders will 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 will be carried to within 5 inches of the existing surface as specified under Trench “A" or Trench "B" of Section 31 23 33. Backfill the remaining depth 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 Contractor's expense, will furnish, place and compact materials necessary to complete the backfilling and restoration operation within the shoulder area.

B. Driveways and Parking Areas:

1. Aggregate driveway areas will be regarded as the area from the right-of-way line to the edge of the traveled roadway and will include the shoulder area.

2. Backfilling of trenches crossing aggregate surfaced driveways and parking areas will be carried to the bottom of the proposed base course as specified under Trench “B”. Backfill the remaining depth 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 the Engineer, by such operations as temporary storage of materials or passage of equipment, will be resurfaced, at the Contractor's expense.

   a. The upper three 3 inches of disturbed areas will 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 will be resurfaced with a minimum of 3 inches of 22A or 23A compacted aggregate, with calcium chloride applied at the rate of of aggregate.

4. Contractor, at Contractor's expense, will 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 will be carried to within 12 inches of the existing surface as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling. The remaining depth will be backfilled with two 6 inches layers of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per ton of aggregate.

2. Contractor, at Contractor's expense, will furnish, place, and compact materials necessary to complete the backfilling and restoration operations within the roadway or street area.

3. Settlement of the aggregate surface will be restored by placing additional aggregate, up to the original grade, and will be at the Contractor's expense.

D. Compaction

1. Compaction of aggregate will be performed by a pneumatic-tired roller or a vibratory compactor until the material forms a stable surface.

3.21 RESTORATION OF PAVED SURFACES

A. Contractor will furnish and provide the materials necessary to complete the backfilling and restoration operations, which includes furnishing, compacting, forming, placing, rolling, floating, jointing, finishing, curing and providing protection against elements.

B. Restoration of roadways that are partially damaged will include a minimum replacement of one (1), full width lane of roadway. The length of replacement will be at least equal to the width.

C. Concrete:

1. The backfilling of trenches crossing concrete driveways, sidewalks, roads, streets or parking areas will be carried to the bottom of the proposed pavement as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling.

2. Unless otherwise specified on the Plans or as determined by the Engineer, concrete removed will be replaced with 3500 psi concrete of the thickness removed and will include reinforcing equal to the existing, if the existing pavement was reinforced.

3. Construction of concrete pavements will be in accordance with Section 31 23 33 - Trenching and Backfilling.

4. Restoration of sidewalks includes the construction of sidewalk ramps at the intersection of the curb and must conform to the current rules and regulations of the state of Michigan, and Section 32 13 15 - Sidewalks and Driveways. Unless otherwise indicated in the Proposal, this Work will be considered incidental to the Project.

D. Bituminous

1. The backfilling of trenches crossing bituminous driveways, sidewalks, roads, streets or parking areas will be carried to the bottom of the base course as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling.

2. Bituminous pavement or bituminous surface course with an aggregate base will be replaced in accordance with Section 32 12 16 - 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, will be resurfaced with an approved bituminous mixture the same thickness as removed, but in no case less than 2 inches in thickness. Replacement material will extend to smooth-cut edges, be uniform in direction and 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 the Engineer, will include complete replacement full width and length (extending a minimum of 25 feet beyond the damaged area both ways). Existing bituminous chip seal shoulders will be brought to proper grade with compacted 22A or 23A aggregate and resurfaced with a double chip seal per Section 32 12 16 - Bituminous Paving.

3.22 SOIL EROSION AND SEDIMENTATION CONTROL

A. Contractor will comply with the requirements of Section 01 57 13. Prior to commencing any type of earthwork, the Contractor will obtain a Soil Erosion and Sedimentation Control permit from the local enforcing agency.

B. Contractor will obtain approvals, secure permits and post 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 will provide the 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.

3.23 EXCESS EXCAVATION

A. Excess excavation will be defined as 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 the Owner, will transport excess excavation to a site(s) designated by the Owner.

1. Excess excavation will be graded by the Contractor to provide positive surface drainage of the site(s).

2. Grading will be done such that adjacent properties are not damaged or affected. The grading will include removal of all surface irregularities to provide a smooth surface ±3 inches.

C. When the excess excavation has not been requested by the Owner, the Contractor will remove and properly dispose of the material at no additional cost to the Owner.

D. Proper disposal of all excess excavation, including transportation, grading, and protection of adjacent properties will 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 will become the property of the Contractor, and will be disposed of per all applicable Laws, rules or regulations. Removal and disposal of this material will 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

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SECTION 02 01 10
LOCATION AND MAINTENANCE OF EXISTING UNDERGROUND UTILITIES

PART 1 SCOPE OF WORK

1.01 GENERAL

A. Protect existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, in accordance with the Contract Documents.

B. Verify the exact locations and depths of all utilities shown and perform exploratory excavations of utilities that may interfere with the work. Perform exploratory excavations as soon as practicable after award of the contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's work. When such exploratory excavations show the utility location as shown to be in error, notify the Engineer.

C. Perform the number of exploratory excavations which is sufficient to determine the alignment and grade of the utility.

1.02 RIGHTS-OF-WAY

A. Do not do any work that would affect oil, gas, water, sanitary sewer, or storm sewer pipelines; telephone, cable television, fiber optic, or electric transmission lines; fences or other structures until Contractor has been notified that the Owner has secured authority therefore from the proper party.

B. After authority has been obtained, the Contractor must give said party due notice of its intention to begin work, if required by said party, and remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.03 PROTECTION OF SURVEY MARKERS

A. Do not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation will be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced.

B. Survey markers or points disturbed by the Contractor must be accurately restored after street or roadway resurfacing has been completed.

1.04 RESTORATION OF PAVEMENT

A. General:

1. Replace paved areas, including asphaltic concrete berms cut or damaged during construction, with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit.

2. Pavement restoration requirement to match existing sections apply to components of existing sections, including sub-base, base, and pavement.

3. Temporary and permanent pavement must conform to the requirements of the affected pavement owner.

4. Pavements which are subject to partial removal will be neatly saw-cut in straight lines.

B. Temporary Resurfacing:

1. Wherever required by the public authorities having jurisdiction, place temporary surfacing promptly after backfilling and maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing:

1. To obtain a satisfactory junction with adjacent surfaces, sawcut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement.

2. Trim back damaged edges of pavement along excavations and elsewhere by sawcutting in straight lines.

3. Pavement restoration and other facilities restoration will be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Private Driveways:

1. Wherever sidewalks or private roads have been removed for purposes of construction, place suitable temporary sidewalks or roadways promptly after backfilling and maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

E. Restoration of Curb and Gutter:

1. Wherever curb and gutter have been removed for purposes of construction, place suitable temporary curb and gutter promptly after backfilling and maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, maintain said temporary curb and gutter until the final restoration thereof has been made.

1.05 EXISTING UTILITIES AND IMPROVEMENTS

A. General:

1. Protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Drawings. Take precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

2. Except where the Drawings indicate utilities have been field located during design or certain expose utility locations as part of the work, the Contractor is responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of Utilities which may interfere with its work.

3. Perform exploratory excavations as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's progress.

4. Notify the Engineer when exploratory excavations show the utility location as shown on the Drawings to be in error.

5. The number of exploratory excavations must be sufficent in number which to determine the alignment and grade of the utility.

6. Costs of locating and repairing damage not due to Contractor's failure to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such work may be paid for as extra work in accordance with the provisions of Section 00 72 00 - General Conditions. Payment for such work will be at the discretion of the Owner.

B. Utilities to be Moved:

1. In case it becomes necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the Owner to move such property within a specified reasonable time.

2. When utility lines that are to be removed are encountered within the area of operations, notify the Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

C. Utilities to be Removed:

1. Where the proper completion of the work requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the owner of the facility.

2. In cases of such temporary removal or relocation, Contractor will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

D. Owner's Right of Access:

1. The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the work of this Contract.

E. Underground Utilities Indicated:

1. Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations must be protected from damage during excavation and backfilling and, if damaged, must be immediately repaired or replaced by the Contractor, unless otherwise repaired by the owner of the damaged utility. If the owner of the damaged facility performs its own repairs, the Contractor will reimburse said owner for the costs of repair.

F. Underground Utilities Not Indicated:

1. In the event that the Contractor damages existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, a verbal report of such damage must be made immediately to the Engineer and a written report thereof will be made promptly thereafter. Engineer will immediately notify the owner of the damaged utility. If the Engineer is not immediately available, the Contractor must notify the utility owner of the damage. If directed by the Engineer, repairs will be made by the Contractor. Additional compensation for such work will be at the discretion of the Owner.

G. Approval of Repairs:

1. Repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.

H. Maintaining in Service:

1. Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the work will remain continuously in service during construction activities, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. Contractor is responsible for and will repair damage due to Contractor's operations, and the provisions of this Section will not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.06 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. General:

1. Except where trees or shrubs or other plantings are indicated to be removed, exercise necessary precautions so as not to damage or destroy trees or shrubs or other plantings, including those lying within street rights-of-way and project limits, and trim or remove trees, shrubs or other plantings unless they have been approved for trimming or removal by the agency having jurisdiction or Owner.

2. Existing trees and shrubs which are damaged during construction will be trimmed or replaced by the Contractor or a certified tree company under permit from the jurisdictional agency and/or the Owner, at the Contractor's expense. Tree trimming and replacement will be in accordance with the following paragraphs.

B. Trimming:

1. Preserve symmetry of the tree during trimming.

2. Do not leave stubs or splits or torn branches. Make clean cuts close to the trunk or large branches.

3. Do not use spikes for climbing live trees.

4. Coat cuts over 1-1/2 inches in diameter with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement:

1. Immediately notify the agency having jurisdiction and the Owner if any tree or shrub is damaged by the Contractor's operations. If, in the opinion of said agency or the Owner, the damage is such that replacement is necessary, the Contractor will replace the tree or shrub at Contractor's expense. The tree or shrub will be of a like size and variety as the one damaged, or, if of a smaller size, the Contractor will pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or Owner. The size of the tree or shrub will be a minimum of 1-inch diameter and a minimum of 6 feet in height. Planting of replacement trees and shrubs will be in accordance with the recommendations of the nursery furnishing the plants. Unless otherwise indicated, the Contractor will water and maintain the replacement trees and shrubs for 6 months after planting.

2. The replacement tree or shrub will be of a like size and variety as the one damaged, or, if of a smaller size, the Contractor will pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the agency having jurisdiction or Owner.

   a. The minimum size of the replacement tree or shrub cannot be less than 1-inch diameter nor less than 6 feet in height.

3. Planting of replacement trees and shrubs will be in accordance with the recommendations of the nursery furnishing the plants.

4. Unless otherwise indicated, water and maintain the replacement trees and shrubs for 6 months after planting.

1.07 LAWN AREAS

A. Repair lawn or landscaped areas damaged during construction to match the pre-construction condition to the satisfaction of the land owner and the Owner.

1.08 NOTIFICATION

A. Prior to excavation in the vicinity of existing underground facilities, including water, sewer, storm drain, gas, petroleum products, or other pipelines; buried electric power, communications, or television cables; traffic signal or street lighting facilities; and roadway or state highway rights-of-way, notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such work if they so desire.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 02 41 13
SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor will furnish labor, materials and equipment necessary for the removal and subsequent disposal of the area(s) slated for demolition, including but not limited to supports, piping, electrical equipment, mechanical equipment, floors, walls, ceilings, doors, windows, wood or metal framing, masonry, and asphalt paving, as shown on the Contract Drawings and specified herein. In addition, various utilities will be cut, abandoned and capped, or completely removed; miscellaneous clearing and grubbing of trees, brush, and vegetation at boundary area will be performed.

1. Work includes the removal and disposal of the building materials and debris including the removal and disposal of miscellaneous site debris, including but not limited to building area debris, woods, piping materials, bricks, roof materials, metal equipment and all other non-specified material and debris found at the site.

2. Work includes the removal and disposal of the building debris and concrete materials generated by the demolition of the structures listed above. Removal and disposal of concrete, rebar, and steel is incidental to the project. It is recommended that steel be recycled. Contractor may recycle concrete and asphalt to reduce cost.

B. Contractor has salvage rights to all salvageable restaurant equipment, electrical equipment, metals, salable items, and other recyclable materials unless indicated otherwise.

1. Do not salvage contaminated building materials; materials may be disposed of in accordance with applicable local, state, and federal regulations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 31 19 - Project Meetings

C. Section 01 77 00 - Closeout Procedures

D. Section 31 23 16 - Structural Excavation and Backfill

1.03 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner’s property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner’s property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to the Owner’s designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Owner, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.04 PERMITS

A. Permits described here cover the general description of the permits called for demolition. The permits described below are not necessarily all of the permits required for completion of this project.

1. Demolition Permit - Contractor is responsible for obtaining a demolition permit from the Building Department. Contractor is responsible for all permit fees.

2. NESHAP Notification of Intent to Demolish - Contractor is responsible for filing and for the fee involved with submitting an intent to demolish permit from the Michigan Department of Environment, Great Lakes and Energy, Air Quality Division.

    a. The notification is describe the demolition tasks to be conducted and the quantities of asbestos containing materials specified for abatement.

3. Soil Erosion and Sedimentation Control - Contractor is responsible for filing and for the fee involved with obtaining soil erosion and sedimentation control permits from the agency having jurisdiction.

1.05 MATERIAL OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner’s property, demolished materials will become the Contractor’s property and are to be removed from the site with further legal disposition legally at Contractor’s option.

1.06 SUBMITTALS

A. Submit each of the following items in accordance with Section 01 33 00:

1. Work Plan: Prior to proceeding with the demolition, removal and disposal work, submit a work plan which includes the means, methods and procedures proposed for the accomplishment of the removal and disposal work.

    a. Provide means, methods and procedures for safe conduct of the work; careful removal and disposition of buildings and structures, and solid materials and wastes; and protection of property that is to remain undisturbed.

    b. Provide a detailed description of the methods and equipment to be used for each operation, including a sequence of operations.

    c. Submit the name and location of disposal facilities for all removed materials in the Work Plan.

    d. Based the Work Plan on work experience and the guidance provided in this specification. The cost of work plan preparation is incidental to the project.

2. Demolition Schedule: Submit a complete coordination schedule for demolition work, including shut-off and continuation of utility services, with the Engineer's approval prior to start of the work.

    a. Contractor's schedule will indicate proposed methods and operations of facility demolition, and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.

3. Disposal Documents: Provide copies of all licenses, certifications, permits, agreements, manifests, chain of custody records, weigh tickets, meter recordings, delivery tickets, and receipts required or issued for the disposal of materials, the methods used, and the disposal areas and facilities. Provide a copy of the results of tests performed to comply with the requirements of each disposal facility.

4. Manifests: Submit a copy of the official manifest for each shipment of removed materials including, but not limited to, building and structure debris, concrete and brick debris, and miscellaneous site debris and solid wastes evidencing delivery of the material to an approved licensed disposal facility. Manifests will be in accordance with the requirements of all the applicable federal, state and local regulations, and will be signed by the Owner or the Owner's designated Representative.

5. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions in accordance with Section 01 77 00.

1.07 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing Environmental Protection Agency notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-Demolition Conference: Conduct conference at Project site to comply with Section 01 31 19.

1.08 PROJECT/SITE CONDITIONS

A. Condition of Facilities: Owner assumes no responsibility for actual condition of facilities to be demolished.

B. Occupancy: Owner may continuously occupy areas of site immediately adjacent to areas of selective demolition. Conduct demolition work in manner that will minimize need for disruption of the Owner’s normal operations.

C. Protections: Provide temporary barricades and other forms of protection to protect the public from injury due to selective demolition work.

1. Provide protective measures as required to provide free and safe passage of the Owner, tenants, vehicles, and general public to areas directly affected by demolition activities and those adjacent to such activities.

2. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain.

3. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.

4. Protect floors with suitable coverings when necessary.

5. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing structures.

6. Provide temporary dust and debris barriers of fire resistant materials to control dust and debris and to confine demolition of existing and finished work.

7. Remove protections at completion of work.

D. Damages: Promptly repair damages caused to adjacent facilities by demolition work.

E. Traffic: Conduct selective demolition operations and debris removal to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

1. Do not close, block, or otherwise obstruct streets, walks, or other occupied or used facilities without approval from the Owner and providing alternate routes around closed or obstructed traffic ways.

F. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. At concealed spaces, such as interior of pipe spaces, verify condition of hidden space before starting flame-cutting operations. Maintain portable fire suppression devices during flame-cutting operations.

G. Explosives: Use of explosives is not permitted.

H. Utility Services: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

1. General:

a. Do not interrupt utilities serving occupied or used facilities, except when authorized in writing by the Owner. Provide temporary services during interruptions to existing utilities or schedule work to install interrupted utilities first, as acceptable to the Owner.

b. Maintain fire protection services during selective demolition operations.

c. Provide temporary support and protection of existing utilities, which cross the proposed piping trench.

d. Permits must be obtained from utility or agency having jurisdiction, if necessary. Contractor is responsible for all permit fees.

e. If relocation of any utility is necessary, the Contractor is responsible for associated fees or expenses, unless indicated otherwise.

2. Electrical Disconnection: Verify that onsite electrical wiring entering all structures to be demolished, or in close enough proximity to be damaged by the demolition operations,

have been disconnected and/or de-energized prior to proceeding with demolition operations.

a. Coordinate with the local electrical utility company for any necessary relocation of utilities and be responsible for any associated fees or expenses.

3. Water Disconnection: Perform or verify that on-site water lines entering all structures or in close enough proximity to be damaged by the demolition operations have been disconnected and/or capped prior to proceeding with demolition operations.

4. Sewer Disconnection: Locate and bulkhead all sewer connections from the building structure prior to proceeding to demolition.

5. Gas Disconnection: Verify that on-site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations have been disconnected and/or capped prior to proceeding with demolition operations.

6. Telephone and Cable Disconnection: Verify that on-site gas lines/mains entering all structures or in close enough proximity to be damaged as a result of the demolition operations have been disconnected and/or capped prior to proceeding with demolition operations.

I. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

J. Provide ventilation to maintain non-toxic unpolluted working area for adjacent the Owner's operating areas and construction/demolition areas. Welding and cutting torches producing smoke or toxic fumes must be adequately ventilated.

1.09 WARRANTY

A. Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 PRODUCTS

2.01 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

2. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Provide written pre-demolition report to the Engineer prior to start of Work. The report will contain the following information at a mini:

1. Determination of condition of framing, floors, and walls, and possibility of unplanned collapse of any portion of structure or adjacent structure where employees may be exposed.

2. Various phases of demolition and description of how employees will be protected from unplanned contact with active utilities, exposure to toxic materials and gases, falling objects, structural collapse, and any other hazards routinely associated with demolition activities.

B. Locate existing utilities within project limits prior to any demolition. Verify that utilities have been disconnected and capped.

1. If unanticipated mechanical, electrical or structural elements that conflict with intended function or design are encountered, investigate and measure nature and extent of conflict and promptly submit a written report to the Engineer.

a. Pending review of the report by the Engineer, the Contractor will rearrange the selective demolition schedule, and notify the Engineer and the Owner as necessary to continue overall job progress without delay.

3.02 PREPARATION

A. Conduct demolition operations and remove debris in manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities designated to remain.

1. Provide temporary barricades and other forms of protection as required for safety and security.

2. Provide barriers and appropriate to restrict pedestrians from wandering into construction areas.

3. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure no water leakage or damage occurs to structure or interior areas.

C. Erect and maintain dust-proof partitions and temporary enclosures to limit dust or dust migration, and to separate areas from fumes and noise, if necessary.

D. Provide and maintain interior and exterior shoring, bracing or structural support to preserve stability and prevent movement, settlement, or collapse of structures and adjacent facilities that are not part of demolition.

E. Provide acceptable temporary security barriers where physical security of buildings or fences is compromised due to demolition work.

3.03 SALVAGE REQUIREMENTS

A. Coordinate with the Owner to identify structure and/or building components and equipment required to be removed and delivered to the Owner subsequent to demolition.

1. Owner will tag components and equipment designated for salvage.

B. Protect designated salvage items from demolition operations until items can be removed.

1. Carefully remove components and equipment indicated to be salvaged.
2. Disassemble as required to permit removal .
3. Package small and loose parts to avoid loss.
4. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
5. Deliver salvaged items to the Owner and obtain signed receipt from the Ownerindicating that the Owner has received tagged items.

3.04 SELECTIVE DEMOLITION

A. General:

1. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
    a. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
    b. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.
2. Perform work in safe and systematic manner.
3. Use such methods as required to complete work indicated on Contract Drawings and minimize disturbance of the Owner’s normal operations.
4. Use water as necessary to lay dust when chipping, coring, or sawing concrete, masonry or similar materials. Water must be controlled inside buildings by damming, mopping or vacuuming. Prevent water from entering underfloor electrical ducts.
5. Completely backfill below-grade areas and voids resulting from utility removal and other demolition work.
6. Remove debris from roof or other above-grade location through enclosed chute or bundle, and lower by hand or with hoisting device.
7. Equipment Removal:
    a. When a piece of equipment is to be removed, ancillary items associated with that equipment are to be removed by the Contractor, unless specifically called out or shown to remain, including but not limited to the following: electrical feed, conduit, wiring, motor starter, concrete base or supports, as well as service piping (e.g., water, gas, propane, etc.) and supports.
    b. Surfaces will be repaired or patched after removing the equipment and ancillary items.
    c. Contractor to field verify the extent of the designated equipment and its ancillary items during the bidding process as the equipment and ancillary items may not be completely shown on the Contract Drawings, as accurate records may not exist.

d. The cost to remove ancillary items and repair/patch surfaces will be considered incidental to the Contract unless otherwise specified.

B. Structure Demolition:

1. Demolish building structures and appurtenances as shown and required to complete work within limitations of governing regulations.

2. Small structures may be removed intact when acceptable to the Engineer and approved by authorities having jurisdiction.

3. Proceed with demolition in a systematic manner, in accordance with permits and approved submittals.

4. Demolish concrete and masonry in sections. Use bracing and shoring to prevent collapse.

5. Disperse demolition equipment throughout the structure. Remove demolished materials to prevent excessive loads on supporting walls, floors or framing.

6. In areas to be remodeled, cut back flush and seal any pipe stub-outs remaining, and remove exposed piping, conduits, fixtures, J boxes, light fixtures, water fixtures, and supports. Remove switches, receptacles, and boxes. Remove or cap and abandoned concealed piping and conduits as necessary to facilitate the remodeling work. Remove other items as shown on the Plans.

C. Below-Grade Demolition:

1. Demolish and remove footings, foundation walls, below-grade construction and concrete slabs on grade.

a. In areas where new construction will take place, remove to a depth which will not interfere with new construction, but not less than 12 inches below existing ground surface or future ground surface, whichever is lower or as indicated on the plans.

2. Fill below-grade areas and voids resulting from demolition of structures completely.

3. Fill and compaction will be in accordance with Section 31 23 16.

4. After fill and compaction, grade surfaces to meet adjacent contours and to provide flow to surface drainage structures, or as shown.

3.05 REPAIRS

A. Provide patching, replacing, repairing, and refinishing of damaged areas involved in demolition as necessary to match the existing adjacent surfaces whether shown or not shown, with materials and procedures approved by the Engineer.

B. Return structures and surfaces not part of demolition, to conditions existing prior to commencement of demolition work.

C. Repair damages caused to adjacent facilities by demolition activities, as directed by the Engineer and at no cost to the Owner.

D. Conduct a detailed inspection after patching and repairing has been completed in the presence of the Owner and Engineer. Carefully remove splattering of mortar from adjoining work

(particularly, but not limited to, plumbing fixtures, trim, tile, and finish metal surfaces), and make good any damage caused by such cleaning operations.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove and legally dispose of demolished materials, site debris, rubbish, and other materials resulting from demolition operations promptly removed.

1. Conduct demolition and removal of debris in a manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities will not be closed or obstructed without prior permission from the Owner.

2. If the Contractor encounters material during removal that is suspected to be potential hazard, stop work immediately and notify the Engineer.

3. Disposal must conform to Federal, State and local requirements.

4. Removed materials will be documented by manifests and disposal facility tickets with copies given to the Engineer 48 hours after removal from the site.

B. Burning of removed materials from demolished structures is not permitted onsite.

3.07 RECYCLING

A. Owner encourages the recycling of demolition debris where appropriate. Contractor has the option to recycle any material found or demolished on site in order to reduce costs or project duration.

B. Although the materials are not limited, it is recommended that at least steel and concrete be recycled.

1. Steel and concrete to be recycled can be stockpiled on site and eventually removed. Steel separated from demolition rubble may be recycled and becomes the property of the Contractor.

2. Contractor will not be allowed to abate on site any lead paint found on the steel unless appropriate procedures and federal, state and local codes or regulations are followed.

3. Remove any material stockpiled for recycling from the site prior to the contract end date and/or site restoration.

3.08 CLEANING

A. During and upon completion of work, promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and leave areas affected by work in a clean, approved condition in Division 01.

B. Clean adjacent structures and facilities of dust, dirt, and debris caused by demolition, as directed by the Engineer or Owner, and return adjacent areas to condition existing prior to start of work.

END OF SECTION

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SECTION 04 05 11
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.

B. Grout is a mixture of sand, water, and fine aggregate mixed to a fluid consistency.

1.03 REFERENCE STANDARDS

A. ACI - 530.1: Specification for Masonry Structures

1. Follow the latest or current ACI Standards, and the “Specifications for Masonry Structures," ACI-530.1, for all mortar and grout work except where otherwise specified herein.

B. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete

C. ASTM C91/C91M: Standard Specification for Masonry Cement

D. ASTM C150/C150M: Standard Specification for Portland Cement

E. ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes

F. ASTM C270: Standard Specification for Mortar for Unit Masonry

G. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition

1.04 SUBMITTALS

A. Submit manufacturer's literature for premixed materials.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Store and handle materials as recommended in ACI 304R.

B. When storing cement in the open, provide a floor at least 6 inches inches above the ground and a waterproof covering. Place the covering to ensure runoff in case of rain. When used, the cement must be free from lumps. Thoroughly shake cement sacks when emptying them into the batch. Do not use cement salvaged by Contractor by cleaning sacks mechanically or otherwise, or from discarded sacks of cement.

C. Furnish, stock, and handle aggregates so uniformity of grading is obtained at batching. Thoroughly clean the area where stockpiles are built of all foreign materials; it needs to be firm,

reasonably level, and well drained. Do not use aggregates that have become intermixed prior to proportioning.

D. Store and handle premixed mortar or grout in strict accordance with the manufacturer's recommendations.

1.06 JOB CONDITIONS

A. Adhere to environmental requirements relative to temperature for mixing and placing mortar or grout in accordance with Part 2 of this Section.

PART 2 PRODUCTS

2.01 PREMIXED MORTAR OR GROUT

A. Premixed mortar or grout must be a complete packaged mixture to which water is to be added at the job site. Mortar and grout must be nonshrink, nonstaining.

2.02 CEMENT

A. Use the type of cement indicated on the Plans or as specified below:

1. Portland cement: Types I, IA or III: ASTM C150/C150M.

2. Masonry cement: Type N, S, or M: ASTM C91/C91M.

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. Do not use integral waterproofing compounds, accelerators, retarders, or other admixtures not specifically mentioned in the specifications in mortar or grout without the approval of Engineer. Use no admixtures containing calcium chloride.

2.05 WATER

A. Water must 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. Test water from other sources before using.

2.06 MIXES

A. General:

1. When using premixed mortar or grout, add water in strict accordance with the manufacturer's recommendations to prepare a stiff or plastic mix, depending on workability needed for application.

2. For job mixed mortar or grout, combine cement, aggregate, water, and any necessary admixtures in proportions that meet MDOT Section 702 requirements to produce mortar or grout for the use indicated on the Plans and as specified herein.

3. For job mixed mortar and grout, proportion cement and aggregate by weight for cubic yard (or cubic meter) batches, or by volume for smaller batches. Do not use the shovel method for measuring volume. When measuring by volume, add water as needed to achieve the required consistency 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 the Plans or Specifications indicate otherwise, use Portland Type I cement. Proportion materials by weight, adding water in amounts to obtain necessary consistency required for the Work.

MDOT Designation	General Use
Type H-1	Joints in precast structural members, spaces under leveling plates, supporting structures, grouting dowels, and anchor bolts

2.07 MIXING

A. Mix for a minimum of five (5) minutes. Adjust mortar consistency to provide the best workability. If mortar stiffens due to evaporation or absorption, retemper the mortar by adding water and remixing. Grout consistency must 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 must be between 40 to 120 degrees Fahrenheit.

2.09 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers of premixed, nonshrink, nonmetallic grout include:

1. Sonneborn "Sonogrout"
2. L&M Construction Chemicals "Duragrout"
3. Masters Builders "Masterflow 713"
4. Five Star Products "Five Star Grout"
5. Engineer-approved equal.

PART 3 EXECUTION

3.01 VERIFICATION

A. Contractor must 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. Unless otherwise specified, prepare surfaces to receive mortar or grout as follows:

1. Remove laitance down to sound concrete.

2. Properly wet cure the surface; it must be 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 using a premixed mortar or grout, prepare surfaces in strict accordance with manufacturer's recommendations.

3.03 INSTALLATION - GENERAL

A. Use mortar and grout within 2-1/2 hours of initial mixing. Do not use mortar or grout after it has begun to set.

B. Use premixed mortar or grout in strict accordance with the manufacturer's recommendations.

3.04 INSTALLATION OF MASONRY UNITS

A. Make mortar joints to bond brick or block no less than 3/8 inch and no greater than 1/2 inch thick. Strike the surface of the joint flush with the masonry units.

3.05 SURFACE FINISHING APPLICATIONS

A. Thoroughly compact nonshrink mortar into all voids, holes, honeycombs, or other defects in the finish surface of concrete. The mortar must be flush with the surrounding concrete and matching in color and texture.

3.06 GROUTING ANCHORING DEVICES

A. Place nonshrink, nonstaining mortar or grout in the provided hole, then set the anchoring device or dowel into the grout-filled hole. The surface must be flush with the surrounding concrete. Apply no pressures or loads 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. Don't place masonry units, mortar, or grout Work in contact with frozen surfaces. Don't perform mortar or grout work when the average air temperature is below 40 degrees Fahrenheitunless the materials are heated and/or Contractor provides adequate protection of the Work. Work must be protected against freezing for no less than 48 hours after placement.

2. Apply heat to materials in a manner that keeps them clean and free from injurious substances.

B. Air Temperature 40 to 32 degrees Fahrenheit:

1. Heat sand or mixing water to produce mortar temperatures between 40 to 120 degrees Fahrenheit. Heat either ingredient to a minimum 70 to 160 degrees Fahrenheit. The ideal mortar temperature should be 70 to 80 degrees Fahrenheit.

C. Air Temperature 32 to 25 degrees Fahrenheit:

1. Heat sand and mixing water to produce mortar temperatures between 40 to 120 degrees Fahrenheit. Maintain temperatures of mortar on boards above freezing. Heat sand and water to a minimum 70 to 160 degrees Fahrenheit.

D. Air Temperature 25 to 20 degrees Fahrenheit:

1. Heat sand and mixing water to produce mortar temperatures between 40 to 120 degrees Fahrenheit. Maintain mortar temperatures on boards above freezing. Use salamanders or other heat sources on both sides of interior bearing walls under construction and on the inside of all exterior walls. Employ windbreaks when wind is in excess of 15 mph.

E. Air Temperature 20 degrees Fahrenheitand Below:

1. Heat sand and mixing water to provide mortar temperatures between 40 to 120 degrees Fahrenheit. Provide enclosure and auxiliary heat to maintain air temperature above 40 to 120 degrees Fahrenheit. Temperature of units when laid must be not less than 20 degrees Fahrenheit.

END OF SECTION

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SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section includes 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 012200

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 22 00 - Grading

E. Section 31 23 13 - Subgrade Preparation

1.03 SOIL EROSION AND SEDIMENTATION CONTROL

A. Contractor, at Contractor's 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 the 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 57 13.

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 the 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 the Engineer, shall be completely removed. Depth of removal shall be in accordance with the requirements specified below.

1. Depth of Removal in Excavation Areas

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 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 below the finish surface elevation.

c. Unless otherwise indicated on the Plans or as designated by the Engineer .

2. Depth of Removal in Embamkmnet Areas

a. Within embankment areas for roadways, parking lots, and other paved areas where the top of finished grade is 5 feet 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 below the existing ground.

b. Within embankment areas for roadways, parking lots, and other paved areas where the top of finished grade is more than 5 feet 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,

d. Unless otherwise indicated on the Plans or as designated by the Engineer.

3.03 SELECTIVE CLEARING

A. 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 the Engineer.

B. Selective Clearing, Type I:

1. Trees and stumps shall be cut off at an elevation not more than 4 inches above the existing ground level.

C. Selective Clearing, Type II:

1. Trees and stumps shall be chipped or ground down to an elevation approximately 4 inches below proposed ground level.

3.04 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. Removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of the Engineer.

3.05 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 4 feet 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 89 00.

C. Burial of trees, stumps and other vegetation, will not be permitted, except at disposal areas indicated on the Plans or as determined by the Engineer. Trees and stumps buried in these areas shall have a minimum cover of 2 feet.

3.06 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 the 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.

3.07 SALVAGING TIMBER

A. Trees required to be removed and having a diameter of 4 inches or more are classed as merchantable timber. On right-of-way, fee simple, merchantable timber shall become the property of the Contractor, unless otherwise specified in the Contract Documents.

1. When such material is placed outside of the right-of-way, the Contractor shall obtain and provide the Engineer with written permission from the property owner 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 the Contractor provides the 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 the Contractor.

C. When such material is placed outside the contract limits, the Contractor shall obtain and provide the Engineer with written permission from the owner of the property on which the timber is to be placed. Timber from 4 to 12 inches in diameter may be left in full tree lengths or cut to commercial lengths, at the option of the Contractor. Timber 12 inches or more in diameter shall be cut into commercial lengths and piled separately from other timber.

END OF SECTION

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SECTION 31 22 00
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 012200

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 11 00 - Clearing and Grubbing

E. Section 31 23 13 - Subgrade Preparation

F. Section 31 23 16 - Structural Excavation and Backfill

G. Section 32 92 19 - Seeding

H. Section 32 92 23 - Sodding

1.03 SOIL EROSION AND SEDIMENTATION CONTROL

A. Provide, maintain, and remove all temporary and/or permanent soil erosion and sedimentation control measures at Contractor's expense, as specified on the Plans or as determined by the Engineer.

B. Implement measures to prevent surface runoff from carrying excavated materials into waterways, reduce erosion of slopes, and prevent silting in 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 57 13 - Temporary Erosion and Sediment Control.

1.04 REFERENCE STANDARDS

A. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

B. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition.

PART 2 PRODUCTS

2.01 GRANULAR MATERIAL

A. Class II granular material meeting the requirements of MDOT Section 902.

2.02 AGGREGATE BASE COURSE

A. 21AA dense graded aggregate conforming to MDOT Section 902.

PART 3 EXECUTION

3.01 SITE GRADING

A. Grade sites as specified on the Plans or as determined by the Engineer. Perform grading to prevent standing water and soil saturation detrimental to structures and improvements.

B. Make provisions to preserve and protect trees and other vegetation specified on the Plans or determined by the Engineer as not to be removed.

3.02 REMOVING AND SALVAGING TOPSOIL

A. Push back and preserve topsoil encountered along the construction route for use in restoration after completing the construction. Keep the topsoil on each parcel and lot throughout the Project, including the existing road right-of-way adjoining the parcel or lot where it originally existed.

B. 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.

C. Remove and stockpile topsoil if the working area is insufficient, then replace it on the original lot or parcel. Provide the Engineer with written permission from the property owner of the stockpile location before starting the stockpiling operation.

D. Salvage topsoil in the quantity required by the Plans. Dispose of any excess topsoil beyond the amount required by the Plans or as directed by the Engineer at Contractor's expense.

E. Reduce vegetation to a height of approximately 4 inches before removing topsoil. Remove and dispose of all such vegetation, brush, stones, rocks, and any other objectionable litter or foreign material before breaking the ground for topsoil removal.

F. Use equipment and methods that avoid lifting the subsoil. Cease stripping when soil or weather conditions are unsuitable, and resume only when conditions allow suitable operation.

G. Remove topsoil within the grading limits for cuts to the width and depth specified on the Plans or as determined by the Engineer.

H. Stockpile topsoil within the limits of construction in areas designated on the Plans or in areas out of the way of construction as determined by the Contractor.

I. Locate and shape stockpiles to avoid diverting storm water runoff, either into or out of construction limits, toward buildings, creating standing water, or interfering with controlled irrigation.

J. Do not place topsoil around trunks and root areas of trees to be preserved.

K. Keep topsoil separate from other excavated materials used for embankment and completely remove it from any designated area before starting regular excavation or placing embankment in that area.

L. Locate topsoil stockpiles as close to the original location as possible; do not allow payment for overhaul.

M. After completing construction, screen the topsoil through a 5/8 inch maximum size mesh screen, then spread, grade, rake, and prepare it for seeding or sodding.

3.03 EXISTING SAND ON-SITE

A. When construction occurs within private easements, do not remove sand from each parcel or lot. Use sand encountered in existing road right-of-way for construction purposes throughout the Project, provided it meets the material requirements for its intended use.

B. Removal of sand from the Project will not be allowed, except for the volume displaced by the new construction.

C. If working area is insufficient, remove, stockpile, and replace the sand on the original lot or parcel. Provide the Engineer with written permission from the property owner of the stockpile location before starting stockpiling operations.

3.04 ROUGH GRADING

A. Grade the site as needed to comply with the Plans or as directed by the Engineer. Roughly establish the subgrade by cutting or filling, keeping it approximately parallel to proposed finished grades and at elevations that accommodate topsoil thickness and installation of site or roadway improvements.

B. Remove all debris from fill areas before filling. Remove and properly dispose of any material detrimental to site improvement as specified in Section 01 89 00.

C. Scarify and bench the original ground, or treat it otherwise, to ensure adequate bond and prevent fill slippage.

D. Use fill material free of debris or detrimental substances and maintain moisture content within 2% of optimum when placing. Compact fill to at least 95% of maximum unit weight, placing it in layers no less than 9 inches and no greater than 15 inches. Determine maximum unit weight according to ASTM D698, Method B.

E. Construct fills or embankments when the ground is frost-free and weather is favorable. If winter grading is necessary, remove all ice and snow from the ground surface before placing the fill or embankment.

F. No frozen material will be allowed in the fill area or in the embankment being constructed.

1. Remove frozen material from a partially completed fill before placing additional fill. Stockpile frozen material outside grading limits until thawed.

2. Thawed material from the stockpiled frozen material may be used in the fill and embankment areas.

3.05 FINISH GRADING

A. Smooth the subgrade parallel to proposed finished grades and elevations specified on the Plans. Scarify the subgrade to ensure bond with the topsoil before spreading the topsoil.

B. Spread topsoil uniformly to provide a smooth, even surface at the finish grade specified on the Plans or acceptable to the Engineer. After spreading, compact the topsoil lightly as necessary to minimize settlement. Ensure final grades do not vary more than 0.1 foot from the elevations indicated on the Plans.

C. Perform finished grading when the ground is frost-free and weather conditions are favorable.

3.06 ADJUST STRUCTURES

A. Adjust structures as called for on the Plans or directed by the Engineer. Apply adjustments where the casting elevation is raised 12 inches or less, or lowered 6 inches or less.

B. For Rehabilitation/Resurfacing Projects

1. Sawcut pavement for structures in existing pavement to a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

a. Adjust structures in concrete pavement, then backfill and compact as specified. Place six inches of aggregate base course below the proposed concrete pavement unless the Plans specify otherwise.

1) In areas of new concrete pavement, pour new concrete pavement around the structure integral with the rest of the pavement.

2) Place expansion or epoxy anchored hook bolts at 18 inches on center around the edges of the existing concrete pavement for resurfacing projects, unless plans show otherwise. Replace concrete pavement, minimum 8 inches thick, around the structure to match the grade of the adjoining concrete pavement.

b. For structures in bituminous pavement, do not sawcut bituminous pavement until after completing the bituminous base or leveling courses. Adjust, backfill, and compact the structure as noted below.

1) Place six inches of aggregate base course below the proposed pavement, unless otherwise noted on the plans. Place a minimum of 8 inches of concrete pavement to the elevation of the adjoining bituminous base or leveling courses, unless otherwise noted on the plans.

2) Place the bituminous wearing course around the structure integral with the wearing course on the remainder of the project.

C. For Bituminous Reconstruction or New Construction Projects

1. Remove the frame and cover on new and existing structures and plate the structure before placing the bituminous base or leveling courses.

2. Place bituminous base and leveling courses over the plated structures.

3. Sawcut the bituminous base and leveling courses a minimum of 5-foot by 5-foot before placing the bituminous wearing course, unless the Plans indicate otherwise. Adjust, backfill, and compact the structure as noted below.

4. Place six inches of aggregate base course below the proposed pavement, unless the Plans note otherwise. Place a minimum of 8 inches of concrete pavement up to the elevation of the adjoining bituminous base course, unless the Plans note otherwise.

5. Place the bituminous wearing course around the structure integral with the wearing course on the remainder of the project.

D. Include sawcutting, removal, and replacement of concrete and bituminous pavement, and aggregate base course as incidental to adjusting the structure, unless otherwise noted in the Contract Documents.

E. Carefully remove and store the existing frame and cover, then reinstall them on the same structure unless the Plans call for a new frame and cover.

F. Remove or install brick courses or concrete adjustment rings as necessary to adjust the structure's frame and cover to the proper elevation.

G. Set brick or concrete adjustment rings in mortar or install them as shown on the Plans and as determined by the Engineer.

H. Apply a masonry plaster coat, minimum 1/2 inch thick, to the outside surface of the new brick or block structures.

I. Backfill the structure properly with granular material, compact it in place, and ensure it meets the approval of the Engineer.

J. Maintain flow in the entire system at the Contractor's expense while performing any part of the Work. Clean the structure and dispose of all unsuitable material at the Contractor's expense.

3.07 RECONSTRUCT STRUCTURES

A. Reconstruct structures as called for on the Plans or as determined by the Engineer. Apply reconstruction where the elevation of the casting requires raising more than 12 inches, lowering more than 6 inches, or to rebuild portions of the existing structure which are deteriorated.

B. For Rehabilitation/Resurfacing Projects:

1. Sawcut the pavement in existing pavement areas to a minimum of 5-foot by 5-foot unless otherwise shown on the plans.

a. Reconstruct, backfill, and compact structures in concrete pavement as noted below. Place six inches of aggregate base course below the proposed concrete pavement, unless otherwise noted on the Plans.

1) Pour the concrete pavement around the structure integral with the rest of the new concrete pavement.

2) Place expansion or epoxy anchored hook bolts 18 inches on center around the edges of the existing concrete pavement for resurfacing projects, unless otherwise shown on the plans. Replace the concrete pavement, minimum 8 inches thick, around the structure to the grade of the adjoining concrete pavement.

b. Do not sawcut the pavement in bituminous pavement areas until after completing the bituminous base or leveling courses.

1) Reconstruct, backfill, and compact the structure as noted below.

2) Place six inches of aggregate base course below the proposed pavement, unless otherwise noted on the Plans. Place a minimum of 8 inches of concrete pavement to the elevation of the adjoining bituminous base or leveling courses, unless otherwise noted on the Plans.

3) Place the bituminous wearing course around the structure integral with the wearing course on the remainder of the Project.

C. For Bituminous Reconstruction or New Construction Projects:

1. Remove the frame and cover on all new and existing structures and plate the structure before placing the bituminous base or leveling courses.

2. Place bituminous base and leveling courses over the plated structures.

3. Sawcut the bituminous base and leveling courses a minimum of 5-foot by 5-foot before placing the bituminous wearing course, unless otherwise shown on the Plans. Reconstruct, backfill, and compact the structure as noted below. Place six inches of aggregate base course below the proposed pavement, unless otherwise noted on the plans.

4. Place a minimum of 8 inches of concrete pavement to the elevation of the adjoining bituminous base course, unless otherwise noted on the plans.

5. Place the bituminous wearing course around the structure integral with the wearing course on the remainder of the Project.

D. Include sawcutting, removal, and replacement of concrete and bituminous pavement, and aggregate base course as incidental to reconstructing the structure unless otherwise noted in the Plans.

E. Carefully remove and store the existing frame and cover, then reinstall them on the same structure unless the Plans call for a new frame and cover.

F. Remove existing corbel entrance sections or precast concrete chimney-type entrance, along with any additional brick courses or precast concrete sections needed to achieve the reconstruction amount called for on the Plans or determined by the Engineer.

G. Install necessary brickwork and precast concrete sections to meet the design grade.

H. Furnish and install manhole steps as necessary, maintaining maximum spacing of 24 inches. Set brick or concrete adjustment rings in mortar or install as shown on the Plans and as determined by the Engineer.

I. Apply a masonry plaster coat, minimum 1/2 inch thick, to the outside surface of the new brick or block structures. Backfill the structure properly with granular material, compact in place, and obtain approval from the Engineer.

J. Maintain flow in the entire system at the Contractor's expense while performing any part of the Work. Clean the structure and dispose of unsuitable material at the Contractor's expense.

END OF SECTION

SECTION 31 23 10
VIBRATION AND NOISE CONTROL

GENERAL

1.01 SCOPE OF WORK

A. This Section specifies requirements for:

1. Limiting and monitoring ground vibrations and noise levels originating from vibration and impulsive-noise producing construction operations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

1.03 DEFINITIONS

A. Impulsive Noise: Noise occurring at low frequencies. The spectrum occurring below 15 Hz is generally not audible to humans.

B. Particle Velocity: A measure of the intensity of ground vibration, specifically the time rate of change of the amplitude of ground vibration.

C. Peak Particle Velocity (PPV): The maximum of the three ground vibration velocities measured in the vertical, longitudinal and transverse directions. Velocity units are expressed in inches per second (in/s).

1.04 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.

B. General Monitoring Plan:

1. Two weeks prior to commencement of vibration and noise-inducing construction operations, submit a General Monitoring Plan that includes:

a. Procedures that will be used to identify appropriate monitoring locations and establish accurate distances to individual operation locations.

b. Methods of notifying private property owners to obtain permission for access and monitoring.

c. Manufacturer's technical information, descriptions, and specifications for all instruments and sensors to be used for vibrations and noise level monitoring.

d. Calibration certificates for all instruments and sensors.

C. Notifications:

1. Notify Owner 24 hours before vibration and impulsive noise-producing operations occur at any specific location. Provide Owner with a schedule for all such operations and notify Owner if any operation delays for more than one hour.

2. Furnish Owner with a list of parties notified in accordance with this requirement prior to starting such operations. Include names, addresses, and telephone numbers on the list.

1.05 COORDINATION DOCUMENTATION

A. Before starting vibration and impulsive noise producing operations at all work sites, notify appropriate local municipal officials, above- and below-ground utility owners, and the general public potentially affected of the intent to conduct controlled operations. Give notice to all operators of buried pipes, cables, conduits, and overhead utility lines and poles within a 100-foot radius of the operation area. Give public notice to occupants and property owners of all buildings within250-foot of excavation operations and within 250 feet of all surface operation locations.

B. Provide written notification to appropriate local municipal officials and utility owners or operators at least 48 hours before starting vibration and impulsive noise producing construction operations at a specific site, or sooner if required by applicable local laws or regulations. Include the expected hours of operation and the anticipated completion date. Upon finishing construction operations at the site, notify utility owners or operators that construction activities in the area have ended for the duration of the project.

PRODUCTS – NOT USED

EXECUTION

3.01 GENERAL

A. Erect and maintain signboards of adequate size at locations agreed upon with the Owner, clearly stating that operations are taking place in the area. Ensure signs remain clearly visible at all points of access to the area.

3.02 VIBRATION AND NOISE CONTROL

A. Do not operate power operated construction tools or machinery between the hours of 7:00 PM and 7:00 AM (See also Section 01 32 13 – Construction and Schedule Constraints). In addition, do not operate at any time any device in such a manner that the noise created substantially exceeds the noise customarily and necessarily attendant to the reasonable and efficient performance of such equipment.

B. Conduct all work in a manner that prevents damage to existing structures from ground vibrations caused by construction operations.

C. Monitor and record ground vibration and noise for all vibration-producing operations, unless approved otherwise by the Owner. Design work to ensure allowable levels are not exceeded.

D. Monitor each activity expected to cause excessive noise or vibration that exceeds the limits set forth herein and in local noise ordinances. Adjust construction procedures accordingly to ensure allowable levels are not exceeded.

E. Vibration and Noise Limits and Control Criteria:

1. Design the operation to conform to the vibration limits shown in the table below:

Structure	Maximum PPV (in/s)
Residential Buildings	0.5
Schools and Public Buildings	0.5
Heavy Commercial Buildings	1.0
Brick-Lined Sewers	3.0

Buried Pipes and Utilities	4.0

2. Ensure the noise level resulting from construction remains within the limits specified in OSHA regulations and all local ordinances.

F. Monitoring Requirements:

1. Monitor and record vibration and impulsive noise for construction operations that generate noticeable ground vibration and impulsive noise, if required by the Owner.

3.03 SUSPENSION OF OPERATION

A. Suspend vibration and noise producing operations upon direction from the Owner for any of the following reasons:

1. Contractor's safety precautions are inadequate.

2. Noise or ground vibration levels exceeding specified limits.

3. Existing structural conditions on-site or offsite are aggravated or are damaged by operation.

B. Do not resume vibration and noise producing operations until the Owner reviews and approves the Contractor's revised operation plan with modifications correcting the conditions that caused the suspension.

3.04 DAMAGE

A. Restore or replace utilities, equipment, and structures damaged by vibrations at no additional cost to the Owner.

END OF SECTION

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SECTION 31 23 13
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 012200

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 23 19 - Dewatering

E. Section 32 31 00 - Fences and Gates

F. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. Conform the Work for this Section to the applicable portions of the following Standard Specifications, unless otherwise specified:

1. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

2. ASTM D4491/D4491M: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

3. ASTM D4533/D4533M: Standard Test Method for Trapezoid Tearing Strength of Geotextiles

4. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile

5. ASTM D4632/D4632M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

6. ASTM D6241: Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe

7. American Association of State Highways and Transportation Officials

8. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition.

1.04 ALLOWABLE TOLERANCES

A. Shape the finished subgrade surface to conform to plan grade and cross section within a tolerance of 1 inch in 10 feet.

1.05 SUBMITTALS

A. Test Reports:

1. Testing lab must provide the Engineer with two (2) certified copies of the sieve analysis of the backfill material.

2. Perform testing of the material and certify the test results through a testing laboratory approved by the Engineer.

3. Testing lab must provide the Engineer with two (2) certified copies of the compaction and moisture tests of the backfill and subgrade materials.

4. Use a testing laboratory approved by the Engineer to perform testing of the materials and certify the test results.

B. Samples:

1. Submit sample of the proposed subgrade stabilization fabric measuring not less than 1 syd in area, and the manufacturer’s certification that the proposed fabric meets or exceeds the requirements listed in Part 2 of this Section.

2. Make submissions no later than 10 working days before any installation.

1.06 PRODUCT DELIVERY STORAGE AND HANDLING

A. Furnish and store geotextile fabric in a wrap that protects it from ultraviolet radiation and abrasion. Cover the geotextile with the aggregate base as per plan within two (2) weeks of placement.

1.07 SOIL EROSION AND SEDIMENTATION CONTROL

A. Provide, maintain, and remove temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.

B. Implement measures to prevent surface runoff from carrying excavated materials into the drain, reduce erosion of the slopes, and prevent silting in of the drain downstream of the Work.

C. Measures should include provisions to reduce erosions by the wind of areas stripped of vegetation, including material stockpiles.

D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS

A. Ensure Granular Material conforms to the requirements for Class II granular material as specified in MDOT Section 902.

2.02 AGGREGATE MATERIALS

A. Use crushed limestone, natural aggregate, blast furnace slag, or crushed concrete for undercut backfill, meeting the requirements of 21AA, 21A, or 22A as specified in MDOT Section 902. Ensure crushed concrete is free of all steel and other deleterious materials.

2.03 SUBGRADE STABILIZATION FABRIC

A. Compose subgrade stabilization fabric of synthetic fibers formed into a woven fabric. Use fibers made of 85% propylene or ester polymers. Ensure the geotextile conforms to the following requirements listed below:

Property	Test Procedure	Test Result
Grab Tensile	ASTM D4632/D4632M	270 lbs. (min)
Elongation	ASTM D4632/D4632M	15% (min)
Trapezoidal Tear	ASTM D4533/D4533M	100 lbs. (min)
CBR Puncture Strength	ASTM D6241	900 lbs. (min)
Apparent Opening Size	ASTM D4751	40 – 70 U.S. Sieve
Permittivity	ASTM D4491/D4491M	0.05 per sec (min)

2.04 SEPARATOR FABRIC

A. Furnish geotextiles of either woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Geotextile must have the minimum required strength values in the weakest primary direction. Contractor may use nonwoven geotextile that is one or a combination of the following:

1. Needle punched, heat bonded, or resin bonded

B. Furnish a manufacturer's certified report of test or analysis that shows the geotextile delivered meets the requirements of this specification to the Engineer at least 15 days before use in the Work. Mark the delivered geotextile to clearly identify it with the applicable test report furnished to the Engineer.

C. If using sewn seams, furnish a field sewn seam sample produced from the geotextile and thread sewn with the equipment that will be used on the project, before incorporating into the work.

D. Furnish geotextile conforming to the following physical properties:

Test	Method	Value
Minimum grab tensile strength	ASTM D4632/D4632M	170 lb
Minimum puncture strength	ASTM D6241	350 lb
Maximum apparent opening size	ASTM D4751	No. 70 sieve
Minimum permittivity	ASTM D4491/D4491M	0.35 s-1

1. Numerical values represent minimum/maximum average roll values. Average test results from all rolls in a lot must conform to the tabulated values.

PART 3 EXECUTION

3.01 REMOVING STRUCTURES

A. Remove structures and sewers as called for on the Plans or as determined by the Engineer. Perform removal or abandonment of structures in accordance with Section 01 89 00.

3.02 HOLES

A. Replace earth removed during any phase of excavation or removal operations that results in a hole or void by backfilling to the proposed subgrade with suitable Granular Material approved by the Engineer.

B. Compact material to 95% of its maximum unit weight.

C. Furnish, place, and compact the backfill material at the Contractor's expense.

3.03 SALVAGING AND STOCKPILING TOPSOIL

A. Remove topsoil, within the grading limits for cuts and where the fill is less than 5 feet in height to the top of the proposed road, to the depth and width specified on the Plans.

B. Do not remove topsoil from peat and muck areas.

C. Topsoil salvaged in excess of that required by the Plans will be disposed of by the Contractor at Contractor's expense.

3.04 PREPARING ROADWAY SUBGRADE

A. Remove, displace, or otherwise treat muck, peat, and other unsuitable material within the roadway as shown on the Plans or as directed by the Engineer.

B. Remove deposits of frost heave material within lines 2 feet outside the proposed roadbed to a depth of 3 feet below the surface of the earth grade, unless otherwise shown on the Plans or as determined by the Engineer.

C. Remove ice and snow from the surface of the ground before placing the embankment.

D. Dispose of muck, peat, frost heave material, and other unsuitable material outside the highway limits or spread them uniformly in low places beyond the roadway limits when approved by the Engineer.

E. Plow or scarify old road surfacing, gravel, crushed stone, or other nonrigid type surfacing occurring within the roadbed area and underlying proposed embankment less than 1 foot in depth, that is not salvaged or incorporated in the new Work, full depth. Spread and compact it to form a uniform foundation before placing any new embankment.

F. Break up, remove, and dispose of old pavement and other rigid structures occurring within the roadbed area and underlying the proposed embankment less than 1 foot in depth that are not incorporated into the new Work.

3.05 SUBGRADE

A. Excavate and smooth the area to be paved to the line, grade, and cross section indicated on the Plans.

B. Compact the subgrade between the lines 2 feet on either side of the proposed edge of pavement or curb to 95% of the maximum unit weight for a depth of 7 inches by rolling with a roller weighing not less than 10 tons.

C. Complete subgrade ahead of placing forms or paving a distance equal to one day's average paving operation. Shape and compact the subgrade to the Plan cross section by approved mechanical means before the paving operation.

3.06 PAVEMENT EXCAVATION

A. Perform pavement excavation 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. Include the following items in excavation, any or all of which may be included or incidental: remove trees, stumps, hedges, roots, culverts, sewers, miscellaneous structures; perform roadway excavation; remove asphalt or concrete pavements, curbs, curb and gutters, sidewalks, end headers; remove aggregate surfaces; salvage and stockpile topsoil; perform subgrade undercut; excavate for structures; trim and finish earth grade; perform fine grading, right-of-way ditching and restoration; and dispose of unsuitable material.

C. Completely remove large stones, trees, stumps, brush, shrubs, logs, matted roots, other vegetation, and debris occurring between lines 3 feet outside the grading limits or as otherwise shown on the Plans. Properly dispose of them as specified in Section 31 11 00.

D. Excavate earth and other existing materials to the full depth and width of the cross section shown on the Plans. Excavate material sufficiently to set forms or slip-form equipment. Limit excavation to 3,000 linear feet of right-of-way unless additional lengths are requested in writing and approved by the Engineer.

E.

F. Remove excess excavated material from the project by the Contractor along approved routes to disposal sites approved by the Owner. Consider disposal of excess excavation and maintenance of the dump sites incidental to the price paid for excavation and perform as specified in Section 01 89 00.

3.07 BORROW EXCAVATION

A. Consider materials secured from locations outside the project limits for completing embankments and other items as borrow excavation. Subject borrow pits and materials to removal to inspection by the Engineer. Secure borrow pits and materials by the Contractorunless otherwise provided.

B. Measure borrow excavation by volume in cubic yards compacted in place, based on the neat lines called for on the Plans or authorized by the Engineer. Perform all regular excavation and grading with existing materials for any designated area to facilitate accurate measurement of borrow quantities, unless otherwise specified in the Contract Documents. Have the Engineer cross section these areas prior to furnishing and placing the required borrow material. Have the Engineer resection the completed area and compute the volume of borrow material in its compacted-in-place state. Do not measure or compute borrow material placed beyond the neat lines called for on the Plans or not authorized by the Engineer in writing as borrow excavation. Reject measurement of borrow material by truck count.

C. Maintain public and private roads used between the source of borrow and the Project at the Contractor's expense, including repairs of any damage caused by Contractor's operations. Apply a dust palliative when necessary, as determined by the Engineer.

3.08 EMBANKMENTS

A. Construct embankments with sound earth. Deposit and compact the materials by either the Twelve Inch Layer Method or the Controlled Density Method. Use the Controlled Density Method unless the Twelve Inch Layer Method or another method is specifically called for on the Plans.

B. Strip topsoil from the entire fill area. Remove topsoil to the depth shown on the Plans or determined by the Engineer. After removing topsoil, compact the entire area for embankment construction to not less than 90% of the maximum unit weight, to a depth of 9 inches.

C. Carefully place material where stones are prevalent so that all large stones distribute well and crevices fill completely with smaller stones, earth, sand, or gravel to form a solid embankment. Do not place rock or fragmental material of a size that prohibits placement in layers of the specified depth in the embankment. Do not place stones over 3 inches in diameter within 12 inches of the surface of the earth grade within the areas between lines 2 feet outside the edges of the proposed roadbed.

D. Do not place frozen material in the embankment, nor place the embankment 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. Deposit and spread the material in layers not more than 12 inches deep, loose measure, parallel to the finished grade and extending to the full width of the embankment. Deposit the material by operating the conveying equipment over the layer being placed, as far as feasible.

        b. Compact each layer to not less than 95% of the maximum unit weight at the existing moisture content. Continue compacting until each layer reaches the required density across its full width.

    2. Controlled Density Method:

        a. Deposit and spread embankment material in layers not more than 9 inches deep, loose measure, extending to the full width of the embankment. Spread and compact granular material in layers not more than 15 inches thick if the specified density is obtained.

        b. Use material for embankments of 5 feet or less and the bottom 4 feet of embankments of more than four 4 feet above the ground surface with no more than the optimum moisture content at compaction time.

        c. Use material for the embankment more than 5 feet above the ground surface with a moisture content not greater than 3% above optimum at compaction time, except keep the moisture content of the top 3 feet of the embankment at or below optimum.

F. If granular material is used to construct the embankment, ensure the moisture content is below saturation.

G. If the material contains an excess of moisture, ensure it is dried to the required moisture content before being compacted.

H. Compact each layer of material containing the required moisture to not less than 95% of its maximum unit weight, unless otherwise specified, before starting the succeeding layer.

I. Change the method of operation when the original ground, any section of compacted embankment, or the soil in cut sections becomes rutted or distorted by the Contractor's equipment. Reshape and recompact all rutted or distorted areas at the Contractor's expense before placing any succeeding layers.

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. Remove any excavated material stored along the line of Work between curb and sidewalk on improved lawns within 48 hours. Leave lawns or other improved areas in a neat and clean state within the specified 48 hours.

C. Keep the Work area free of water during the excavation operation, including placement of the subbase. Provide and maintain a dewatering system at the Contractor's expense. Keep the dewatering system in operation until 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.

B. Make one-half of the proof rolling passes under structures in a direction perpendicular to the other passes.

C. Perform proof rolling in the presence of the Engineer. Undercut material showing rutting or pumping, as determined by the Engineer, and replace it with the appropriate fill material.

D. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades.Replace materials degraded by proof rolling a wet or saturated subgrade, as determined by the Engineer, at no cost to the Owner. Notify the Engineer 3 days prior to proof rolling.

3.11 SUBGRADE UNDERCUT EXCAVATION

A. Unsuitable subgrade excavation must be the operation of:

1. removing unsuitable soils as determined by the Engineer, below the level of the ground after topsoil has been stripped in fill areas where the embankment is to be 5 feet or less in height to plan grade, or;

2. the removal of unsuitable soils below the subgrade elevation, as determined by the Engineer in cut areas after the subgrade has been established.

B. In fill areas, after topsoil has been stripped in accordance with this Section, the 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, the Engineer will inspect the subgrade to determine the extent of any additional excavation of unsuitable soils.

D. Backfill areas excavated of unsuitable material with non-frost heaving material similar to adjacent soil, unless otherwise specified in the Contract Documents. Backfill excavation with MDOT Granular Material, Class II, and provide drainage in areas with free water due to seepage as determined by the Engineer. Compact backfill 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. Lay the fabric smooth and free of tension stress, wrinkles, or creases.

B. Place fabric strips to provide a minimum overlap of 24 inches for each joint. Position fabric so the upper strip overlaps the next lower strip.

C. If the geotextile sustains damage during construction, repair the torn or punctured section by placing a fabric piece large enough to cover the damaged area plus 24 inches beyond to adjacent undamaged geotextile in all directions.

3.13 GEOTEXTILE SEPARATOR FABRIC

A. Before placing the geotextile, smooth, shape, and compact the subgrade to the required grade, section, and density. After placing the geotextile on the subgrade, do not allow traffic or construction equipment to travel directly on the geotextile.

B. Roll the geotextile out on the roadway and pull taut manually to remove wrinkles. Join separate pieces of geotextile by overlapping or sewing. Place the geotextile in the overlapped joints so it overlaps at least 18 inches.

C. Engineer may require the use of weights or pins to prevent the wind from lifting the geotextile.

D. After placing, do not expose the geotextile longer than 48 hours before covering.

E. Place backfill material over the geotextile by back dumping with trucks and leveling with a crawler dozer. Do not use construction equipment that causes ruts deeper than 3 inches. Fill ruts with additional material. Do not smooth ruts without adding additional material. Cover damaged areas with a patch of geotextile using a 3 foot overlap in all directions.

3.14 TRIMMING AND FINISHING EARTH GRADE

A. After constructing the earth grade to the required grade, remove all stones and rocks more than 3 inches in diameter appearing on the subgrade surface.

B. Trim earth grade and subgrade to the grade called for on the Plans. Trim subgrade requiring a subbase or base course to the established grade within ± 0.1 foot. Trim subgrade without a subbase or base course to the established grade within ± 3/4 inch.

C. Trim the earth grade outside the subgrade, smooth all irregularities, and complete the entire site or roadway to the required lines, grades, and cross sections. Finish backslopes and fill

slopes as either Class A or Class B slopes. Require Class A slopes unless otherwise specified in the Contract Documents.

1. Class A Slopes:

    a. Finish Class A slopes to the average slopes shown on the Plans, allowing no variations exceeding 0.1 foot above or below the established grade measured at right angles to the slopes.

2. Class B Slopes:

    a. Finish Class B backslopes to the average slopes shown on the Plans, allowing no variations exceeding 0.5 foot above or below the established grade measured at right angles to the slope.

    b. Finish Class B fill slopes to within 0.2 foot of the established grade and cross section from the outside shoulder line for a distance of 3 feet down the slope. Ensure the remainder of the completed fill slope conforms to the requirements for Class B backslopes.

3. Obtain the degree of finish of the slopes from machine operations. Do not require the smoothness of surface finish ordinarily associated with template, string line, or hand operations, but do not permit abrupt variations.

4. Remove debris except sod, leaf mold, and rotted forest litter. Break or remove loose clods of earth extending beyond the specified slope tolerance.

5. Where waste earth or other surplus material is deposited on fill slopes, the slopes may be flattened or otherwise altered as directed by the Engineer, to produce a uniform cross section which blends with the topography and presents a pleasing appearance.

D. Round the tops of backslopes, bottoms of fill slopes, and all other angles in the cross section lines to form vertical curves as shown on the Plans or as determined by the Engineer, where trees or other restrictions do not interfere. Make transitions in length of vertical curves gradual to present a uniform and attractive appearance. Omit vertical curves when constructing ditches in peat.

3.15 SUBBASE

A. Spread and compact Granular material for subbase evenly as specified in MDOT Section 301.

B. Determine the thickness of each layer placed by the required density obtained, but do not exceed 15 inches in depth, loose measure.

C. Construct the subbase to the alignment, grade, and cross section shown on the Plans. Cease operation immediately if the subgrade becomes soft or unstable causing rutting, or if subgrade material forces up into the subbase during placing. Remove and dispose of the mixed material. Correct the subgrade and place and compact new subbase material. Consider this Work incidental to the construction of the Project.

3.16 SCARIFY, RE-GRADE AND COMPACT EXISTING SUBGRADE

A. Scarify the existing subgrade (base) to a depth of 9 inches within the limits as shown on the plans. Reshape the subgrade to the cross section shown on the plans and compact it to 95% of its maximum unit weight by rolling with a roller weighing not less than 10 tons.

3.17 ROADWAY DITCHING

A. Construct ditching at the locations called for on the Plans or as determined by the Engineer. Shape the ditch by machine grading or another method approved by the Engineer to achieve the cross section, line, and grade shown on the Plans.

B. Dispose of the excess material from ditch construction by the Contractor at Contractor's expense.

C. Grade the ditch section to receive topsoil and seed.

1. Conform topsoil, seed, fertilizer, and mulch to the requirements specified on the Plans and in Section 32 92 19.

D. Furnish, place, and compact any additional material needed to construct the ditch at the location and cross sections called for on the Plans, at Contractor's expense.

3.18 RIGHT-OF-WAY RESTORATION

A. Restore the right-of-way in accordance with the type and location specified on the Plans. Shape the right-of-way by machine grading or another method approved by the Engineer to achieve the cross section, line, and grade shown on the Plans.

B. Dispose of excess material from the right-of-way restoration operation by the Contractor at Contractor's expense, as specified in Section 01 89 00.

C. Grade the right-of-way to receive topsoil and seed.

1. Conform topsoil, seed, fertilizer, and mulch to the requirements specified on the Plans and in Section 32 92 19.

D. Furnish, place, and compact any additional fill meeting the Engineer's approval, needed to construct the right-of-way to the cross sections called for on the Plans, at Contractor's expense.

3.19 MACHINE GRADING

A. Perform machine grading consisting of light grading that generally utilizes excavation from ditches and roadbed to shape shoulders and adjacent shallow fills. Use a blade grader or similar equipment. Apply machine grading on the sections shown on the Plans or specified in the Contract Documents.

B. Include all necessary scarifying, plowing, discing, moving, and shaping of the earth to develop the cross section shown on the Plans.

C. Make ditches conform reasonably close to the line and grade shown on the Plans or as directed, and drain runoff waters to outlets shown on the Plans or designated by the Engineer.

D. Finish the roadbed to grade using a blade grader or equivalent equipment.

E. Grade intersections, approaches, entrances, and driveways as shown or directed, excluding loading and hauling of earth as part of this Work.

3.20 MAINTENANCE AGGREGATE

A. Furnish and install MDOT 21A, 21AA or 22A maintenance aggregate to maintain pedestrian and traffic access. Place and compact aggregate to maintain access in areas determined by the Engineer.

B. Maintenance aggregate will be incidental to the Project unless otherwise specified in the Contract Documents.

3.21 TESTING

A. During the course of the Work, the Engineer may require testing for compaction, sieve analysis and moisture content of the backfill and subgrade materials.

B. Have a testing laboratory suitable to the Owner and approved by the Engineer perform sampling and required testing.

C. Engineer must determine the location and number of samples to be made. ve the testing laboratory furnish the Engineer with two (2) certified copies of the results of all tests.

D. Conform testing procedures to current MDOT Standards for Construction .

E. Understand maximum unit weight, when measuring soil compaction or density, as the maximum unit weight per cubic foot (or cubic meter) determined by ASTM D1557, Method D, modified to include all the material passing the 1 inch sieve.

3.22 DEFECTIVE WORK

A. Correct any portion of the backfill, subbase, or subgrade deficient in specified density by methods approved by the Engineer.

B. Charge any extra testing or sampling required by the Engineer due to deficiencies to the Contractor's expense.

END OF SECTION

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SECTION 31 23 16
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 57 13 - Temporary Erosion and Sediment Control

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 11 00 - Clearing and Grubbing

D. Section 31 23 19 - Dewatering

E. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. Conform the Work for this Section, unless otherwise specified, to the applicable portions of the following Standard Specifications:

1. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)

2. American Association of State Highway Transportation Officials

3. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 SUBMITTALS

A. Have the testing laboratory provide the Engineer with two (2) certified copies of the backfill compaction test results. Perform compaction testing and certification by a testing laboratory approved by the Engineer.

1.05 SOIL EROSION AND SEDIMENTATION CONTROL

A. Provide, maintain, and remove temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or determined by the Engineer.

B. Prevent surface runoff from carrying excavated materials into waterways, reduce erosion of slopes, and prevent silting 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 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS

A. Make granular material conform to the requirements for Class II, as specified in MDOT Section 902. Use natural bank run sand for granular material.

2.02 COARSE AGGREGATE

A. Make coarse aggregate conform to the requirements for 6A, as specified in MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

A. Dewater the area within the vicinity of the new Work in accordance with Section 31 23 19 prior to the excavation operation.

B. Ensure the depth of dewatering allows the excavation to remain dry during the construction of the structure, including excavating, backfilling, and compacting operations.

3.02 SHEETING, SHORING, AND BRACING

A. Furnish, place, and maintain sheeting, shoring, and bracing of the excavated area at all times to ensure the safety of workmen and protect the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines, and conduits next to or crossing the excavated area, as well as the safety of pedestrian and vehicular traffic.

B. Take responsibility for the complete design of all sheeting, shoring, and bracing Work. Design the system to suit soil conditions, with sufficient strength, quality, dimension, and spacing to prevent caving, loss of ground, or squeezing within the neat lines of the excavation, and to effectively restrain movement of adjacent soil.

C. Submit Plans for sheeting, shoring, or bracing Work to the Engineer for informational purposes only before installation.

D. Make sheeting, shoring, bracing, and excavation conform to current federal or state safety regulations.

E. Install and leave sheeting, shoring, and bracing in place where indicated on the Plans and necessary in the Work. No extra compensation will be paid to the Contractor for sheeting, shoring or bracing left in place unless otherwise indicated in the Proposal.

F. Make supports for pipes, conduits, etc., crossing the excavated area conform to the requirements of the owners of such facilities, and leave them in place if necessary.

G. Provide, place, maintain, and remove sheeting, shoring, and bracing materials at the Contractor's expense unless otherwise indicated in the Proposal.

H. Do not remove sheeting, shoring, or bracing until the structure attains sufficient strength to support external loads.

I. Prevent sheeting, shoring, and bracing material from contacting the structure, and install them to avoid transmitting concentrated loads or horizontal thrusts to the structure.

3.03 COFFERDAMS

A. Maintain, install, and remove a cofferdam as a substantially watertight enclosure, well-point system, or similar system that permits construction of the substructure above seal or subfooting in dry conditions and without damaging the Work.

B. 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.

C. 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.

D. Make interior dimensions of cofferdams sufficient to provide clearance for constructing forms, inspecting their exteriors, and permitting dewatering outside the forms.

E. Right or enlarge cofferdams, caissons, or cribs tilted or moved laterally during sinking to provide necessary clearance.

F. Do not brace cofferdams to substructure forms. Construct cofferdams to protect the Work in place from damage by high water and prevent foundation injury by erosion.

G. Prevent timber bracing from extending into or remaining in the finished concrete.

H. Remove cofferdams without disturbing or marring the finished concrete. Leave cofferdam sheeting in place when called for on the Plans or when necessary in the Work.

I. Provide, construct, maintain, and remove cofferdams, including pumping, at the Contractor 's expense.

J. Take responsibility for any claims for damages resulting from electing to use a well-point system or similar system.

3.04 EXCAVATION

A. Include site clearing and grubbing, excavating and disposing of all encountered materials, supporting and protecting all structures and/or utilities above and below the ground surface, and removing water from the construction site in excavation.

B. Include removal of existing structures, as shown on the Plans or determined by the Engineer, in excavation.

C. Perform rock excavation, if applicable, as part of the excavation according to specifications contained elsewhere.

D. Keep excavation operations within reasonable close conformity with the location and grade of each structure.

E. Temporarily store excavated materials to avoid damage to trees, shrubs, fences, improvements, utilities, private property, or traffic. Do not place excavated materials in locations that endanger excavation banks by imposing loads.

F. Make the excavation large enough to allow construction of the new Work, placement and compaction of backfill, and dewatering operations.

G. Take special care not to disturb excavated surfaces, other than rock, where concrete will bear. Perform final removal of foundation material to grade just before placing the concrete.

H. Do not place concrete until checking the excavation depth and reviewing the suitability of foundation material with the Engineer.

I. Excavated material, determined by the Engineer as suitable for backfill may be used.

J. Dispose of excess materials at the Contractor's expense, as specified in Section 01 89 00.

K. Make changes to footing bottom elevations as necessary to ensure a satisfactory foundation. Review any required changes with the Engineer before proceeding.

L. Clean all rock or hard material surfaces of loose fragments and cut them to a firm surface before placing concrete. Make the surface level, stepped, or serrated, as shown on the Plans.

M. Remove unsound material underlying proposed structures and replace it with granular material approved by the Engineer, in layers not exceeding 6 inches in depth. Compact each layer to 95% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

3.05 BACKFILL

A. Place backfill material only after the Engineer inspects the new Work and backfill material.

B. Do not place backfill against any portion of the new Work until completing required curing, surface finishing, and waterproofing. Avoid placing backfill that creates unequalized horizontal loading until the concrete reaches at least 70% of its design strength. Place required backfill on opposite sides at the same time to equalize horizontal loadings.

C. Use granular material for backfilling within 3 feet of all manholes, chambers, valve wells, valve boxes, other pipeline structures, footings, piers, abutments, columns, walls, foundations, etc., unless otherwise indicated in the Contract Documents.

D. Backfill spaces excavated and not occupied by the new Work or specified backfill material with suitable material from the excavation.

E. After placing and compacting backfill to the flow line elevation of any weep holes indicated on the Plans, cover the back end of each weep hole with no less than 2 cubic feet of coarse aggregate.

F. Exclude large stones, boulders, broken rocks, concrete, and masonry from backfill.

G. Carry backfill up to the surface of adjacent ground or to the elevation of proposed earth grade, and neatly grade its top surface. Trim fills around all new Work to the lines shown on the Plans or as directed by the Engineer.

3.06 COMPACTING BACKFILL

A. Place all backfill behind and around the new Work in layers not exceeding 9 inches in depth, and compact to at least 95% of maximum unit weight.

B. Compact areas where density does not affect construction, as determined by the Engineer, to at least 90% of maximum unit weight.

C. Place backfill material as specified in MDOT Section 206.03.B, except for the following modifications. Ensure moisture content does not exceed 3% above optimum at the time of compaction. Dry material to required moisture content before installation if it contains excess moisture.

D. Compact each layer containing the required moisture to at least 95% of maximum unit weight before starting the succeeding layer, unless otherwise specified on the Plans or authorized by the Engineer.

E. Consider compaction of backfill incidental to the Work of backfilling, including all soil manipulation to achieve specified densities, with no separate payment. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 CLEANUP

A. Remove and dispose of excess material immediately after placing and compacting backfill at the Contractor's expense, as specified in Section 01 89 00.

B. Grade the construction area and leave it in a neat, workmanlike condition.

C. At a seasonally correct time, rake the disturbed area, place topsoil, fertilize, and restore according to the requirements of 32 92 19.

3.08 TESTING

A. During the Work, perform testing for backfill compaction or density as required by the Engineer. Have a testing laboratory approved by the Engineer take samples and conduct the testing.

1. Charge the cost for testing and sampling to the Owner.

B. Have the testing laboratory furnish the Engineer with two (2) certified copies of all test results. Conform testing procedures to current MDOT's Standard Specifications for Construction.

C. Understand the maximum unit weight, when measuring soil compaction or density, as the maximum unit weight per cubic foot or cubic meter determined by ASTM D1557, Method A, for Granular Materials, and Method C for all other soils.

3.09 DEFECTIVE WORK

A. Correct any portion of the backfill deficient in specified density by methods approved by the Engineer. Charge any extra testing or sampling required due to apparent deficiencies to the Contractor's expense.

END OF SECTION

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SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes 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 012200

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 23 16 - Structural Excavation and Backfill

E. Section 31 23 33 - Trenching and Backfilling

1.03 DESIGN OF DEWATERING CONSTRUCTION

A. Geotechnical investigations made in relation to this Project are provided as reference documents. Interpretations of all data and reports, performing any additional investigations, and obtaining any additional data for construction purposes is the responsibility of the Contractor.

B. Take responsibility for the complete design of all structures and methods proposed for dewatering the project site, including implementing materials, tools, and equipment proposed for the Work.

C. Make temporary wiring associated with dewatering comply with applicable portions of the National Electrical Code.

D. Provide monitoring wells as necessary to determine the groundwater levels along the alignment and shaft locations.

1.04 SOIL EROSION AND SEDIMENTATION CONTROL

A. Design and construct dewatering systems to conform to Part 91 of Soil Erosion and Sedimentation Control, Act 451 "Natural Resources and Environmental Protection Act" of 1994; and Section 01 57 13 - Temporary Erosion and Sediment Control. Obtain and pay for all permits and inspections for dewatering construction according to PA 451, State of Michigan, 1994, and all local government agencies with jurisdiction. Deny additional compensation claims due to failure to obtain or pay for such permits and inspections.

B. Provide, maintain, and remove temporary and/or permanent soil erosion and sedimentation control measures at the Contractor's expenseas specified on the Plans or determined by the Engineer. Prevent surface runoff from carrying excavated materials into waterways, reduce erosion of slopes, and prevent silting downstream of the Work. Include provisions to reduce wind erosion of areas stripped of vegetation, including material stockpiles.

1.05 FEDERAL, STATE, AND LOCAL REGULATIONS

A. Make dewatering operations conform to the requirements of all federal, state, and local agencies having jurisdiction.

B. Obtain any required permits from federal, state, or local agencies for discharging dewatering water to streams, drains, or sewers. Comply with all water quality requirements before discharging dewatering water. Take responsibility for testing and treatment to meet water quality standards prior to discharge. Do not discharge to sanitary sewers without prior approval from local agencies with jurisdiction over sanitary sewers.

1.06 PROTECTION

A. Take necessary steps during the Work of this Section to protect surrounding property, adjacent buildings, private water supplies, roads, drains, sewers, structures, and appurtenances. Implement adequate measures to protect such property and construction from the effects of 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. Design the dewatering system by a professional with a minimum of seven years of documented experience in dewatering system installation and design. Submit plans signed and sealed by a registered Professional Engineer in the state of Michigan, stating that the proposed dewatering method adequately performs the required tasks.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Provide electrical power from the local utility. Supply stand-by power and other auxiliary dewatering equipment to ensure continuous dewatering capability. Maintain continuous dewatering where required. Do not stop dewatering during work stoppage without Engineer approval. Coordinate construction operations to minimize the duration and extent of required dewatering.

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 a minimum of 200-foot intervals located between dewatering wells. Provide access to monitoring wells by Engineer.

B. Modify dewatering operation if geotechnical instrumentation or survey measurements indicates 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. Verify in the field the location, type, and capacity of existing drainage facilities and conditions affecting the Work of this Section before beginning. Make no allowances for conditions discovered during dewatering operations caused by failure to verify such conditions.

3.04 EXISTING STRUCTURES AND UTILITIES

A. Make field verification of existing structures and utilities at the Work site that are scheduled to remain and may be affected by this Section. Take responsibility for damage to existing structures and utilities caused by the Work and repair such damage at the Contractor's expense to the satisfaction of the Engineer or utility owner.

3.05 DRAINAGE OF EXCAVATIONS

A. Maintain finished excavation Work free of water during subgrade preparation and until Work completion. Prevent discharge of ground or surface water into existing sanitary sewers. Do not construct any unit of Work under water unless otherwise determined by the Engineer.

B. Provide and maintain adequate dewatering equipment to remove and dispose of surface or groundwater entering excavations, trenches, or other Work areas. Keep each excavation dry during subgrade preparation and continually until construction completes.

C. Dewater excavations extending to or below the static groundwater elevation by lowering and maintaining the groundwater level at least 12 inches below the excavation bottom. Design drainage system methods to avoid damage to wells or adjacent property.

D. Keep outlet drainage piping and conduit clean and free from sediment. Hold the Contractor responsible for the condition of existing pipes, conduits, and structures used for drainage.

3.06 DEWATERING SUMPS AND PUMP WELLS

A. Strongly sheath and brace sumps and pump wells used in the dewatering system to protect construction during use. Cover tops of well casings to prevent animals and debris from entering, positioning them 2 to 3 feet above ground. Backfill and compact sumps and wells upon abandonment to the Engineer's satisfaction.

3.07 DRILLING

A. Take responsibility for methods used in drilling wells associated with dewatering systems. Ensure methods are acceptable to the Engineer.

B. Ensure drilling methods place well materials properly and avoid displacement of earth formations.

C. Use equipment of proper type, in good condition, and acceptable to the Engineer for drilling.

3.08 PUMPING

A. Take responsibility for equipment and methods for pumping associated with dewatering systems. Ensure they are acceptable to the Engineer. Construct or furnish adequate discharge piping to conduct and dispose of water, preventing damage to existing structures or property.

B. Use pumping equipment of proper type and size for the Work, in good condition, and acceptable to the Engineer. Provide necessary 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 Contract Drawings and as determined by the Engineer. Compact earth fills to a density equal to the surrounding undisturbed earth.

END OF SECTION

SECTION 31 23 33
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 57 13 - Temporary Erosion and Sediment Control

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 11 00 - Clearing and Grubbing

D. Section 31 22 00 - Grading

E. Section 31 23 16 - Structural Excavation and Backfill

F. Section 31 23 19 - Dewatering

G. Section 32 92 19 - Seeding

H. Section 32 92 23 - Sodding

I. Section 33 14 00 - Water Utility Distribution Piping

J. Section 33 30 00 - Sanitary Utility Sewerage Piping

K. Section 33 31 00 - Sanitary Sewerage Piping

L. Section 33 41 00 - Storm Utility Drainage Piping

1.03 REFERENCE STANDARDS

A. Conform to the applicable portions of the following Standard Specifications for the Work in this Section, unless otherwise specified:

1. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete

2. ASTM C150/C150M - Standard Specification for Portland Cement

3. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements

4. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

5. ASTM C1479/C1479M - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations

6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

8. American Association of State Highway Transportation Officials
9. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 TEST REPORTS

A. Testing laboratory must provide the Engineer with two (2) certified copies of the test results of the compaction of the backfill.

B. Perform testing for compaction and certify the test results through a testing laboratory approved by the 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. Provide, maintain, and remove temporary and/or permanent soil erosion and sedimentation control measures at Contractor's expense, as specified on the Plans or as determined by the Engineer.

B. Prevent surface runoff from carrying excavated materials into the drain, reduce erosion of the slopes, and prevent silting in of the 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 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS CLASS II

A. Conform to the requirements for Granular Material Class II as specified in MDOT Section 902, except the granular material must be natural bank run sand with a maximum size of 1-1/2 inches.

2.02 CRUSHED STONE BEDDING

A. Crushed, angular, natural stone material, meeting the requirements of 21AA coarse aggregate as specified in MDOT Section 902. Crushed concrete and slag are not allowed.

2.03 CONCRETE

A. Conform to MDOT Section 1004 ; use 3,000 psi strength; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without Engineer's approval.

2.04 FLOWABLE FILL FOR BACKFILLING

A. Materials

1. Use Fly Ash with a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).
2. Ensure water meets the requirements of ASTM C94/C94M.
3. ASTM C150/C150M or ASTM C595/C595M, Type I or Type IA.

B. Mixture (Strength 100 to 120 psi)

1. Fly Ash: 2,000 lbs per cyd min
2. Cement: 70 lbs per cyd min
3. Water: Sufficient water to produce desired flowability 700 lbs per cyd

C. Maintain the temperature of the flowable fill mix at a minimum of 50 degrees Fahrenheit during manufacture and delivery.

D. The 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. Dewater the area within the vicinity of the trenching operation in accordance with Section 31 23 19 prior to the trenching operation.

B. Ensure the depth of dewatering is sufficient to allow trench excavation, backfilling, and compacting to proceed in a dry condition.

3.02 TRENCH EXCAVATION

A. Include site clearing and grubbing, excavation of all encountered materials, supporting and protecting structures and/or utilities above and below ground, and removal of water from the construction site in open cut trench excavation.

B. Commence the trenching operation at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified on the Plans or directed by the Engineer.

C. Excavate the trench in reasonably close conformity with the lines and grades specified on the Plans or as established by the Engineer.

D. Temporarily store excavated materials along the trench without causing damage to trees, shrubs, fences, improvements, utilities, private or public property, or traffic. Avoid placing excavated materials in locations that endanger trench banks by imposing loads.

E. Excavate the trench for rigid pipe to a width sufficient to provide adequate working space for pipe installation and compaction of bedding material under and around the pipe. Ensure the width of the trench from below the pipe bedding to 12 inches above the top of the pipe does not exceed the following dimensions:

Diameter of Pipe	Width of Trench
6 thru 12 inch pipe	30 inches wide
15 thru 36 inch pipe	outside diameter plus 16 inches
42 thru 60 inch pipe	outside diameter plus 20 inches

over 60 inch pipe	outside diameter plus 24 inches

1. When the maximum trench width specified for rigid pipe is exceeded, install at Contractor's expense, concrete encasement to support the additional load of the backfill. Completely surround the pipe with encasement having a minimum thickness of 1/4 the outside diameter of the pipe or 4 inches, whichever is greater; or at Contractor's expense, install another type bedding, approved by the Engineer. Use 3,000 psi strength concrete for the encasement.

F. For flexible pipe, ensure the minimum trench width is not less than the greater of the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25, plus 12 inches. Do not exceed the minimum width by more than 6 inches for the maximum trench width.

1. When the maximum trench width specified for flexible or semi-rigid pipe is exceeded, install at Contractor's expense, crushed stone bedding material to the full width between undisturbed trench walls or at least 2.5 pipe diameters on each side of the pipe to support the additional load of the backfill.

G. When proper alignment and grade cannot be maintained due to construction procedure or unsuitable ground conditions, excavate below the normal trench bottom grade at Contractor's expense. Fill the void with large size aggregate or 3,000 psi (21 MPa) concrete as approved by the Engineer to ensure the pipe maintains correct alignment and proper grade when laid in the proper bedding.

H. Brace and/or sheet trench excavations, including those for shafts and structures, adequately to prevent caving or squeezing of the soil.

3.03 SHEETING, SHORING, AND BRACING

A. Furnish, place, and maintain sheeting, shoring, and bracing of the trench and/or shaft as required to ensure the safety of workmen and protect the new Work, adjacent structures, including pavement, curbs, sidewalks, pipelines, and conduits next to or crossing the trench, and to protect pedestrian and vehicular traffic.

B. Take full responsibility for the complete design of all sheeting, shoring, and bracing Work. Design for the specific soil conditions and ensure strength, quality, dimension, and spacing sufficient to prevent caving, ground loss, or squeezing within the neat lines of the excavation, and to effectively restrain movement of adjacent soil.

C. Submit plans for installing sheeting, shoring, or bracing to the Engineer for informational purposes prior to installation.

D. Conform sheeting, shoring, bracing, and excavation to current federal or state safety regulations.

E. Install and leave sheeting, shoring, and bracing in place where indicated on the Plans and necessary in the Work. Do not pay additional compensation to Contractor for sheeting, shoring or bracing left in place.

F. Conform supports for pipes, conduits, etc. crossing the trench to the requirements of the facility owners and leave them in place if necessary.

G. Furnish, place, brace, maintain, and remove sheeting, shoring, and trenching materials at the Contractor's expense.

H. Do not remove trench sheeting, shoring, and bracing until the pipe is properly bedded and the trench backfilled to sufficiently support external loads.

I. Install sheeting, shoring, and bracing material without contact with the pipe, preventing concentrated loads or horizontal thrusts from transmitting to the pipe.

3.04 PIPE BEDDING

A. Install and compact in 6 inch layers. Take particular care to fill and tamp all spaces under, around, and above the top of the pipe. Work by hand in and around the pipe to provide uniform support.

B. Rigid Pipe Bedding:

1. Conform rigid pipe bedding to ASTM C1479, except as noted.

2. Class R-A:

a. Bed pipe in crushed stone material on the trench bottom. Ensure bedding has a minimum thickness beneath the pipe of 4 inches or 1/4 of the outside diameter of the pipe, whichever is greater, and extends up the sides of the pipe to the horizontal centerline.

b. Cover the top half of the pipe with a monolithic plain concrete arch having a thickness of at least 4 inches 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 8 inches or 1-1/4 of the diameter of the pipe, whichever is greater.

3. Class R-B:

a. Bed the pipe in crushed stone bedding material placed on the trench bottom. Ensure the bedding has a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and extends up the sides of the pipe to the horizontal centerline.

b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe using granular material Class II. Place this material in 6 inch layers and thoroughly compact each layer by mechanical means until the finished compacted material reaches a minimum of 12 inches above the top of the pipe.

4. Class R-C:

a. Bed the pipe in granular material Class II placed on the trench bottom. Ensure the bedding has a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and extend the bedding to a level not less than 12 inches above the top of the pipe.

b. Place this material in 6 inch , thoroughly compact each layer by mechanical means, and ensure the finished compacted material reaches a minimum 12 inches above the top of pipe.

C. Flexible Pipe Bedding:

1. Conform flexible pipe bedding to ASTM D2321, except as noted.Provide a continuous and uniform bedding in the trench for all buried pipe.

2. Class F-I:

    a. Bed the pipe in crushed stone bedding material placed on the trench bottom. Ensure the bedding has a minimum thickness of 4 inches and beneath the pipe and extends up the sides until the top of the pipe is covered by at least 12 inches of material.

    b. Use bedding to the full width between undisturbed trench walls where allowable trench widths are exceeded. Do not use concrete cradle bedding.

3. Class F-II:

    a. Bed the pipe in crushed stone bedding material placed on the trench bottom. Ensure the bedding has a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and extends up the sides of the pipe to the horizontal centerline.

    b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe using granular material Class II. Place this material in 6 inch layers and thoroughly compact each layer by mechanical means until the finished compacted material reaches a minimum of 12 inches above the top of pipe.

    c. Use bedding to the full width between undisturbed trench walls where allowable trench widths are exceeded. Do not use concrete cradle bedding.

4. Class F-III:

    a. Bed the pipe in granular material Class II placed on the trench bottom. Ensure the bedding has a minimum thickness beneath the pipe of four 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and extends to a level not less than 12 inches above the top of the pipe. Place this material in 6 inch layers and thoroughly compact each layer by mechanical means until the finished compacted material reaches a minimum of 12 inches above the top of the pipe.

    b. Use bedding to the full width between undisturbed trench walls where allowable trench widths are exceeded. Do not use concrete cradle bedding.

3.05 BACKFILLING TRENCHES

A. Place backfill material on sections of bedded pipes only after receiving approval from the Engineer for the pipe bedding and backfill materials.

B. Follow pipe laying with trench backfilling as closely as possible. Do not allow pipe laying in any trench to precede backfilling by more than 100 feet, unless otherwise directed by the Engineer.

C. Do not perform backfilling in freezing weather except by permission of the Engineer. Avoid using frozen materials in trench backfilling.

D. Use the following trench backfill specifications for the portion of the trench beyond the pipe bedding, which normally ends 12 inches above the top of the pipe. Place backfill material above the pipe bedding free of cinders, ashes, refuse, boulders, roots, stumps, trees, timbers, brush, debris, or other materials deemed unsuitable by the Engineer. Do not place rocks or stones larger than 6 inches within three 3 feet of the top of the pipe. Place large stones in the remainder of the trench backfill only if well separated and arranged to avoid interference with backfill settlement.

E. Conform the type and method of backfilling to the following requirements based on its location and function:

1. Trench B:

a. Backfill trenches under road surfaces, pavement, curb, driveway, sidewalk, and where the trench edge is within three 3 feet of the pavement, as well as areas noted on the Plans, with natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.

b. Backfill trenches under pavement to be constructed in the near future, as noted or shown on the Plans, with natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.

c. Where a pipe is installed under an existing or proposed utility, backfill between the two with natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans, and construct as herein specified.

d. Place the material in uniform layers that can be adequately compacted and tested from the surface of each layer. Compact each layer to 95% of the material’s maximum unit weight, unless otherwise specified on the Plans or by the Engineer.

2. Trench A;

a. Backfill trenches with suitable excavated material placed in uniform layers that can be adequately compacted and tested from the surface of each layer.

b. Thoroughly compact each layer by approved mechanical methods to a density equivalent to the undisturbed adjacent soil or 90% of its maximum unit weight, whichever is less.

3. Carry trench backfill to the level of the adjacent existing ground or proposed grade, whichever is higher, unless otherwise specified on the Plans or directed by the Engineer.

4. Use care to avoid displacing any pipes or structures due to fluid pressure where flowable fill is used for backfill or bedding as shown on the Plans or specified. Secure pipes in backfill areas as needed to counteract the buoyancy effect.

3.06 COMPACTING BACKFILL

A. Do not pay separately for backfill compaction; consider it incidental to the work of pipe installation and backfilling, including all soil manipulation to achieve the specified densities. Do not allow additional compensation for delays required to obtain the specified moisture content or density.

3.07 CLEANUP

A. Immediately remove and dispose of excess material by the Contractor, at the Contractor's expense, as specified in Section 01 89 00, following the placing and compacting of the backfill. Level the construction area and leave it in a neat, workmanlike condition.

B. Rake the disturbed area at a seasonally correct time approved by the Engineer, place topsoil thereon, and restore the area.

1. Restore the area with seed, fertilizer, and mulch according to the requirements of Section 32 92 19 .

2. Restore with sod in accordance with Section 32 92 23.

3.08 FIELD TESTING

A. Conduct testing for compaction or density of the backfill during the Work when required by the Engineer. Perform sampling and testing through a testing laboratory suitable to the Owner and approved by the Engineer.

B. Define the maximum unit weight, when measuring soil compaction or density, as the maximum unit weight per cubic foot or cubic meter determined by ASTM D1557, Method C.

3.09 DEFECTIVE WORK

A. Correct any portion of the trench backfill deficient in the specified density using methods approved by the Engineer.

B. Charge additional testing or sampling required due to deficiencies to the Contractor's expense.

END OF SECTION

SECTION 31 50 00
EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work specified in this Section includes initial ground support systems for trenches and near surface excavations for manholes, junction chambers, diversion structures, and miscellaneous concrete structures.

B. This Section does not apply to shafts or tunnel excavations.

C. Use the minimum designs of temporary excavation support systems for SCS-2-DS, SCS-2-GSS, E-01C-DV, E-10A-MH, E-12A-JN, E-13A-DV, E-18A-DV, and E-18A-JN as included in the Contract Drawings. Design temporary excavation support for all other near surface excavations.

1.02 RELATED SECTIONS SPECIFIED ELSEWHERE

A. Section 31 23 19 - Dewatering

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M: Carbon Structural Steel

B. ASTM A53/A53M: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

C. ASTM A307: Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength

D. ASTM A328/A328M: Steel Sheet Piling

E. ASTM A500/A500M: Cold-Formed Welded

F. ASTM A501/A501M: Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

G. ASTM A572/A572M: High-Strength Low-Alloy Columbium-Vanadium Structural Steel

H. ASTM A690/A690M: High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments

I. ASTM A992/A992M: Structural Steel Shapes

J. ASTM F3125/F3125M: High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength

K. AWS D1.1/D1.1M: Structural Welding Code – Steel

L. AWPA C2: Lumber, Timber, Bridge Ties and Mine Ties Preservative Treatment by Pressure Processes

M. 29 CFR: US Department of Labor, Occupational Safety and Health Administration, Code of Federal Regulations Title 29 Labor

1.04 DEFINITIONS

A. Initial ground support system: the support installed prior to or concurrent with excavation to maintain stability of the opening until the excavation is closed.

B. Apply definitions of terms in OSHA 29 CFR, Subpart P - Excavations, 1926.650(b), in their entirety to this Section. The following terms are of particular interest to this Section: excavation, trench, protective system, support system, shoring system, sloping system, benching system, shield, trench box, cave-in, and competent person.

1.05 SUBMITTALS

A. Submit Contractor's designer and subcontractor qualifications a minimum of 30 days prior to the execution of the excavation. Demonstrate experience in designing and constructing at least three similar projects, including excavation support system types, depths, and ground and groundwater conditions.

B. Submit an excavation support plan stamped and signed by a Professional Engineer licensed in the State of Michigan at least 30 days before excavation begins. Include the following information in the plan:

1. Limits of working area, including minimum lateral distance from the edge of the excavation support system for construction equipment, stockpiled construction, and excavated materials.
2. Maintenance of traffic (if any).
3. Proposed excavation support systems, location, layout, depth, extent of the different types of support relative to existing features and projected structures, and methods and sequence of installation and removal (if applicable).
4. Design assumptions and calculations.
5. Member sizes and thickness, and bending tolerances of structural steel.
6. Connection details.
7. Maximum allowable spacing between bracing points on compression members to maintain stability and alignment.
8. For initial support members installed in advance of excavation, describe: methods of installation, of quality control, and of correcting support system defects exposed by subsequent excavation.
9. List and specifications sheets of equipment to be used for installation of the excavation support systems.
10. Quality of materials to be used (by reference to recognized standards such as ASTM), including but not limited to timber structural members, steel plates, and blocking; steel structural members, plates, and bars; concrete; and grout.
11. Monitoring schedule, installation procedures and location plans for vibration/noise monitoring, and geotechnical instrumentation.

C. For excavations utilizing Cement-Bentonite (C-B) Wall with Embedded Soldier Piles, submit the following:

1. Include description of methods of pre-trenching to clear debris prior to installing guide walls.
2. Provide details of guide walls.
    a. Submit complete descriptions of all equipment to be used in the trench excavation, and in the mixing, storing, circulating, pumping and placing the wall lagging material.
3. Clearances from adjacent and final structures including excavation tolerances.
4. Sequence and details of wall excavation and backfill, set time, and final strength.
5. Schedule of operations including anticipated times for mobilization, trench excavation, mixing, and backfilling the wall for each location.
6. Parameters and assumptions for the cement-bentonite mix including, but not limited to, the slurry density, viscosity, trench stability calculations, and C-B strength upon setting.
7. Location and methods of monitoring and testing cement-bentonite slurry mix to comply with specified requirements.
8. Method of excavating through boulders or other obstructions.
9. Method of monitoring plumbness and deviation of wall during excavation, and details of proposed corrective measures to be implemented if necessary.
10. Methods for checking and proving the cleanliness of trench bottoms prior to placement of soldier piles
11. Details for placement of soldier piles to be embedded in the walls.
12. Method of maintaining stability of excavated trenches in case of sudden loss of slurry suspension.
13. Measures for preventing slurry from entering utility facilities.
14. Method of protecting slurry operations, including storage, handling, and disposal, during all seasons.
15. Control of drainage, spills, wastes, etc.
16. Method of controlling/containing spoils, slurry, cement-bentonite, within the construction area.
17. Proposed cement-bentonite and/or lean mix concrete mix design.
18. Manufacture’s specifications for bentonite including laboratory test results.
19. Details of testing methods used to verify the effectiveness of mix design, with respect to strength, hydraulic conductivity criteria and acceptance criteria.

D. After construction, provide records of the following information:
    1. Panel and piles identifications
    2. Dates, times, and quantities of panel/pile excavation; end stop and soldier pile placement, if used; tremied concrete placement; and end stop removal, if used.

3. Plan location, deviation from plan location, and dimensions of the excavation.
4. Details and locations of any instrumentation installed.
5. Description of any variations from the Contract Drawings and Shop Drawings

E. For protective systems for trench excavations, submit, as applicable:

1. OSHA soil classifications used in design
2. Tabulated data used in design
3. For sloping and benching systems, submit trench configurations and maximum allowable slopes.
4. For shield systems, submit plan indicating the sizes, types, and configurations of structural components; lateral load capacity; and connection details, where shields are to be stacked.
5. For shield systems or support systems that are manufactured or pre-engineered, submit, in addition, specifications, recommendations, and limitations issued by the manufacturer; and manufacturer's written approval of any deviation from said specifications, recommendations, and limitations.

1.06 QUALITY ASSURANCE

A. Testing of bentonite slurry must be performed by the Contractor as required hereinafter with the results of every test submitted to the Contractor within the time limit specified herein. Use testing methods and equipment in accordance with API RP 13B-1.

1. Required Tests:
   a. Density, by mud density balance
   b. Viscosity, by Marsh Cone Method
   c. pH
2. Calibrate density measuring devices (e.g. Baroid scale) monthly, or more often if necessary, to ensure correct calibration.
3. Slurry sampling and testing: Collect slurry samples for testing in accordance with the requirements herein.

B. Slurry Trench Excavation Bottom Inspection: Measure and record the excavation bottom elevation in the presence of the Owner at the following stages to determine whether soil from trench or excavation sides, or other sediment, has collected:

1. Immediately after excavation to the final depth.
2. Immediately after each cleaning and desanding.

C. Perform testing and inspection of soldier pile and cast-in-place concrete in accordance with requirements specified elsewhere in the Contract Documents.

1.07 PERFORMANCE REQUIREMENTS

A. General:

1. Select methods of excavation and temporary excavation support systems that are compatible with conditions described in the Geotechnical Baseline Report (GBR) , and with requirements for placement of permanent structures, control of water, safety of personnel, and protection of adjacent property.

2. Provide lateral support, prevent loss of ground, limit ground displacements, and prevent damage to adjacent property (including utilities, structures, roadways, and other facilities) with temporary excavation support systems throughout the entire duration of excavation activities and until the final structures reach design strength.

3. Specific methods of initial ground support and groundwater control required in this Section or shown on the Drawings are acceptable support systems. Contractor is solely responsible for any additional construction measures necessary to achieve the requirements of this Section and is solely responsible for any damages resulting from failure to meet the requirements of this Section.

B. Tolerances:

1. Set out and construct temporary excavation support systems to maintain the minimum clear dimensions for permanent structures as shown on the Contract Drawings and provide adequate working space to construct the permanent structures.

2. Check the verticality of drilled soldier piles and C-B panels every 15 feet of depth during excavation of each element at a minimum. Keep vertical tolerance within 0.5% of the depth.

3. Limit the depth of the support of excavation system to within 1 ft of the planned depth, unless the Owner accepts a deviation to accommodate field conditions.

1.08 INITIAL GROUND SUPPORT SYSTEMS SHOWN ON DRAWINGS

A. Evaluate the initial support system designs shown on the Drawings and provide additional capacity as necessary to ensure full compatibility with the means and methods of construction.

B. Change the size and configuration of excavation from that shown on the Drawings to accommodate means and methods of construction, subject to approval by the Owner and compliance with minimum requirements and any limitations in the Contract Documents.

C. Contractor will be solely responsible for any revision of designs shown, and for design of all connections. Prepare and seal the design by a registered Professional Engineer licensed in the State of Michigan, with at least 5 years of experience designing similar support systems in similar ground conditions.

1.09 INITIAL GROUND SUPPORT SYSTEM DESIGN BY CONTRACTOR

A. Contractor will be solely responsible for design of initial ground support systems not shown on the Drawings. Prepare and seal the design by a registered Professional Engineer licensed in the State of Michigan, with at least 5 years of experience designing similar support systems in similar ground conditions.

B. Design initial ground support systems to the minimum ground loads, hydrostatic loads, and surcharge loads provided in the Geotechnical Baseline Report (GBR). Verify that ground loads and surcharge loads for design adequately reflect the expected ground conditions and suit the

type of support system proposed. Add construction loads appropriate to the means and methods of construction.

C. Consider the following in the design of the initial ground support system:

1. Ground conditions described in the Geotechnical Baseline Report (GBR) .
2. Methods for control of surface and ground water.
3. Maintenance of soil stability at the bottom of the excavation.
4. Deformation of the support system under load.
5. The proximity of existing underground and above-ground structures, including buried water lines and gas lines, and the potential effect of their rupture.
6. Effects of vibration on adjacent structures, from driving and pulling support elements.
7. Loading conditions, including loading due to delay in adding support members, removal of support members, and dynamic loading.
8. Placement of permanent lining and structures.

1.10 TRENCH EXCAVATIONS

A. Conform protective systems for trench excavation to OSHA 29 CFR Subpart P, Section 1926.652. Include sloping and benching systems, shield systems, and support systems as defined in Section 1926.652.

B. Shield and support systems pre-manufactured and sold in interstate commerce may be used, provided they are selected as appropriate for the Work by a Professional Engineer licensed in the State of Michigan.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Steel Pile:

1. Use structural steel piles as rolled steel sections of the weight, shape, and length shown. Ensure the material in steel piles meets the requirements of ASTM A572/A572M or ASTM A690/A690M. Maintain a minimum yield point of 50,000 psi.
2. Make splices in steel piles by a full penetration butt weld of the entire cross section. Properly align adjacent sections to keep the pile axis straight. Do not allow splices in the top 10 feet of the piles. Perform all welding by qualified welding operators.

B. Timber Lagging:

1. Grade wood for an extreme fiber stress of at least 1,000 psi. Use timber dimensions of 4”x6” nominal with a maximum length of 8’-0”. Use Spruce-Pine-Fir, Mechanically Graded, or equal for timber lagging material.

C. Internal Bracing System:

1. Structural steel: Use structural steel for walers, struts, pile bracing, points, caps, and splices as follows.

a. Wide Flange Shapes: ASTM A992/A992M

b. Other Shapes, Plates, Bars: ASTM A36/A36M

c. Pipe, Pipe Columns, Bollards: ASTM A53/A53M, Type E or S, Grade B standard weight unless noted otherwise

2. Structural HP Shapes: ASTM A572/A572M, Grade 50

a. HSS: ASTM A500/A500M ,Grade B

3. Use bolts for connections per ASTM F3125/F3125M, unless indicated otherwise. Use bolts to connect dissimilar metals per ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.

D. Furnish structural members full length without splices unless otherwise indicated or approved by the Owner.

E. Cement-Bentonite Slurry:

1. Portland Cement: ASTM C150/C150M, Type I or Type II.

EXECUTION

3.01 GENERAL

A. Construct initial ground support systems to line, grade, dimensions, and tolerances that allow permanent structures and pipes to be placed as shown on the Drawings and in accordance with specified tolerances. Do not let initial support systems project into the limits of the permanent structure.

B. Supplement the support system as designed to address variations in ground conditions as they are exposed in the excavation.

C. Install and remove support members following the sequence of operations shown on the Contractor’s design drawings.

D. Develop and maintain firm and uniform bearing of the support system against the ground by advancing the support system in advance of excavation, by timely placement of internal supporting members, by expanding the support system tightly against the ground, or by timely backfill grouting between a non-expanding support system and the ground.

E. Periodically examine initial ground support systems in place to identify loosening or instable ground; loss of ground through the support system; or excessive deformation, overstress, or weakening of the support system.

F. Maintain the initial ground support system in fully functional condition for the duration of its use. Promptly reset, repair, or replace support system elements that settle, become misaligned, were improperly installed, or become damaged.

3.02 INITIAL GROUND SUPPORT SYSTEMS IN SOIL

A. Use steel piles (soldier piles) and wood lagging, timber sheeting and bracing, steel ribs and timber lagging, steel ribs and steel liner plates, or comparable systems for initial ground support systems in structure excavations in soil.

B. Do not use driven or vibrated sheeting.

C. Install bracing members called for in the initial ground support system design within 5 feet of the current excavation bottom in shafts, unless otherwise shown on the Drawings.

D. Coordinate the installation of initial support systems with excavation to prevent heaving or raveling of exposed soils.

3.03 STEEL PILES

A. Install steel piles by pre-drilling or other pre-excavating methods to their proposed tip elevations. Impact and vibratory driving for steel pile installation is prohibited.

B. Keep equipment on-site able to advance the pre-excavated hole for installing steel piles through obstructions in the fill and native soils.

C. Within the same day of seating the steel piles in the pre-excavated holes, completely backfill the holes and fully encase the steel piles with concrete of class as specified in the Contract Documents from the pile tip to the ground surface.

D. Leave steel piles in place after completing structure construction and excavation backfilling, and cut them off at least three (3) feet below finished grade, unless specified otherwise in this Section.

3.04 TIMBER LAGGING

A. Install lagging with louvered openings (gaps) between boards in accordance with ground conditions encountered in excavations and subject to the approval of the Owner. In no case will the louvered openings be allowed to exceed one (1) inch.

B. Pack louver openings between lagging with filter fabric, hay, excelsior, jute matting, or other porous material to allow free drainage of groundwater without loss of retained soil or backpacking.

C. Limit the maximum permissible height of unlagged (unsupported) face of excavation to three (3) feet. Reduce the maximum height of unlagged face to eight (8) inches if water flows from the face of the excavation or if soil to be retained moves toward the excavation.

D. If unstable ground is encountered, take suitable measures (Backfill Grouting or other approved method) to retain the material in-place and prevent loss of ground or movements which may cause damage to adjacent structures or utilities.

3.05 PRE-EXCAVATION AND GUIDE WALL CONSTRUCTION

A. Before commencing cement-bentonite trench, hand or vacuum excavate as required to expose all utilities known to cross or suspected of crossing the footprint of the proposed excavation and to determine the locations of potentially unknown utilities.

B. Pre-excavation (Pre-trenching): Pre-excavate the alignment of the wall to a minimum depth of 10 feet from the top of the wall prior to commencing guide wall construction to remove obstructions, rubble, loose fill, and unsuitable materials. Make the width of the pre-excavation zone at least twice the thickness of the C-B wall. Backfill the zone with stable, excavatable material that meets the clean fill criteria required elsewhere in the Contract Documents.

Support the pre-excavation according to the requirements specified elsewhere in the Contract Documents.

C. Construct guide walls as continuous, cast-in-place reinforced concrete on a stable subgrade. Remove fill debris at the guide-wall bearing surface or stabilize the ground to provide a stable bearing. Use suitable temporary internal bracing or other stabilizing measures to prevent guide wall movement.

D. Protection: Protect existing or new construction, utilities, roadways, walkways, or other facilities whenever their safety appears endangered.

3.06 CEMENT-BENTONITE WALL INSTALLATION

A. Panel Excavation:

1. Layout and measure panels taking as reference the outside face of the permanent structures as shown on the Contract Drawings and including the anticipated installation tolerances.

2. Excavate trenches using clamshell, hydromill, or other suitable trenching equipment. Ensure the excavating tool has a minimum width equal to the specified trench width.

3. Maintain the stability of the excavated trench at full depth at all times.

4. Maintain cement-bentonite slurry in workable condition until completing the panel excavation.

5. Remove any deleterious sediment that settles out of the slurry or falls to the bottom of the trench using the excavating tool or other suitable equipment.

6. Check the verticality of the panel during panel excavation at a minimum of 15-foot intervals and make modifications to the excavation procedures as required to maintain verticality and meet the clear dimensions shown in the Contract Drawings.

7. Take all necessary measures to prevent collapse of the excavated slurry trench prior to cement placement. In the event collapse occurs, backfill with lean concrete and re-excavate per approved method.

B. Slurry Mixing and Placing:

1. Prepare bentonite slurry by mixing water and bentonite until the bentonite particles fully hydrate and the slurry appears homogeneous.

2. Blend cement thoroughly into the slurry until the mix is homogeneous and cement particles fully disperse in the bentonite slurry.

C. Introduce slurry into the trench at the same time trenching begins and maintain the slurry level in the trench during excavation.

1. Begin continuous excavation once the cement-bentonite slurry is introduced into the trench. Do not disturb the panel or join it with a new panel for at least 48 hours or until the hardened cement-bentonite becomes self-supporting.

2. Allow leaving a panel open over a weekend or holiday, provided slurry levels in the panel are monitored and maintained at all times.

3. Maintain a reserve supply of mixed bentonite slurry equal to 25 percent of the volume of one fully excavated panel. Base the size of the slurry reserve volume on the largest panel if panel sizes vary.

D. Key:

1. Follow the Contract Drawings for the bottom of the slurry trench unless directed otherwise. Measure and check the final depth and penetration of the trench immediately after excavation, and obtain approval from the Owner immediately following excavation.

E. Continuity Between Trench Segments:

1. Any time that a trench segment is extended where the slurry in the previously excavated trench has set, the excavation tools will be arranged to re-excavate a minimum 24 inches overlap into the end of the previously excavated trench, measured at the ground surface.

F. Trench Top Treatment:

1. Check the top of the completed trench for free water or surface depressions after initial slurry hardening. Remove any free water and fill the trench with slurry to the specified elevation. After the initial set of this additional slurry, cover the top of the trench with material to prevent drying. Do not place cover material until the Contractor and the Owner inspect the trench.

G. Clean-Up:

1. Stockpile or dispose of material excavated from the trench per the Contract Documents. Clean the work surface of all excess slurry after completing the slurry trench.

3.07 INTERNAL BRACING SYSTEM

A. Install and maintain support members in tight contact with each other and with surface being supported.

B. Brace structural members adequately against buckling with a factor of safety of at least 1.5 for maximum axial loading conditions, including temperature effects.

C. Where required, pre-load bracing members in accordance with methods, procedures and sequence as described on accepted Shop Drawings. Coordinate excavation work with installation of bracing and preloading. Use steel shims and steel wedges, welded or bolted in place, to maintain preloading force, where required, in bracing after release of jacking equipment pressure.

3.08 REMOVAL OF INITIAL GROUND SUPPORT SYSTEMS

A. Remove support or bracing members only if the removal is sequenced with backfill operations or the construction sequence for casting the final lining. Install rebracing as needed and in accordance with the Contract Documents.

B. Remove support elements in a manner that maintains soil stability and strength, and avoids disturbing adjacent utilities and structures. Backfill voids left during removal to prevent subsidence.

C. Support elements may be left in place at Contractor's expense and with the written approval of the Owner, provided that the top 3 feet below final grade is removed. Provide additional clearance as necessary for new or relocated utility lines or other structures.

3.09 CONTROL OF VIBRATIONS

A. Contractor will be responsible for adverse effects of vibrations from installing the support systems, regardless of compliance with vibration and air overpressure limits specified herein. Do not exceed ground vibration or air overpressure limits under any circumstances.

B. Conform vibration limits and noise limits to the requirements specified elsewhere in the Contract Documents.

C. Use monitoring equipment that conforms to requirements specified elsewhere in the Contract Documents.

D. Contractor will be responsible for monitoring noise and vibration from construction operations.

END OF SECTION

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SECTION 32 11 23
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 012200

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 23 13 - Subgrade Preparation

D. Section 32 12 16 - Bituminous Paving

1.03 REFERENCE STANDARDS

A. Unless otherwise specified, conform the work for this section to the applicable portions of the following Standard Specifications.

1. ASTM D98: Standard Specification for Calcium Chloride

2. ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

3. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition

1.04 ALLOWABLE TOLERANCES

A. Shape the finished surface to conform to plan grade and cross section within a tolerance of 3/4 inch in 10 feet.

1.05 TEST REPORTS

A. The testing lab must provide the Engineer with two (2) certified copies of the test results of the thickness of the compacted aggregate. The core drilling, testing for thickness and the certification of the test results must be performed by a testing laboratory approved by the Engineer.

1.06 STOCKPILING AGGREGATE

A. Deposit aggregate in stockpiles. Remove material from stockpiles using methods that provide aggregate with uniform gradation.

B. Stockpiling of aggregate, in excess of 4 feet in depth, on the completed subbase or aggregate surface will not be permitted, except with the approval of the Engineer.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with the requirements for aggregate base or surfacing installations due to outside ambient air temperatures specified in Part 3 of this Section.

PART 2 PRODUCTS

2.01 DENSE-GRADED AGGREGATE

A. Dense-graded aggregate gradation to conform to Class 21 and 22, as specified in MDOT Section 902.05.

2.02 CALCIUM CHLORIDE ADDITIVES

A. Calcium chloride additives to conform to ASTM D98 and as specified in MDOT Section 922.12.

2.03 WATER

A. Use reasonably clean water for compaction and dust control; ensure it is free from substances injurious to the finished product. Use potable water from Michigan State Department of Public Health-approved sources.

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.

B. Ascertain that excavation and compacted subgrades or subbases are adequate to receive the new Work.

C. 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.

B. If the subgrade or subbase remains wet after all surface water has been removed, the 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 the Engineer, prior to any changes.

3.04 PREPARATION OF SUBGRADE OR SUBBASE

A. Fine grade subgrade or subbase to the cross section indicated on the Plans. Compact it thoroughly prior to placing the aggregate material.

3.05 INSTALLATION - GENERAL

A. Indicate width, thickness, and type of aggregate materials on the Plans or as directed by the Engineer.

B. Do not place aggregate material until the Engineer approves the subgrade, subbase, or existing aggregate surface.

3.06 INSTALLATION OF AGGREGATE BASE COURSE

A. Place aggregate base course with a mechanical spreader or other approved means. Spread it in uniform layers to a depth that, when compacted, achieves the thickness shown on the Plans.

B. Compacted, the depth of any one layer must not exceed 8 inches. If unable to achieve required compaction for the full aggregate base course depth, reduce the thickness of each course. Alternatively, with Engineer's approval, use adequate equipment to compact the aggregate to the required unit weight.

C. Shape the subgrade or subbase to the specified crown and grade. Maintain it in a smooth condition. If hauling equipment causes ruts or holes, do not permit it on the subgrade or subbase; operate it on the aggregate base course behind the spreader instead.

D. Compact aggregate to at least 95% of maximum unit weight by the use of approved pneumatic-tired compaction equipment or vibratory compactors.

E. Maintain optimum moisture content until achieving the prescribed unit weight. Compact each layer until attaining the maximum unit weight before placing the succeeding layer.

F. When approved by the Engineer, additional water may be applied to the aggregate by an approved means to aid in the compaction and shaping of the material.

G. Use motor graders, trimmers, or other approved equipment to shape and maintain the aggregate base course until placing the surface course.

H. Limit the weight and speed of equipment when hauling material over the base course, subbase, or subgrade to avoid damage. If operations cause rutting in the subgrade, subbase, or aggregate base course, remove and replace the damaged sections until acceptable to the Engineer, at the Contractor's expense.

I. With the approval of the Engineer, chloride additives may be used by the Contractor to facilitate compaction and maintenance of the aggregate surface. The amount and method of combining the chloride additives are at the option of the Contractor and are at Contractor's expense.

3.07 MAINTENANCE DURING CONSTRUCTION

A. Continuously maintain aggregate base course and aggregate surface in a smooth and firm condition during all phases of the construction operation.

B. Provide additional materials at the Contractor's expense to fill depressions or bind the aggregate.

3.08 TEMPERATURE LIMITATIONS

A. Do not place aggregate materials when indications show the mixtures may freeze before reaching maximum unit weight.

B. Do not place aggregate on a frozen subgrade or base course unless approved by the Engineer.

3.09 TESTING

A. Engineer may require testing for compaction, density, and thickness of material during the course of the Work. Perform required testing and coring through a testing laboratory

acceptable to the Owner and approved by the Engineer. Charge the cost for testing and coring to the Owner.

B. Make a minimum of one depth (thickness) measurement every 400 feet per traffic lane when performing thickness tests. Use the lane width indicated on the Plans or as determined by the Engineer.

1. If two (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 1200 square yards of such areas or fraction thereof.

C. Location of the depth measurement will be at the discretion of the Engineer.

D. Understand maximum unit weight to mean the maximum unit weight per cubic foot as determined by ASTM D1557, Method A.

3.10 DEFECTIVE WORK

A. Thickness:

1. Measurements of aggregate base course thickness will be made to the nearest 1/4 inch.

a. Allow depths to be 1/2 inch less than the thickness indicated on the Plans, provided the average of all measurements taken at regular intervals equals or exceeds the specified thickness.

b. In determining the average in place thickness, measurements which are more than 1/2 inch in excess of the thickness indicated on the Plans will be considered as the specified thickness plus 1/2 inch.

2. Specify locations of depth measurements as stated herein unless the Engineer determines otherwise. Correct sections deficient in depth using methods approved by the Engineer.

B. Weight

1. When the aggregate material is measured by weight in 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 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 12 16
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 012200

B. Section 01 33 00 - Submittal Procedures

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 11 00 - Clearing and Grubbing

E. Section 31 23 13 - Subgrade Preparation

F. Section 32 11 23 - Aggregate Base Courses

G. Section 32 17 23 - Pavement Markings

H. Section 32 92 19 - Seeding

I. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

A. Unless otherwise specified, the Work for this Section must conform to the applicable portions of the following Standard Specifications:

1. AASHTO M 17 - Standard Specification for Mineral Filler for Bituminous Paving Mixtures
2. AASHTO M 29 - Standard Specification for Fine Aggregate for Asphalt Mixtures
3. AASHTO M 81 - Standard Test Methods and Practices for Emulsified Asphalts
4. AASHTO M 82 - Standard Specification for Cutback Asphalt (Medium-Curing Type)
5. AASHTO T 180 - Standard Method of Test for Moisture–Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
6. ASTM D244 - Standard Test Methods and Practices for Emulsified Asphalts
7. ASTM D692/D692M - Standard Specification for Coarse Aggregate for Asphalt Paving Mixtures
8. ASTM D1073 - Standard Specification for Fine Aggregate for Asphalt Paving Mixtures
9. ASTM D2026 - Standard Specification for Cutback Asphalt (Slow-Curing Type)
10. ASTM D2027/D2027M - Standard Specification for Cutback Asphalt (Medium-Curing Type)

11. ASTM D2028 - Standard Specification for Cutback Asphalt (Rapid-Curing Type)
12. American Association of State Highway and Transportation Officials
13. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition
14. Michigan Asphalt Paving Association

1.04 ALLOWABLE TOLERANCES

A. Following the final rolling, the surface will be tested longitudinally using a 10 foot straight edge at locations selected by the Engineer. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface will at no point exceed the following limits:

1. For Bituminous Base Course Mixtures:
    a. Multiple Courses:
        1) 3/8 inch for top course
        2) 3/4 inch for lower courses
2. For Bituminous Surface Course Mixtures:
    a. Multiple Courses:
        1) 1/8 inch for top course
        2) 1/4 inch for lower courses
    b. Single Course:
        1) 1/4 inch
3. Variations in excess of the specified tolerance must be corrected as determined by the Engineer.

1.05 MATERIAL REPORTS

A. At the request of the Engineer, the Contractor must provide the Engineer with certification that the various materials to be used conform to the Standards referred to in the Specifications.

B. Contractor must provide the Engineer with the load tickets prior to the placing of the materials.

C. Contractor must supply the Engineer with a certified Job Mix Formula for each type of bituminous mixture proposed for use on this Project.

1.06 TEST REPORTS

A. The testing lab will provide the Engineer with two (2) certified copies of the test results of the mix design and the thickness of the bituminous paving material.

B. The core drilling, testing for mix design and thickness, and the certification of the test results will be performed by a testing laboratory approved by the Engineer.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with the requirements for bituminous concrete installation due to outside ambient air temperatures specified under this Section.

PART 2 PRODUCTS

2.01 BLENDED AGGREGATE

A. Blended aggregate must conform to:

1. AASHTO M29
2. ASTM D692/D692M
3. ASTM D1073
4. MDOT Sections 501 and 902

2.02 MINERAL FILLER

A. The mineral filler gradation must conform to:

1. AASHTO M17

2.03 ANTI-FOAMING AGENTS

A. The anti-foaming agents must conform to anti-foaming agents, as specified in:

1. MDOT Section 904.

2.04 ASPHALT BINDER

A. Asphalt binder for use in production of bituminous mixtures must be performance graded asphalt binder:

1. PG58-28 per MDOT Section 904 unless otherwise indicated on the Plans.

2.05 LIQUID ASPHALTS

A. Liquid asphalts for use in pavement construction must conform to:

1. ASTM D2026
2. ASTM D2027/D2027M
3. ASTM D2028
4. AASHTO M81
5. AASHTO M82
6. MDOT Section 904

2.06 EMULSIFIED ASPHALT (BOND COAT)

A. Emulsified asphalt for use in pavement construction must conform to:

1. ASTM D244
2. MDOT Section 904

2.07 COMPOSITION OF MIXTURES

A. Bituminous mixtures must be mixed and placed in accordance with applicable requirements specified in MDOT Section 501 except as otherwise specified in this Section.

B. The blended aggregate used for the bituminous wearing course on this Project must have an Aggregate Wear Index (AWI) of 260, or higher.

C. The aggregates, mineral filler (if required), and asphalt binder must be combined as necessary to produce a mixture of the type as specified on the Plans.

1. Superpave Hot Mix Asphalt Mixtures must be in accordance with MDOT Section 501.

2. Marshall Hot Mix Asphalt Mixtures must be in accordance with MDOT Section Special Provision 20SP-501X-01 (latest edition).

D. The bituminous mixture specified on the Plans or in the Proposal, when tested at optimum asphalt content (determined in accordance with MDOT "Procedures for Mix Design Processing"), must 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 for the type of mix.

E. Mixtures failing to meet the requirements specified 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 requirements.

F. If there is a change in the source of any of the aggregates, a new job-mix formula will be required.

G. After the job-mix formula is established, the aggregate gradation and the asphalt binder content of the bituminous mixture furnished for the Work must be maintained within the Range 1 uniformity tolerance limits permitted for the job-mix formula as specified in "Uniformity Tolerance Limits" table below.

1. If two (2) consecutive aggregate gradations on one (1), or asphalt binder contents as determined by the field extractions are outside the Range 1 but within the Range 2 uniformity tolerance limits, the Contractor will suspend all operations. Work days will be charged during the down time.

2. Before resuming any production, the Contractor will make necessary alterations to the materials or plant so that the Job Mix Formula can be maintained within the deviations permitted per Table 1.

Table 1 - Uniformity Intolerance Limits

Type of Course	Range (a)	(b)	Percentage Passing Designated Sieves			Asphalt Binder Content
			No. 8	No. 30	No. 200	
Top and Leveling	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

Table 1 - Uniformity Intolerance Limits
(a) This range allows for normal mixture and testing variations. The mixture will be proportioned to test as loosely as possible to the Job Mix Formula
(b) This includes all sieve sizes No. 4 and larger listed on the Job Mix Formula

H. Mixtures exceeding the maximum tolerances listed in the table, or exceeding the maximum limits specified for the master gradation range will be rejected and the Contractor may be required to remove and replace any bituminous pavements which the Engineer determines were constructed with mixtures in the excess of these tolerances.

I. Contractor will 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 will 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 the Engineer.

1. 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 sample per 250 Tons of mixture, but not more than four samples per day.

2. During other periods where tests indicate the aggregate gradation is stable, truck samples will be taken at a frequency of one sample per 500 Tons of mixture, but no more than two samples per day.

L. Exact mixture proportions will be based on composite samples of aggregate and the particular bituminous material called for on the Plans.

PART 3 EXECUTION

3.01 EXCAVATION

A. Prior to the installation of bituminous concrete pavement, Contractor will examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that excavation and compacted subgrades are adequate to receive the bituminous pavement to be installed. Correct defects and deficiencies before proceeding with the Work.

3.02 SUBGRADE AND BASE COURSE CONDITIONS

A. Prior to the installation of any bituminous pavement, Contractor will 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 surface water has been removed, the Engineer may require the installation of edge drain.

3.03 EXISTING IMPROVEMENTS

A. Contractor will 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 the Engineer, prior to any changes.

3.04 EQUIPMENT REQUIREMENTS

A. General:

1. Contractor will furnish sufficient equipment for completing the Work in a timely and efficient manner.

2. Equipment will be on the job site and ready for normal operation before the placing of material is started.

3. Equipment will be in good working order. Equipment will be subject to inspections and testing during construction.

4. Equipment will be of sufficient capacity that the operation can be continuous, and a rate of production obtained which ensures good workmanship and eliminates overloading of the equipment or frequent interruptions or delays.

5. Equipment will conform to the requirements as specified in MDOT Section 501 and as specified herein.

B. Pavers:

1. Paver will 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 will be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of surface being applied will be screeded by an oscillating or vibrating screed.

2. Paver will at all times produce a uniformly finished surface, free from tearing or other blemishes that would require hand work. The screed will be adjustable to provide for tilting to secure the proper dray or compressive action necessary to produce the desired surface texture.

3. Paver will be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder will 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. To ensure that adequate material will be fed to the center portion of the lane being paved, reverse pitch augers or paddles will 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 will be installed at the required location.

5. When extensions are added to the paver, they will be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. The extensions will also be equipped with a continuation of the automatically controlled spreading augers. The screed and any extensions will be provided with an approved method of heat distribution.

6. Unless specified otherwise, bituminous pavers will be equipped with an automatically controlled and activated screed and strike-off assembly capable of grade reference and transverse slope control.

    a. A manufacturer approved grade referencing attachment, not less than 30 feet in length, will be used for all lower courses and the first lane of the wearing course.

    b. After the first lane of the wearing course has been placed, a 10 feet 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 8 feet 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 will be as approved by the 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 will be an approved rotary reduction machine having positive depth control adjustments in increments of 1/2 inch and capable of reducing material which is at least 6 inches in thickness.

2. The machine will 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. The cutting drums will be enclosed and will have a sprinkling system around the reduction chamber for pollution control.

3. The rate of forward speed must be positively controlled 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.

4. Crushing equipment must meet the approval of the Engineer.

D. Cold Milling Machine:

1. Cold milling machine for removing concrete or bituminous surfaces will 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 in length will be used.

2. Equipment for removing the concrete or bituminous surface will 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 will 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 must be of sufficient length and heating capacity to adequately soften the edge of the mat. The heater will be oriented parallel to the joint edge.

2. Bituminous pavement will not be heated by a direct open flame.

F. Rollers:

1. Steel-wheel rollers will weigh at least 8 tons and must be self-propelled, vibratory or static, tandem rollers or must be self-propelled static 3-wheel rollers.

   a. Steel-wheel rollers will be free from backlash, faulty steering mechanism, or worn king bolts. The steering device will respond readily and permit the roller to be directed on the alignment desired.

   b. Rollers will be equipped with wheel sprinklers and scrapers.

   c. Roller wheels will be smooth and free from openings or projections which will mark the surface of the pavement.

2. Vibratory rollers will have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph and will have provisions to lock in the manufacturer's recommended speed, vibrations per minute, and amplitude of vibration (dynamic force) for the type of bituminous mixture being compacted.

3. The pneumatic-tired roller will be of the self-propelled type with a total weight, including ballast, not greater than 30 tons.

   a. It must 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 is obtained.

   b. The tires must be smooth and must be capable of being inflated to or adapted to achieve a pressure necessary to provide ground-contact pressures of at least 80 psi.

   c. The tire pressures must not vary by more than 5 psi between individual tires. Contractor must furnish a tire gage which will be available to enable the Engineer to check the tire pressures.

   d. Contractor must furnish the 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 must be equipped with a mechanism capable of reversing the motion of the roller smoothly.

5. Roller must be equipped with wheel sprinklers and scrapers or mats.

6. Rollers must 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 must be self-propelled and must be equipped with pneumatic tires.

2. Spreader will be equipped with a screen mounted below the metering gage.

3. Spreader must be capable of spreading the cover material uniformly at widths of 3 to 12 feet, or separate spreaders will be provided for the specific widths required.

4. Rate of discharge of the spreader will be adjustable to spread uniform layers of 10 to 50 pounds per square yard.

H. Bituminous Concrete Curbing Machine:

1. Bituminous concrete curbing machine must be self-propelled and must be capable of laying and satisfactorily compacting curved and straight line curb to the cross section specified on the Plans. It must 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 must meet the approval of the Engineer at the time of placement of any mixture.

B. Prior to placing any bituminous mixture, the surface of any existing pavement, including joints and cracks, must be thoroughly cleaned of all dirt and debris.

C. Existing structures within the limits of the new Work must be adjusted as specified in the Plans, or as determined by the Engineer.

3.06 PREPARATION OF AGGREGATE BASE

A. Prior to the placing of prime coats or bituminous mixtures, density, grade and cross section of the aggregate base must meet the approval of the Engineer.

B. Surfaces that have become too wet or too dry must 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. Broken pavement or pavement not bonded to the base pavement, and loose bituminous surfacing or patches must be removed.

B. Longitudinal and transverse joints and cracks will be cleaned in accordance with Article 3.14 - Joint Cleaning of this Section.

C. Butt joints at the end of surfacing sections and at intersections of adjoining streets must be made in accordance with Article 3.08 - Butt Joints of this Section. The vertical face of the cut will 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 the Engineer, the old surface will be cut back for at least 5 feet to a depth of at least 1 inch for the full width of the joint. The vertical face of the cut will 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 will be performed as required to give a straight, sharp edge at the proper elevations.

B. The existing base under the bituminous surface will be left undisturbed.

3.10 REMOVING BITUMINOUS SURFACING

A. When removing existing bituminous surface course, the edges of the area to be removed will be cut along straight lines, either perpendicular to or parallel to the direction of travel, for the full depth of the full depth of the surface course; with the cut edge a minimum of 18 inches 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 determined by the Engineer, it will be saw cut along the edges of the patched area to prevent the tearing of adjoining pavement surfaces during the removal operation.

B. The 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 proof rolling the crushed base to the proper elevation and slope.

B. Additional materials required to fill holes and voids will be furnished at the Contractor’s expense. Additional aggregate, if required, will be MDOT 21A.

C. The material will be scarified and uniformly pulverized to a maximum size of 2 inches, in addition, 95-100 percent of the material must have a particle size of 1-1/2 inches or smaller.

D. The material will be scarified and uniformly pulverized, in one or more passes, to the depth specified on the Plans or as determined by the Engineer.

E. The maximum length or width of roadbed to be scarified and pulverized at any one time will be as specified on the Plans or as determined by the Engineer.

F. The crushed material will be rough graded to within 3/4 inch of the final grade as called for on the Plans or as determined by the Engineer. Additional aggregate will be placed, if necessary, to attain the required cross sections.

G. After the material has been balanced, it will 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 will be shaped and compacted in reasonably close conformity with the lines, grades, and cross sections shown on the Plans or as established by the Engineer. Excess material will be removed and disposed of by the Contractor at Contractor's expense.

I. Finished rolling will be done with a vibratory steel wheel roller.

J. Aggregate-bituminous pavement mixture will be compacted to not less than 95 percent of the unit weight obtained by the AASHTO T 180 test method. The test will be made on the

aggregate-bituminous mixture at the field moisture content existing during the compacting operation. Required density will be maintained until the material has been surfaced.

K. Prior to the placing of any surface courses, the pulverized material must be proof rolled. Proof rolling will be accomplished with an 18,000 lbs single axle load.

L. Unstable areas must 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 determined by the Engineer, the filler material must be an approved bituminous mixture. 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.

B. Patches will 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 determined by the Engineer, the joint sealants and foreign material will be removed to a minimum depth of 1 inch 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 determined by the Engineer, the existing bituminous surface and any loose or spalled concrete around the joints and cracks will be removed.

B. Each joint or crack will be cleaned and will be filled with an approved mixture and the mixture will 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 will be milled to the shape and cross section as shown on the Plans. Immediately after cold milling, the surface must be cleaned.

B. Contractor will remove and dispose of resulting debris.

C. When allowed by the Engineer, milling materials may be used for temporary wedging.

1. Prior to placing pavement, temporary wedging materials must be removed and disposed of. 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 will be specified on the Plans, indicated in the Proposal or as determined by the Engineer.

B. At street intersections, curb drops conforming to the current rules and regulations of Act 8, Michigan PA 1973, as amended, must be provided for the construction of sidewalk ramps. In

addition, curb drops for sidewalks and driveway approaches must be provided in locations called for on the Plans or as determined by the Engineer.

C. Existing improvements, including structures, will 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 will be treated with bituminous material for prime coat or bond coat as specified. A bond coat will be applied to each layer of bituminous mixture before the succeeding layer is placed.

B. The bituminous material will be applied uniformly by means of a pressure distributor. In areas inaccessible to the regular distributor operation, the bituminous material will be applied by means of the hand spraying apparatus of the distributor.

1. Where necessary to accommodate traffic, the surface will be treated half-width or as recommended by the Engineer.

2. The foundation will be free from moisture when the treatment is applied.

3. Under no circumstances will pools of bituminous material be allowed to remain on the surface.

C. The amount of prime coat to be applied per square yard will be 0.05 gallons per square yard unless otherwise specified on the Plans or directed by the Engineer.

D. When prime coat is applied, the surface course will not be placed until the prime coat has properly cured. No blotting of the prime coat with aggregate in lieu of proper curing will be permitted.

E. The prime coat may be omitted or reduced when authorized by the Engineer.

F. The bond coat will be applied at the rate specified or as directed by the Engineer. This rate will be between 0 to 0.10 gallons per square yard on a bituminous or concrete foundation and between 0-0.05 gallons per square yard between subsequent courses.

G. The bond coat material will be applied ahead of the paving operation for a distance of at least 1500 feet depending on traffic conditions or as determined by the Engineer. The surfacing will not be placed until the bond coat has cured.

3.19 TRANSPORTATION OF MIXTURES

A. The transportation of the mixtures as specified will 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 1000 feet in length

3. placing the first course of a base course mixture on an earth grade or on a sand subbase

4. placing base course mixtures in widths less than 8 feet

B. Bituminous base course mixtures will not be placed in lifts exceeding unless otherwise approved by the Engineer. Approval to place lifts in excess of 3 inches will be based on the ability of the 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 or greater, a berm of shoulder material will 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. The width of material placed will be twice the height of the bituminous layer being placed but in no case less than a 6 inch width.

D. When the application rate for a bituminous wearing course exceeds 220 pounds per square yard, the pavement will be constructed in two or more courses, unless otherwise specified on the Plans or as authorized by the Engineer.

E. The bituminous mixture will 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 will be dumped into the center of the hopper and care must be exercised to avoid overloading the paver and spilling the mixture upon the base.

2. The paver speed will be adjusted at the discretion of the 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, paving will be stopped and a transverse construction joint placed.

G. Bituminous mixture will be placed in one or more layers as called for on the Plans or as approved by the Engineer.

1. To take out irregularities in the existing road surface, wedging with bituminous mixture will be done by placing several layers with the paver.

2. Corrections to the foundation by wedging with bituminous material will be made by placing, compacting, and allowing the material to cool prior to paving.

H. Bituminous mixtures will be placed using two pavers in echelon or one paver equipped with an approved joint heater. Engineer may omit the use of the joint heater if the temperature of the previously placed mat does not fall below 170 degrees Fahrenheit prior to placement of the adjacent course.

1. Echelon paving will be permitted when allowed by the Engineer.

I. Cold joints will be permitted along acceleration and deceleration lanes, lanes less than full width, irregularly shaped sections, and at transverse joints. The edges of the initial mat for cold joints will be painted with bituminous material before the bituminous mixture is placed in the adjacent section.

J. In placing the bituminous mixture adjacent to joints, hand raking or brooming will be required to provide a dense smooth connection.

K. Connections with existing surfaces at the beginning and end of resurfacing sections, and at intersections will be made by feathering out the mix, by constructing a butt joint, or as approved by the Engineer.

L. Placing the bituminous mixture will be in accordance with MDOT Section 501.

M. If the lanes are being constructed with two or more pavers in echelon, the loss depths of bituminous material from each paver will match at the longitudinal joints.

3.21 ROLLING AND COMPACTING OF BITUMINOUS MIXTURES

A. Each layer of bituminous mixture will be compacted with approved rollers. At least two rollers will be required when the mixture lay-down rate exceeds 800 square yards per hour.

1. Steel 3-wheel rollers may be used for initial compaction immediately following the paver.

B. The final rolling operation on each layer of bituminous mixture will be accomplished by use of tandem steel-wheel rollers or by use of vibratory rollers operated in the static mode.

1. Roller wheels will be kept properly moistened with water.

C. Pneumatic-tired rollers will be operated in a competent manner and will not mark or rut the surface or displace the pavement edges. The pneumatic-tired roller must be ballasted to obtain the required ground-contact pressures as directed by the Engineer.

1. To obtain a uniformly textured mat and the desired pavement density, the Engineer may recommend the Contractor to raise or lower tire pressures at any time during the rolling operations.

2. Roller operations will be conducted in such a manner as to prevent scuffing or chatter marks in the pavement surface.

3. The number of passes made by the pneumatic-tired roller will not be less than two round trip passes over each area.

D. Rolling of the mixture will begin as soon after placing without undue displacement, picking up the mat, or cracking. Rolling will 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.

1. Alternate trips of the roller must be of slightly different lengths.

2. Maximum roller speed must not exceed the manufacturer's recommended speed for the type of mixture or thickness of layer being placed.

E. When compacting an adjoining lane, the longitudinal joint will be rolled first with the roller supported mainly on the cold lane with only 3 to 6 inches of the roller extending onto the freshly placed bituminous material.

F. Finish rolling will continue until all roller marks are eliminated.

G. Pneumatic-tired rollers will not be permitted on wearing courses.

H. Areas too narrow to be rolled directly by standard 8 ton tandem rollers will be compacted by self-propelled trench rollers of suitable width, approved by the Engineer, and weighting not less than 300 pounds per inch of width.

I. 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 must be removed and replaced at the Contractor's expense.

3.22 WEATHER AND SEASONAL LIMITATIONS

A. Bituminous mixtures will 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 the Engineer in writing, seasonal limitations for placing bituminous mixtures must be in accordance with the following:

1. Seasonal Limitations:

a. May 5 to November 15

C. Unless otherwise approved by the Engineer in writing, minimum mixture temperature limitations at the time of placement for placing bituminous mixtures must be in accordance with Table 2.

Table 2 - Mix Temperature Limitations

Temperature of Surface being Overlayed	Rate of Application of Bituminous Material		
	<120 lbs per syd	120-200 lbs per syd	>200 lbs per syd
35 to 39 degrees F			330 degrees F
40 to 49 degrees F		330 degrees F	315 degrees F
50 to 59 degrees F	330 degrees F	315 degrees F	300 degrees F
60 to 69 degrees F	315 degrees F	300 degrees F	285 degrees F
70 to 79 degrees F	300 degrees F	285 degrees F	270 degrees F
80 to 89 degrees F	285 degrees F	270 degrees F	270 degrees F
90 degrees F and over	270 degrees F	270 degrees F	270 degrees F
Bituminous paving will not be allowed when the mix temperature is 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 will be heated in such a manner as to ensure a uniform temperature throughout the entire mass with efficient and positive control at all times. It will be heated to a temperature consistent with the type of material used and only to such temperature as will ensure the necessary fluidity.

1. Excessively high temperatures must be avoided.

2. A thermometer must be provided to enable the Engineer to observe the temperature at any time.

3. Any bituminous material which has been overheated will be rejected and replaced at Contractor's expense.

B. Asphalt emulsion will 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 must be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by means of a circulating heater.

2. Any asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected and replaced at Contractor's expense.

3.24 PATCHING

A. Where patching is required on a bituminous surface or concrete surface because of small holes or pitted surface, the holes will be cleaned of dirt and foreign material.

B. Bituminous patching material will be placed, struck off and compacted so that when completed, the patch will be flush with the adjacent pavement. Compaction may be done with a hand tamper, vibratory compactor or roller as approved by Engineer.

C. When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill will be compacted to not less than 95 percent of the maximum unit weight. An aggregate base material of not less than 12 inches compacted thickness, or a bituminous base of the specified thickness on the Plans, will be used. The top of the base will be 2 to 2-1/2 inches below the surface of the adjacent pavement. Bituminous patching material will be placed and compacted.

D. The surface of the bituminous patch will be smooth and not vary more than 1/4 inch from the crown and grade of the adjacent pavement. Variations over 1/4 inch from the established grade must be corrected by the Contractor, as determined by the Engineer.

3.25 CHIP SEAL

A. Seal coating will consist of one or more applications of bituminous material applied to the prepared surface and one or more coverings of coarse or fine aggregate applied to the bituminous material.

B. Asphalt emulsion must be CSEA or CRS-2M and aggregate will be MDOT 29A unless otherwise specified on the Plans.

C. Cover materials used for seal coating will be sufficiently dry when it comes in contact with bituminous material. Moisture content must not exceed three percent by weight on a dry basis. Satisfactory means will be provided by the Contractor for protection of the coating materials against excessive moisture by covering stockpiles, aeration or through approved manipulation.

D. Bituminous material specified for surface coat will 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 the Engineer. Each application of bituminous material must 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 must be uniformly spread over the surface by means of approved mechanical spreaders, in the amount per square yard specified or as determined by the Engineer. Truck wheels will ride on spread cover material and not on bituminous material.

F. Irregularities or deficiencies in the uniformity of the cover aggregate on the surface must be corrected by hand spreading and dragging.

G. Following the spreading of each course of cover material, the surface will be rolled by means of approved rollers.

H. Rolling will immediately follow the placing of cover material before the bituminous material has set. At no time will there be more than 300 feet of unrolled cover material. No cover material will be left unrolled for more than 5 minutes.

I. Sufficient rolling will 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 must be added. For areas with excessive cover material, the excess cover material must be removed before the next seal is applied. The final application of cover material will be swept with a power broom.

K. The completed surface will 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 2-5 days, as determined by the Engineer, depending on weather and materials used.

3.26 HOT MIX ASPHALT (HMA) CURB

A. HMA curb will be constructed to the design specified on the Plans or as approved by the Engineer and will 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 will meet the requirements as specified in this Section, as well as those specified in MDOT Section 904.

C. HMA curb mixture will be the same HMA mixture required to construct the leveling and top courses of pavement, unless otherwise approved by the Engineer.

D. HMA curb must be constructed to conform to the Plans or as determined by the Engineer. The method of construction must conform to MDOT Section 805, unless otherwise specified.

E. HMA must be thoroughly compacted by a curbing machine to the cross section shown on the Plans, or as determined by the Engineer. Curb will be formed to the density to produce a tight surface texture. Curbs showing segregation, slumping, or misalignment must be removed and replaced at the Contractor's expense.

F. When specified on the Plans or as directed by the Engineer, an application of asphalt emulsion or other approved bituminous coating will 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 will not commence until the HMA has cured.

H. Backfill material must be placed and thoroughly tamped and compacted to the satisfaction of the Engineer, without disturbing the curb, and will be left in a neat and smooth finished appearance.

3.27 BITUMINOUS APPROACHES, SIDEWALKS, AND SHOULDERS

A. This Work will consist of constructing a bituminous surface course as specified on the Plans, or as approved by the Engineer. The bituminous surface course will be placed on a prepared foundation.

B. Bituminous materials used will be as specified on the Plans, or as approved by the Engineer. Materials acceptable for use are specified in this Section and MDOT Section 904.

C. Bituminous approach mixture must be in accordance with MDOT Section 501, unless otherwise approved by the Engineer.

D. Existing pavement or aggregate base will be prepared to receive the bituminous surface course as specified in this Section.

E. Bituminous prime and bond coats used must meet the requirements specified in this Section. Care must be taken to prevent spreading of bituminous material on adjoining surfaces. When approved by the Engineer, the prime coat may be omitted.

F. Bituminous mixture will be placed to the thickness specified on the Plans or as determined by the Engineer.

G. Placing the bituminous mixture must conform to this Section.

H. When approved by the 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 the Engineer, only one roller may be used with each paver.

3.28 TENNIS COURTS

A. Bituminous tennis courts will be constructed to the cross section shown on the Plans, or as determined by the Engineer.

B. The materials used in the construction of the bituminous tennis court must meet the requirements specified in this Section and MDOT Section 904.

C. Bituminous base course mixture will be Marshall Mix MDOT 4C or 13A as specified in MDOT Special Provision 20-SP501X-xx and in accordance with MDOT Section 501, unless otherwise specified on the plans.

D. Bituminous surface course mixture will be Marshall Mix MDOT 4C, 13A or 36A as specified in MDOT Special Provision 20-SP501G-xx and in accordance with MDOT Section 501, unless otherwise specified on the plans.

E. Asphalt content and performance grade will be determined by the job mix formula submitted by the Contractor and approved by the Engineer.

F. The bituminous base course and wearing course will be constructed to conform to the Plan. The method of construction must conform to MDOT Section 501, unless otherwise specified.

G. The bituminous bond coat used must meet the requirements specified in this Section.

H. The rate of application must be 0.05-0.10 gallons per square yard.

I. For the preparation of the foundation to receive the bituminous base course and bituminous surface course see Part 3 of this Section.

J. The bituminous base course, if required, and the bituminous surface course will be installed to thickness shown on the Plans. The method of installation of mixtures must conform to this Section.

3.29 CLEANUP

A. The area adjacent to the new Work will be backfilled with sound earth of topsoil quality.

B. The backfill will be compacted, leveled and left in a neat, smooth condition. At a seasonally correct time the disturbed area will be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 92 19 - Seeding.

3.30 MONUMENT BOXES

A. All government, plat, and street intersection monuments within existing or proposed pavement must be preserved by enclosing in standard monument boxes. Monument box castings must be furnished and installed by the Contractor and will be East Jordan Iron Works No. 1570 or approved equal.

B. Existing monument boxes will be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box will be concrete bedding, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter will be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.31 TESTING

A. During the course of the Work, the Engineer may require testing for mix designs, aggregate gradation and physical properties, bitumen content, compaction or density, and thickness of material. The testing and coring required must be performed by a testing laboratory approved by the Engineer.

1. The cost for testing and coring will be at the expense of the Owner.

2. The testing laboratory will furnish the Engineer with two certified copies of the test results .

B. Testing procedures must conform to current MDOT Standards.

1. Testing of asphalt binders, liquid asphalts, asphalt emulsions, and tars must conform to MDOT Section 904.

C. Rolling will proceed until the required compaction is attained and the amount of rolling required will 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, the nuclear gage method will be used to govern the compaction requirements.

D. When the total tonnage for the Project is in excess of 1,000 tons, the nuclear gage method will be used to govern the compaction requirements.

1. The control density for the bituminous mixture to be placed, will be determined by use of a modified Marshall Test.

E. Control Density:

1. During the Contractor's start-up operations, a rolling procedure to attain the control density will be established.
    a. The rolling procedure will be based on the number and type of rollers used and the rolling pattern.
    b. The goal of the compaction effort will be to establish a rolling procedure which will achieve 100 percent of the control density but in any case, the density achieved must not be less than 95 percent of the control density.
    c. Density values less than 98 percent will be sufficient cause for the 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 will 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, the Engineer will determine the control density for the new mixture and require the Contractor to again establish the number and type of rollers and the rolling pattern required on the new mixture to attain the control density.
    a. Compaction procedures thus determined will be used when placing the remainder of that mixture.
4. Density checks will be made at the discretion of the Engineer to determine if the compaction procedure being used is achieving the required density, or if a change in procedure is necessary.
5. Each layer of bituminous mixture will be compacted to at least 95 percent 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 percent or more, the mixture produced will be evaluated by the Engineer and if in the Engineer's judgment the defective pavement warrants removal, the Contractor must remove and replace the affected area at the Contractor's expense.
        a. If it is determined that the removal is not required, the Contract unit price of the affected mixture will be reduced by ten percent.

B. 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, the Engineer will evaluate the test results and will recommend removal and replacement or a credit to the Owner.

END OF SECTION

SECTION 32 13 13
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 22 00 - Unit Prices

B. Section 01 50 00 - Temporary Facilities and Controls

C. Section 31 23 13 - Subgrade Preparation

D. Section 31 23 19 - Dewatering

E. Section 32 11 23 - Aggregate Base Courses

F. Section 32 17 23 - Pavement Markings

G. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. AASHTO M 33M - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

B. AASHTO M 324 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

C. AASHTO T 26 - Standard Method of Test for Quality of Water to Be Used in Concrete

D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

E. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

F. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

G. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

H. ASTM C33/C33M - Standard Specification for Concrete Aggregates

I. ASTM C94/C94M- Standard Specification for Ready-Mixed Concrete

J. ASTM C143/C143M- Standard Test Method for Slump of Hydraulic-Cement Concrete

K. ASTM C150/C150M- Standard Specification for Portland Cement

L. ASTM C172/C172M- Standard Practice for Sampling Freshly Mixed Concrete

M. ASTM C260/C260M- Standard Specification for Air-Entraining Admixtures for Concrete

N. ASTM C309- Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

O. ASTM C494/C494M- Standard Specification for Chemical Admixtures for Concrete

P. ASTM C618- Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

Q. ASTM C989/C989M- Standard Specification for Slag Cement for Use in Concrete and Mortars

R. ASTM D98 - Standard Specification for Calcium Chloride

S. ASTM D994/D994M- Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

T. ASTM D1751- Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

U. ASTM D5893/D5893M - Standard Specification for Cold Applied Single Component Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

V. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

W. American Concrete Paving Association

X. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 MATERIAL REPORTS

A. Provide certification to Engineer, upon request, that the various materials to be used conform to the standards referred to in the Specifications.

B. Submit a list of material supply sources for review prior to placing any order.

C. Provide Engineer with the mix design, as required by ASTM C94/C94M, prior to the actual delivery of the ready-mixed concrete.

1.05 THICKNESS AND COMPRESSIVE STRENGTH REPORTS

A. Contractor to make sure the testing lab provides Engineer with two (2) certified copies of the test results for the thickness and compressive strength of the concrete. Perform core drilling, testing for thickness and compressive strength, and certification of results through a testing laboratory approved by Engineer.

1.06 WATER QUALITY TEST REPORTS

A. Contractorto make sure the testing lab provides Engineer with two (2) certified copies of the test results for the quality of water to be used in the concrete. Conduct sampling and testing of water quality in accordance with AASHTO T 26 requirements, and have the certification of test results performed by a testing laboratory approved by Engineer.

1.07 REQUEST FOR MATERIAL VARIANCE

A. Make all requests for variances in the materials, as specified, in writing to Engineer.

B. Submit two (2) copies of the request for the 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 Part 3 of this Section.

B. Comply with the requirements for protecting new Work against damage from rain, as specified under Part 3 of this Section.

C. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Part 3 of this Section.

PART 2 PRODUCTS

2.01 CEMENT

A. Use low alkali, air-entraining Portland cement conforming to ASTM C150/C150M, Type IA or Type IIIA.

2.02 FINE AGGREGATES

A. Ensure the fine aggregate gradation conforms to ASTM C33/C33M and to fine aggregate, 2NS, as specified in MDOT, Section 902.08.

2.03 COARSE AGGREGATE

A. Ensure the coarse aggregate gradation conforms to ASTM C33/C33M and to coarse aggregate, 6A, or 6AA as specified in MDOT, Section 902.03.

2.04 WATER

A. Use water for mixing and curing concrete that is reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable matter, or other substances injurious to the finished product.

B. Waters from sources approved by the Owner as potable may be used without testing.

C. Test water requiring testing in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T-26, and as specified in MDOT, Section 911.

2.05 CONCRETE ADMIXTURES

A. Air-Entraining Admixtures:

1. Use air-entraining admixtures for concrete that conform to ASTM C260/C260M and as specified in MDOT, Section 903.01.

B. Concrete Accelerators:

1. Use chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete that conform to ASTM C494/C494M, Type C or Type E.

2. Use calcium chloride in flake or pellet form that conforms to ASTM D98, Type S, Grade 1 or grade 2, flake or pellet form, and as specified in MDOT, Section 903.04.

3. Use calcium chloride in solution form that conforms to MDOT, Section 903.04.

C. Water-Reducing and Water-Reducing Retarding Admixtures:

1. Use water-reducing admixtures and water-reducing retarding admixtures that conform to ASTM C494/C494M, Type A or Type D, without containing calcium chloride, and as specified in MDOT, Section 903.02.

D. Pozzolanic Admixtures:

1. Use Fly Ash that conforms to ASTM C618, Type F, and as specified in MDOT, Section 901.07.

2. Use ground granulated blast furnace slag that conforms to ASTM C989/C989M, Grade 100, minimum.

2.06 CONCRETE CURING COMPOUNDS

A. Use white membrane curing compound for curing concrete that conforms to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 903.06.

B. Use transparent membrane curing compound for curing base course concrete that conforms to ASTM C309, Type 1-D, Class B Type 1-D, Class B Vehicle, and as specified in MDOT, Section 903.06.

2.07 LANE TIE BARS

A. Use bar reinforcement for pavement tie bars that conforms to ASTM A706/A706M, or ASTM A615/A615M, Grade 60, and as specified in MDOT, Section 914.09.

2.08 STEEL WELDED WIRE FABRIC

A. Use welded steel wire fabric for concrete mesh reinforcement that conforms to ASTM A1064/A1064M, and as specified in MDOT Section 905.06. Fabricate the mesh as shown on the Plans.

2.09 DOWEL BARS

A. Use dowel bars and basket assemblies for transverse expansion and contraction joints that conform to ASTM A615/A615M Grade 40 and MDOT Section 914.07.

2.10 STEEL HOOK BOLTS

A. Use hook bolts that conform to ASTM A706/A706M, Grade 60 of ASTM A615/A615M, or ASTM A996/A996M., with a diameter of 5/8 inch. Use expansion anchored hook bolts along the edge of existing concrete.

2.11 JOINT FILLERS

A. Use fiber joint filler material for expansion joints that conforms to ASTM D1751, and as specified in MDOT, Section 914.03.

B. Use bituminous premolded joint filler material that conforms to ASTM D994/D994M and AASHTO M33M.

C. Use polyethylene premolded joint filler for pressure relief joints made from a flexible, low-density, expanded, extruded polyethylene plank. Form the plank by expanding polyethylene base resin through an extrusion process, ensuring it is homogeneous, closed-cell, and multi-cellular.

2.12 JOINT SEALANTS

A. Use hot-poured type joint sealant that conforms to AASHTO M324 or ASTM D6690 Type II and as specified in MDOT, Section 914.04.

B. Use cold-applied, single component type joint sealant that conforms to ASTM D5893.

2.13 CONCRETE MIX

A. Ensure concrete yields a minimum compressive strength of 3500 PSI when cured in a moist room at a temperature between 65 to 75 degrees F for a period of 28 days.

B. Use a nominal 564 lbs/cyd mix with a minimum of 25% Type F Fly Ash. Provide documentation from actual project mixes showing 28-day compressive strength of at least 3500 PSI when tested under field conditions.

1. Use water reducers, additional fly ash, ground granulated blast furnace slag (GGBFS), and other pozzolans only when approved by Engineer. Limit fly ash quantity to a maximum of 40%; maintain GGBFS quantity between 25% and 40%.

2. Limit total cement replacement to a maximum of 40%. Replace cement with GGBFS and Fly Ash on a pound-for-pound basis.

C. Use air-entraining Portland cement ASTM C150/C150M, Type IA. Use Type IIIA when high-early strength concrete is required.

D. Use high early strength concrete with 4500 PSI, 658 lbs/cyd, and a water reducer. Maintain a water-cement ratio between 0.38 and 0.39.

E. Adjust the air content of the concrete based on the maximum size aggregate as follows:

Maximum Size of Aggregate	Air by Volume (%)
1-1/2 to 2-1/2 inch	5
3/4 to 1 inch	6
3/8 to 1/2 inch	7-1/2

F. Maintain the slump of the concrete between 1-1/2 to 2-1/2 inchwhen using machine methods for striking off and consolidating. Increase the slump to 3-1/2 inch if hand finishing is permitted by Engineer

G. Produce ready-mixed concrete in accordance with ASTM C94/C94M, Alternate 2, with a minimum compressive strength of 3500 PSI when cured in a moist room at a temperature within a range of 65 to 75 degrees F for a period of 28 days.

H. Provide Engineer 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 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. Obtain an adequate site for the batch plant at Contractor’s expense. Maintain the site and operate the plant in accordance with the conditions and requirements established by the local community.

3.05 FINE GRADING

A. Fine grade the subgrade to the cross section shown on the Plans and thoroughly compact it prior to placing forms or concrete.

3.06 INSTALLATION - GENERAL

A. Construct the concrete pavement to the width, thickness, and type specified on the Plans or as approved by Engineer.

B. Provide curb drops at street intersections for the construction of sidewalk ramps, conforming to the current rules and regulations of Act 8, Michigan PA 1973.

C. Provide curb drops for sidewalk ramps and driveway approaches at locations specified on the Plans or as approved by Engineer.

D. Restrict construction operations to the existing right-of-way. If additional area is needed, furnish Engineer with written permission from the property owner for any operation conducted outside the established right-of-way.

E. Maintain traffic access at intersections. Ensure vehicle access to commercial and public properties, and other locations as designated by Engineer.

3.07 FORMS

A. Except when paving with a slip-form paver, use forms made of metal with an approved section that provides rigidity under impact, thrust, and the weight of the heaviest machine carried on them. Use metal with a minimum thickness of 1/4 inch, or 3/16 inch if the form has a trapezoidal cross section.

B. Use forms with a minimum length of ten 10 feet and a depth not less than the prescribed edge thickness of the Work. Allow the subgrade to be a maximum of 1 inch lower than the bottom of the forms only when approved by Engineer. Contractor to make sure the base width in direct bearing on the soil is at least 0.75 of the form depth, with a minimum base width of 8 inches.

C. Provide at least three (3) stake pockets for each 10 feet section of form. Keep the forms straight and free from distortion. Contractor to make Ensure no vertical variation exceeds 1/8 inch in 10 feet lengths from the true plane surface on the top of the form when tested with a 10 feet straightedge. Maintain no lateral variation greater than 1/4 inch from the true plane surface on the vertical face of the form when tested with a straightedge.

D. 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.

E. Use a connection method between form sections that forms a locked joint. Prevent vertical movement exceeding 1/8 inch and horizontal movement exceeding 1/4 inch under the impact, thrust and weight of the heaviest machine carried on the forms.

F. Provide sufficient forms to avoid removing them in less than 12 hours after placing the concrete, or longer if required.

3.08 EQUIPMENT REQUIREMENTS

A. Use approved mechanical concrete placing and finishing equipment for concrete paving, except in gapped areas or where Engineer approves otherwise.

B. Furnish sufficient equipment for placing concrete pavement. Keep the equipment on the job site and ready for normal operation before starting the paving operation. Maintain equipment in good working order. Subject the equipment to inspections and testing during construction.

C. Use equipment with sufficient capacity to allow the paver to operate continuously, achieve a production rate that ensures good workmanship, and eliminate equipment overloading or frequent interruptions and delays.

D. Equip equipment operating on or near the pavement with rubber-tired wheels.

E. Subgrade Roller or Compactor:

1. Use self-propelled steel-wheeled or pneumatic-tired rollers weighing not less than 8 tons, or self-propelled vibratory compactors of adequate size to compact the subgrade to the required density.

F. Subgrade Planer:

1. A 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. Adjust the steel-shod template to fit the shape of the pavement bottom. Connect it adequately to a rigid frame to maintain the crown.

3. Use a planer with sufficient weight to plane off all high spots encountered.

G. Base Trimmer:

1. Use a powered, self-propelled base trimmer for slip-form construction. Contractor to make sure the base trimmer can trim the base to the required cross section.

H. Water Supply Equipment:

1. Use pumps and pipe lines with sufficient capacity and nature to ensure an ample supply and adequate pressure of water simultaneously for machinery, mixing, sprinkling subgrade, and other Work requirements.

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.

I. Finishing Machine:

1. Use a power-driven finishing machine of an approved type that strikes off and compacts the concrete with screeding and troweling action. Ensure the machine can finish the concrete as specified and 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 in length and 18 feet in width or when approved 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.

J. Concrete Spreader:

1. Use an approved concrete spreader with a strike-off board or a separate strike-off to level each layer of concrete before placing reinforcement and before finishing the concrete.

a. Ensure the equipment has sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete.

b. Two separate spreaders are not required where an approved mesh depressor type machine is used.

2. A concrete spreader is not required for the construction of residential street concrete pavement when approved by Engineer.

K. Vibratory Screed:

1. Provide an approved hand-propelled vibratory screed for use in gapped areas at driveways and intersections, and where machine methods cannot feasibly screed and consolidate the concrete.

a. Limit gaps finished by this method to one (1) joint spacing in length and one (1) single lane width.

2. Construct the screed with a steel-shod strike board at least two 2 inches thick, equipped with a gasoline engine capable of producing at least 5,000 vibrations per minute.

3. Other vibratory screeds may be approved by Engineer.

L. Membrane Sprayer:

1. A mechanically-pumped pressure sprayer capable of applying a continuous uniform film of curing compound will be required.

2. Ensure the equipment provides adequate stirring of the compound during application.

M. Slip-Form Paving Equipment:

1. When pavement is placed by the slip-form method, operate slip-form paving equipment to spread, consolidate, screed, and mechanically float freshly-placed concrete, minimizing hand finishing needed to produce a dense and homogeneous pavement.

2. Equip the machine to vibrate the concrete across the full width and depth of the pavement being placed.

N. Floats:

1. Use a combination float finisher as the mechanical float. Omit a separate mechanical float when a mechanical float forms an integral part of a slip-form paver.

2. Construct a float finisher as a machine with two (2) screeds and equip it with a suspended pan float. Suspend the second screed and pan float so they operate independently of the side forms.

3. A mechanical float will not be required for the construction of residential street concrete pavement.

O. Footbridge:

1. Provide a movable bridge when necessary to finish the pavement or construct joints satisfactorily. Design and construct the bridge to avoid contact with the concrete.

P. Transverse Float:

1. Make this float of metal, at least 10 feet in length, and of the box or channel type with a floating face at least 6 inches wide. Construct it to be light in weight, rigid, and free from warps.

Q. Vibrator:

1. Use an approved internal electric or mechanical vibrator, at least 2 inches in diameter, to consolidate concrete along the faces of the forms and adjacent to joints. Maintain a minimum frequency of 5,000 vibrations per minute for a tube 2 inches in diameter, 3,600 vibrations per minute for a tube 4 inches in diameter, or a proportionate frequency for an intermediate size.

2. Provide at least two (2) vibrators for each concrete paving unit on the project.

3. Connect vibrators used adjacent to the forms in conventional paving to the equipment on which they are mounted. Start concrete vibration automatically with the equipment's forward movement and stop it automatically whenever forward movement ceases.

R. Form Tamper:

1. Use a mechanical form tamper of approved design on all projects. Ensure it thoroughly and uniformly compacts the soil under the forms.

S. Strike-Off for Reinforcement:

1. Use an approved strike-off to level the concrete before placing pavement reinforcement. Adjust it and support it with two (2) flanged wheels on each end resting on the side forms.

2. Ensure it has sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete.

3. Use an approved hand strike-off resting on the forms for irregular areas.

4. The strike-off may be a part of the concrete spreader or a finishing machine.

T. Lane Tie Bar Installer:

1. Install lane tie bars with an approved mechanical device when not placed on approved chairs.

U. Reinforcement Carrier:

1. Transfer reinforcement not placed on chairs from hauling equipment to a movable bridge spanning the pavement being cast or place it by other approved means that avoid contaminating the concrete.

2. Design the bridge to carry the reinforcement load without appreciably deflecting the forms.

V. Joint Filling and Sealing Equipment:

1. Make equipment for filling and sealing joints available for inspection and testing at least 48 hours before use.

2. Include a mechanical mixer in the sealing machine to mix sealing components into a uniform, homogeneous mass.

3. Use a heating kettle for hot poured sealing material of the indirect-heating or double boiler type, employing oil as the heat transfer medium.

a. Equip the heating kettle with a thermostatically controlled heat source, a built-in automatic agitator, and thermometers indicating the temperatures of both the melted sealing material and the oil bath.

b. Demonstrate that the proposed equipment consistently produces a joint sealer of proper pouring consistency.

4. Apply the hot-poured sealing material directly from the heating kettle. Equip the kettle with a pressure pump, hose, and nozzle suitable for forcing sealing material to the bottom of the joint and completely filling the joint.

    a. Control the application rate to completely fill the joint without spilling material on the pavement surface.

    b. Maintain the temperature of sealing materials in the hose and nozzle, ensuring temperature loss does not exceed 10 degrees F between the nozzle and the heating tank.

    c. Do not use direct flame heat on the nozzle to maintain the proper temperature of the sealing material.

    d. Mount the heating equipment on rubber-tired wheels. Use only rubber-tired equipment to move the heating equipment on the pavement.

5. Apply cold applied sealing compound using pressure equipment that forces the material to the bottom of the joint and completely fills the joint without overflowing onto the pavement surface.

W. 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.

X. Sandblasting Equipment or Power Wire Brush:

1. Use sandblasting equipment of proper size and capacity to achieve the specified cleaning. Operate it at a nozzle pressure adequate for the performance of the Work.

2. Use nozzles with a diameter appropriate for the width of the joint. Replace them as necessary when enlarged by wear.

3. A power wire brush may be used in place of sandblasting equipment.

Y. Air Compressors:

1. Use portable air compressors capable of supplying sufficient air to maintain nozzle pressure adequate to remove all loose concrete fragments and foreign material from the joints.

2. Employ suitable traps to keep the compressed air free of oil and moisture.

Z. Power Broom:

1. A mechanical broom with pickup suitable for cleaning the pavement will be required.

AA. Concrete Saw:

1. Provide two (2) self-propelled concrete saws adequately powered to cut hardened concrete to the minimum depth shown on the Plans. Use saw blades with a minimum thickness of 3/16 inch.

2. Equip saws with suitable guards.

BB. Miscellaneous Equipment:

1. Provide all other small tools necessary to completely and satisfactorily finish the Work, including straightedges for testing pavement and forms.

3.09 PLACEMENT OF FORMS

A. Place and check forms for line and grade at least 500 feet in advance of placing concrete.

B. Stake and brace forms adequately to resist the pressure of concrete and the thrust of the equipment.

C. Ensure forms 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. Thoroughly clean forms before placing them.

F. Join forms neatly and tightly. Secure them with at least three (3) stakes per form.

G. Oil forms before placing concrete against them.

H. Check forms for line and grade after setting them.

I. Adjust forms showing a variance from the staked line exceeding 1/4 inch or from the staked grade exceeding 1/8 inch in 10 feet.

J. Provide sufficient back bracing when using flexible forms to prevent undue deflection during concrete placement.

3.10 PLACING CONCRETE

A. Placing of concrete should not commence or continue until the condition of the subgrade has been approved by Engineer.

B. Spread or distribute concrete immediately after placing. If not using a mechanical spreader, deposit concrete to minimize re-handling and avoid segregation and separation of materials. Deposit concrete to a height sufficiently above grade so that consolidation and finishing achieve the required finished grades.

C. Consolidate and compact concrete along the faces of forms and adjacent to joints to fill all voids.

D. Do not vibrate forms to consolidate the concrete.

E. When the pavement is placed in two (2) layers, the first layer may be cast 3 to 6 inches 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.

F. Vibrate concrete placed full depth across the complete width and depth of the pavement being placed. Vibrate only the second layer for concrete placed in two (2) layers.

G. Place concrete continuously as much as possible between transverse joints.

H. Cover concrete and the unfinished slab end with wet burlap or plastic whenever a temporary halt in operation occurs.

I. Place a construction joint if the Work interruption continues more than 20 minutes, provided the proposed joint is 15 feet or more from the last joint for reinforced pavement and at least 10 feet or more from the last joint in plain concrete pavement.

1. Do not permit sections of pavement shorter in length; remove and replace any constructed sections at Contractor's expense.

J. Construct integral curbs monolithic with the pavement slab where specified or required. Place the curb material before the pavement begins its initial set, using the same mix as the concrete pavement.

K. Use base and back forms when constructing straight curbs. Use back forms with templates of the required curb shape when constructing rolled and mountable curbs. Spade curb concrete sufficiently to eliminate all voids and tamp to bring mortar to the surface. Give the curb a final finish to match the pavement texture.

L. Fill any visible honeycomb or minor defects immediately after removing forms with mortar made of one part Portland cement and two parts fine aggregate. Apply the mortar with a wooden float.

M. Do not operate equipment on recently placed concrete in adjacent pavement lanes constructed in separate pours until the pavement attains at least 85% of design strength from testing cores or reaches 14 days old, as determined by Engineer.

N. Operate any equipment wheels on the pavement at least 1 foot from the pavement edge. Use rubber-tired equipment wheels.

O. Do not permit the paver on the new slab until the pavement attains full design strength. Prevent the paver from operating on any new slab without using wood mats of approved thickness and width to avoid marking or structural damage.

P. Pavers are not permitted to operate on residential streets.

Q. Repair damaged curing compound by spraying additional curing compound on damaged areas as soon as the Work is completed.

R. Pour the filler strip on pavement widening projects as soon as possible, but no later than the first working day after placing the slab.

S. Complete construction at all intersections and where property access is required by gapping the proposed pavement. Place load transfer, contraction, or end-of-pour joint devices at the gapped pavement ends.

T. In lieu of pavement gapping, Contractor may elect to place a temporary bridge, of a design approved by Engineer, to provide access. Furnish, place, maintain, and remove the bridge at Contractor's expense.

3.11 PLACING PAVEMENT REINFORCING

A. Place reinforcement sheets or mats at the depth below the finished pavement surface shown on the Plans.

B. Ship and deliver pavement reinforcement to the Work in flat sheets or mats.

C. Lap adjacent sheets or mats as indicated on the Plans, fastening them to each other in no fewer than two (2) places in each pavement lane.

D. Maintain reinforcement requirements as called for on the Plans where pavement width varies. Use split sheets or mats to conform to the specific pavement configuration. Ensure side laps are not less than the spacing of longitudinal wires or bars.

E. Substitute 1/2 inch diameter longitudinal reinforcing bars for standard reinforcement on widening Projects where the pavement slab is less than 6 feet wide. Space bars no more than 12 inches center-to-center. Place the first bar no more than 3 inches from the edges of the widened slab and lap bars a minimum of 12 inches.

F. Install reinforcement using one of the following methods:

1. Use chairs that support the reinforcement and provide sufficient bearing on the base to prevent undue penetration. Space chairs to maintain reinforcement at the specified depth. Place reinforcement directly from the hauling unit onto the chairs.

2. Mechanically spread and strike off the first concrete layer to the required depth below the proposed finished surface when placing reinforcement between two (2) layers of concrete. Place reinforcement directly from the carrier onto the struck-off concrete.

3. Mount reinforcement on chairs in any area where using the mechanical spreader or mechanical strike-off is not feasible.

3.12 JOINTS

A. Construct all longitudinal and transverse joints to conform to the details and at locations shown on the Plans or as directed by Engineer.

B. Construct all joints true to line with faces perpendicular to the pavement surface.

C. Construct transverse joints at right angles to the pavement centerline, unless otherwise specified on the Plans or determined by Engineer. Limit joint variation to no more than 1/4 inch from a true line.

D. Finish the pavement surface adjacent to all joints to a true surface. Edge joints to the radius shown on the Plans or a minimum 1/4 inch radius where indicated. Test the surface across joints with a 10 foot straightedge as joints are finished, and correct any irregularities before the concrete hardens.

E. Place transverse joints in succeeding partial-width slabs in line with the corresponding joints of the first slab. For widening existing pavements, place transverse joints as shown on the Plans or as directed by Engineer.

F. Form keyways accurately using templates of metal, wood, or paper securely pinned in place. Ensure the gauge or thickness of template material forms the full keyway as specified and in the correct location.

G. Longitudinal Joints:

1. Construct longitudinal joints as longitudinal lane tie joints with tie bars or bulkhead construction joints with hook bolts. Build a keyway in the bulkhead construction joint where called for on the Plans.

a. Longitudinal Lane Tie Joint (D):

1) Form longitudinal lane tie joints with tie bars as planes of weakness by sawing a groove in hardened concrete according to the alignment, width, and depth shown on the Plans.

2) Place tie bars of the specified type, diameter, and length at the required depth parallel to the finished surface, at right angles to the joint, and at the uniform spacing called for on the Plans or as approved by Engineer.

3) Use bar chairs to support the lane tie bars or install the lane tie bars with a mechanical device approved by Engineer. Do not place lane tie bars in the concrete by hand methods.

4) Saw the joint as soon as the concrete will not spall or within three (3) days after placement, and complete the sawing before any traffic uses the pavement. Immediately after sawing the joint, remove the slurry completely from the joint and surrounding area by flushing with a jet of water under pressure.

5) Blow out the joint with a jet of compressed air to remove the flushing water.

(a) After the joint dries, clean it out with a jet of compressed air at a working pressure of at least 90 psi, then seal it in accordance with these specifications using an approved hot or cold applied type joint sealing compound.

(b) Apply the sealing compound with approved pressure type equipment, extending the nozzle into the groove, and fill the groove until the sealer overlaps the pavement about 1/8 inch.

b. Longitudinal Bulkhead Construction Joint (D):

1) Use longitudinal bulkhead construction joints with hook bolts in part-width concrete pavement construction and other locations shown on the Plans or as approved by Engineer. Follow the size, spacing, and depth of the hook bolts below the pavement surface as shown on the Plans.

2) Substitute lane ties of an approved type for hook bolts in slip-form paving and space them at 30 inch centers, unless otherwise indicated on the Plans.

(a) Place lane ties for slip-form paving in the concrete using a pneumatic powered installer or equipment producing equal results.

(b) Replace lane ties that are not set with adequate concrete consolidation or are not within 30 degrees of perpendicular to the pavement edge in a horizontal plane with drilled-in expansion-anchored lane ties.

3) Attach hook bolts and couplings to the forms when constructing a bulkhead joint and hold them in position during concrete placing and finishing to allow removal of the pavement forms without damaging the concrete or hook bolt assembly. Protect the ends of the couplings to prevent concrete, dirt, or other materials from entering and obstructing a satisfactory connection with either hook bolt.

4) Insert rust preventive oil into the open end of the couplings immediately after removing the pavement forms where hook bolts or lane ties are installed for future

pavement widening, curb, or curb and gutter construction, using a hand-operated pump to apply enough oil to completely cover the internal threads.

(a) After applying the protective oil, insert neoprene or plastic plugs into the ends of the couplings to completely seal the opening without protruding more than 3/8 inch outside the couplings.

5) Edge the concrete with a tool matching the radius of curvature and depth of lip shown on the Plans. Use a longer lipped edging tool for the second concrete pour than the one used for the first pour.

6) After the concrete cures for the required time, remove all extraneous material from the joint and then seal the joint with an approved hot-poured or cold-applied elastic-type compound. Clean the joint before sealing using sandblasters and a jet of compressed air.

H. Transverse Joints:

1. Design transverse joints as contraction joints, plane of weakness joints, dummy joints, expansion joints, construction joints, end-of-pour joints, and pressure relief joints.

a. Contraction Joints (C):

1) Construct contraction joints with a load transfer unit and a joint groove formed by sawing. Build contraction joints as indicated on the Plans and space them at a maximum of every 57' - 3" or as otherwise provided.

2) Use epoxy-coated dowel bars as the load transfer unit, spacing and arranging them according to the positions indicated on the Plans. Hold them accurately in place with an approved metal device to keep them perpendicular to the pavement cross-section plane and parallel to the centerline, at a depth from the surface equal to 1/2 the slab thickness.

3) Use a device consisting of connected transverse and longitudinal members arranged to hold each dowel firmly so that its final position after concreting does not vary more than 1/8 inch per foot of length from the designated line and grade. Design the device to allow complete assembly of the joint alongside the Work and to be sufficiently rigid to lift the joint into place on the subgrade as a unit.

4) Allow one end of each dowel bar to move freely in the slab as the concrete contracts and expands.

(a) Lubricate 2/3 of each dowel’s length thoroughly with liquid asphalt to allow movement. Apply the liquid asphalt coating to a sawed end of the dowel bar or, for dowel bars with sheared ends, place a metal cap on the coated end.

(b) Allow the asphalt coating to dry sufficiently before using the dowels to prevent removal during handling and placement in the joint.

(c) Install the bars so that the coated end alternates on each side of the joint.

b. Plane of Weakness Joints (WT):

1) Place Plane of Weakness joints only in plain concrete pavements immediately after finishing operations. Form a groove in the plastic concrete with a metal forming bar to the depth indicated on the Plans.

2) Place a premolded bituminous filler strip in the groove formed by the metal bar using a bridge operating on the pavement forms.

3) Float the concrete against the sides of the filler, then edge the joint to a 1/8 inch radius.

c. Plane of Weakness Joint for Concrete Base Course (WTB):

1) Place dummy joints in reinforced concrete pavements only where called for on the Plans.

2) Construct dummy joints immediately after finishing operations by forming a groove in the plastic concrete with a metal forming strip and placing expanded polystyrene or another approved temporary filler into the groove.

3) Install the material flush with the pavement surface and finish the area on both sides of the joint. Do not edge transverse joints with a temporary filler.

4) Continue the pavement reinforcement through this joint.

d. Expansion Joints (E) and (E1):

1) Construct expansion joints (E1) with a load transfer unit and a premolded fiber filler and use them on reinforced concrete pavements or where shown on the Plans.

2) Construct expansion joints (E) with a premolded fiber filler without the load transfer unit and use them for joints in concrete capping, end connections with structures or existing pavements, plain concrete pavements, and other locations shown on the Plans or where installing the load transfer unit is not feasible, as approved by Engineer.

3) Assemble the load transfer units and lubricate the epoxy-coated bars with liquid asphalt. Provide a close-fitting metal cap on the liquid-asphalt-coated end of each bar.

4) Extend the fiber filler the full depth and width of the joint.

(a) After installation, position the top at no less than 1/2 inch and no more than 1 inch below the finished surface.

(b) Furnish the units in lengths not less than the lane widths being poured. Provide additional partial lengths with a minimum length of load transfer unit and premolded fiber filler sufficient to span two (2) dowel bar spacings.

(c) Securely join sections together when more than one (1) section is allowed and used in a joint.

5) Extend the fiber filler used in the pavement completely through the curb section for expansion joints in curb lanes with integral curb or separate curb and gutter. Place the fiber filler above the slab in the curb at 1 inch in width.

6) Hold the joint in place during installation with an approved installing device securely staked.

(a) Protect the top edge of the filler during concrete placement with a metal channel cap of at least 10-gage material, having flanges not less than 1-1/2 inches in depth.

(b) Shape the channel cap to the proposed crown of the pavement and extend it over the full length of the filler.

e. Pressure Relief Joints (PR):

1) Construct the pressure relief joint using the method indicated on the Plans.

2) Use a flexible, low-density, expanded, extruded polyethylene plank as the pressure relief joint material. Cut the joint material off to 1/2 inch below the top of the pavement surface, and extend it entirely through and to within 1/2 inch of the face and top of the curb.

f. End of Pour Joints and Construction Joints:

1) Form end of pour joints in reinforced pavement by placing a bulkhead and installing a load transfer device, as specified for contraction joints, except do not lubricate the ends of the dowel bars. Install the load transfer device so that each dowel bar is embedded in the concrete for 1/2 of its length.

2) Provide a space for hot-poured rubber joint filler during the next pour by placing a temporary filler in the fresh concrete.

3) Construct end-of-pour joints using 2-piece dowels and a bulkhead, and place them where a delay of three (3) days or more is anticipated between the casting of adjacent pours.

4) Seal construction joints and end-of-pour joints as specified for transverse contraction joints.

5) Form end-of-pour joints in plain concrete pavements by placing a bulkhead, fiber keyway, and installing 1/2 inch diameter deformed bars, 30 inches in length, at 18 inch intervals across the end of the pavement.

6) Thicken the pavement across the end of both slabs, and edge and seal the joint.

2. Extend all transverse joints in concrete pavement entirely through the integral curb or separate curb and gutter. Use the same kind of material to construct the joint in the curb as provided for the pavement.

3. Use bituminous fiber filler to construct expansion joints in the integral curb of reinforced concrete pavements.

a. Set the thickness of the fiber filler material in the curb above the gutter to 1 inch.

b. Precut the joint material to conform to the geometric shape and cross-sectional area of the curb, and place it in intimate contact with the filler material in the pavement.

I. Round the edges of all transverse joints in the integral curb with an approved finishing tool, having a radius of 1/4 inch.

3.13 CONSOLIDATING AND FINISHING

A. Follow this sequence of operations after placing the concrete:

1. Striking off and consolidating
2. Floating
3. Edging
4. Final finishing with burlap drag

B. Employ mechanical methods to strike off and consolidate or compact the concrete, except in gapped areas or where the pavement width prevents machine methods. Finish gaps less than one (joint opening in length by hand methods, ensuring 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.

1. Maintain at least 4 inches of concrete above the finished pavement grade ahead of the screed for its entire length.
2. Operate a single screed finishing machine twice over each section of the pavement when consolidating the surface on residential street construction.
3. Work only sufficient mortar to the surface to provide a dense, smooth finish.
4. Do not operate the machine excessively over a given area. Thoroughly mix segregated particles of coarse aggregate collected in front of the screed by hand with the mass of concrete already on the subgrade.

D. Use an approved, self-propelled vibratory screed to strike off and properly consolidate the concrete surface to the required finish grade when mechanical equipment cannot be used on irregular areas.

1. Consolidate the entire area of the pavement to ensure an absence of voids.
2. Where it is not possible to use a vibratory screed, a hand strike board of an approved design, will be permitted.

a. Move strike-off boards forward with a combined longitudinal and transverse motion, keeping both ends in contact with the side forms during the process.

b. Keep a slight amount of excess concrete in front of the front edge at all times.

c. When striking off and consolidating by hand, pours will be limited to single lanes or 1/4 of intersections.

E. Make the surface uniform by longitudinal or transverse floating using a mechanical method after striking off and consolidating, unless constructing the pavement in single lane widths is permitted.

F. Where mechanical floating is an integral part of the operation of a slip-form paver, separate mechanical floating methods will not be required.

G. Mechanical longitudinal floating will not be required for residential street construction.

H. Operate a transverse float at least 10 feet in length across the pavement by starting at the edge, slowly moving to the center, and back to the edge when mechanical equipment is not used for floating. Then move the float ahead 1/2 of its length and repeat the operation.

I. Preserve the crown and cross section of the pavement carefully.

J. Do not proceed with the float finishing operation until the concrete attains a consistency that prevents excess concrete from being carried ahead of the float, yet allows the entire surface to be floated and sealed.

K. Immediately after float finishes and while the concrete remains plastic, test the slab surface for trueness using a 10 foot straightedge or acceptable float.

    1. Place the straightedge at the center of the slab with the blade parallel to the centerline, and pull it slowly and uniformly to the edge. Repeat this operation until the concrete surface is free from irregularities and makes contact at all points with the bottom of the straightedge. Then move the straightedge forward half its length and repeat the operations.

    2. Fill depressions found in the surface with fresh concrete and consolidate them by floating with a long-handled float not less than 10 foot in length. Use this float also to smooth sections of the surface that have become rough or torn by dragging with the straightedge.

L. Determine edge settlement for pavement constructed by the slip-form method as soon as practical after paving operations begin. Correct edge settlement exceeding 3/8 inch before the concrete hardens.

    1. Suspend paving and make operational corrections when edge settlements exceed 1/4 inch before Engineer permits resumption of paving. Discontinue slip-form methods and place pavement using conventional forms if Contractor consistently fails to construct pavement within these tolerances.

    2. Wipe all mortar paste from the sides of the slab when paving is accomplished by the slip-form paving method.

    3. Test the surface for smoothness with the straightedge. Ensure uniform contact of the straightedge with the concrete over the entire length tested. Perform testing when the surface is free from soft mortar or excessive water. Use the testing straightedge exclusively for this purpose.

M. Work all laitance, surplus water, and inert material entirely off the pavement as soon as hand floating is completed when the float finisher method is not utilized. Smooth the surface by dragging with a rigid 10 foot straightedge and test the surface.

N. Finish the pavement by dragging a seamless strip of damp burlap or cotton fabric, not less than 5 feet nor more than 6 feet in width, over the full width of the pavement as soon as all excessive moisture disappears and while it remains possible to produce a uniform surface of gritty texture.

1. Pull the burlap or cotton drag by a bridge supported on pavement forms. Renew the fabric as often as necessary to obtain the required texture.

O. Finish the edges of the slab and all specified joints immediately after the initial finishing with burlap using an edging tool to the radii indicated on the Plans. Then give the pavement a final finish by dragging damp burlap or cotton fabric over the portion of the pavement disturbed by the edging operation.

3.14 SURFACE REQUIREMENTS

A. Remove or reduce high spots in the surface exceeding 1/8 inch from the straightedge but not more than 1/2 inch in 10 feet by rubbing with a carborundum brick and water until contact with coarse aggregate is made. Remove high spots that contact coarse aggregate before reaching acceptable tolerance using an approved surface-grinding machine before accepting the pavement.

B. Have Engineer evaluate high spots exceeding 1/2 inch in 10 feet. Remove and replace the work at Contractor's expense if it is rejected.

C. Take immediate steps to eliminate the cause of the defective surface.

3.15 CURING

A. Completely coat and seal the surface of the slab with a uniform layer of white membrane curing compound after finishing operations are completed and immediately after the free water has left the surface.

B. Apply the compound in a continuous uniform film using mechanically pumped pressure sprayer equipment at a rate of 1 gallon per 200 sft of surface. Do not thin the curing compound.

C. Provide equipment with adequate stirring of the compound during application. Contractor to make sure the equipment for applying the compound is on the Project and approved by Engineer before starting Work.

D. 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.

E. 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.

F. Protect the treated surface from injury for at least seven (7) days. Consider all traffic, including foot traffic, injurious to the film of the applied compound. Permit only minimal foot traffic on the dried film as necessary to properly carry on the work, including removal of high spots. Immediately repair any damage to the film by applying a second coat of the compound.

G. Coat the entire area of the side of the slab with the curing compound immediately after removing the forms, applying it at the rate specified for the pavement surfacing.

H. Provide sufficient burlap or polyethylene coverings on the Project to protect the pavement in case of rain or spray equipment breakdown. Consider failure to provide proper curing as sufficient cause for immediate suspension of concreting operations.

3.16 REMOVAL OF FORMS

A. Remove forms from freshly placed concrete after it has set for 12 hours, provided no damage occurs to the pavement or curb edge. Cease form removal if damage occurs during the process, and wait until the concrete has attained greater strength before resuming.

   1. The period of time for removing forms may be increased or decreased when approved by Engineer.

B. Clean the ends of all joints immediately after form removal. Fill any visible areas of honeycomb or minor defects with mortar composed of one part Portland cement and two (2) parts fine aggregate from the same source as used in the pavement, applying it with a wooden float.

   1. Take immediate steps to correct the conditions contributing to these defects.

C. Spray the sides of the pavement with curing compound immediately upon form removal, except where honeycombed areas require pointing, then cure those areas immediately.

D. Do not place forms and pins on new pavement being cured with membrane.

3.17 SAWING JOINTS

A. Saw contraction joints, longitudinal lane-tie joints with tie bars, and end of pour joints.

B. Saw joints before permitting any traffic on the pavement.

   1. 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.

   2. When permitted on the pavement, the water supply truck must be kept a minimum of 50 feet behind the sawing operation.

C. Make at least two (2) approved concrete saws available for use at all times, ensuring one saw can cut a joint groove 2-1/2 inch deep.

D. Cut the saw groove for transverse end-of-pour joints to receive the joint sealing material.

E. Saw longitudinal lane-tie joints with tie bars according to the alignment and dimensions indicated on the Plans.

F. Saw the joint groove for joints formed in one operation before any transverse cracks develop. Repair raveling or spalling along the joint as specified elsewhere in this Section.

G. Saw transverse contraction joints in two stages:

   1. Stage 1 Sawing:

      a. Make the first stage a relief cut directly over the center of the load transfer assembly. Perform the initial relief cut as soon as the saw can be placed on the freshly poured concrete, and continue sawing as long as the pavement can support the saw without creating or appreciably raveling the joint.

      b. Apply membrane curing compound immediately when water is not used in the sawing operation.

c. Completely remove the slurry resulting from sawing when water is used by flushing the cut and immediate area with a jet of water. Apply additional membrane curing compound within 12 hours after making the relief cut.

2. Stage 2 Sawing:

a. Start the second stage of joint sawing only after the concrete has cured for a minimum of 48 hours. Center the joint groove over the relief cut and saw it to the specified dimensions shown on the Plans, including any increase in width of the relief cut due to shrinkage or contraction. Maintain a groove width tolerance of ± 1/16 inch.

b. Blow joints sawed without water clean of all foreign material using a jet of compressed air.

c. Completely remove the slurry resulting from the sawing operation when water was used by flushing the groove and immediate area with a jet of water, then blow dry with compressed air.

H. Perform a final cleaning of transverse joint grooves with a jet of compressed air adequate to remove all foreign material just before permanent sealing.

I. Temporarily seal the joint groove with a suitable material or device to prevent infiltration of foreign material if the specified seal is not installed within seven days of final sawing.

J. Do not permit traffic over the full width joint grooves before installing the permanent or temporary seal.

3.18 PATCHING JOINTS

A. General:

1. Inspect joints for spalls and voids after sawing and cleaning.

2. Remove loose, unsound, or damaged concrete to the satisfaction of Engineer.

3. Classify spalls and voids as minor, intermediate, or major, and repair accordingly.

B. Minor Spalls:

1. Repair spalls or voids that increase the specified size of the joint groove beyond any limits, but less than 36 square inches, by patching with an approved epoxy mortar before installing the seal.

a. Spalls which extend more than 1/4 inch from the joint face and over 1/2 inch below the surface of the pavement.

b. Spalls which extend more than 1/4 inch from the joint face and 2 inches or more in length, regardless of the depth of spall below the surface of the pavement.

c. Void areas larger than 1/2 inch in diameter in the upper 1 inch of the joint face or larger than 1 inch in diameter regardless of location.

2. Thoroughly clean the spalled concrete surface by sandblasting, power-wire brushing, or hand-wire brushing. Then blow the patch area clean with a jet of compressed air.

3. Insert a heavy polyethylene sheet or rigid material into the joint groove and hold it tightly against the joint face to be patched.

4. Ensure concrete is clean and dry when placing epoxy resin mortar. Remove frost by heating with a clean heat source approved by Engineer until dry. Take care not to damage the concrete during heating.

5. Epoxy binder will be a mixture of two (2) parts epoxy resin to one (1) part curing agent by volume, or as approved by Engineer.

6. Mix epoxy resin compound in a clean metal or polyethylene container using an approved stirrer operating at 250 to 500 rpm. Gradually add the curing agent compound while mixing. Stir the mixture for a minimum of three (3) minutes until uniform.

7. Reserve a small portion of the thoroughly mixed epoxy binder for priming.

    a. Uniformly blend dry MDOT 2NS sand into the remaining mixture to create an epoxy mortar of stiff or trowelable consistency. Use one part of mixed binder to about 3.5 parts of dry sand by volume to achieve a workable mix.

8. Prime the spalled surface with freshly mixed epoxy binder by scrubbing it into the surface using a suitable applicator. Ensure complete wetting and coverage of all areas where the epoxy mortar must bond.

9. Place the epoxy mortar in the spalled area immediately after priming and finish it to match the shape of the original pavement surface. Apply a second coat if the bond coat is not tacky when placing the mortar. Ensure the patch edge conforms with the rest of the joint groove.

10. Sprinkle dry MDOT 2NS sand onto the fresh epoxy mortar surface to eliminate gloss. Carefully remove the polyethylene insert after the epoxy mortar has cured sufficiently to resist damage during sealing operations.

11. Clean joints finally with a jet of compressed air to remove foreign material.

12. Place the hot-poured elastic type joint seal the day following epoxy resin mortar patch placement when air and pavement temperatures exceed 50 degrees F. Determine curing time for epoxy mortar by Engineer when air and concrete temperatures fall below 50 degrees F.

C. Intermediate Spalls:

1. Repair spalls larger than 36 square inches, but not extending below the reinforcing mat, by sawing and chiseling out unsound concrete and patching with Portland cement mortar.

2. Make a saw cut at least 1 inch deep parallel to the joint groove at the outer extremity of the spalled area. Chip out concrete to the saw cut to create a vertical face at the back of the repair area, and trim the two ends of the repair area to approximately vertical faces.

3. Sandblast the repair area to remove all loose particles, then blow it clean with a jet of compressed air to remove sand and other foreign materials.

4. Flush the repair area with clean water and blow out excess water with compressed air.

5. Insert a heavy polyethylene sheet or rigid material into the joint groove and hold it tightly against the joint face to be patched.
6. Prime the bottom and vertical faces of the repair area with a grout of creamy consistency made from a 1:1 mixture of Portland cement and MDOT 2NS sand with water.
7. The 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.
8. Carefully apply cement grout to the rough surfaces of the spall area immediately before placing fresh mortar, ensuring the prime coat remains wet when covered by mortar.
9. Tamp Portland cement patching material into the repair area and finish it level with the pavement surface.
    a. Mix Portland cement mortar using 1 part Portland cement to two (2) parts MDOT 2NS sand with a water content not exceeding 4 gallons per sack of cement.
    b. Add a liquid air-entraining agent to maintain an air content of 8% to 11%.
    c. Calcium chloride in an amount of one (1) percent of the cement content may be added as an accelerator, if approved by Engineer.
10. Match the edge of the patch at the joint face with the rest of the joint groove.
11. Spray white membrane curing compound on the patch surface immediately after casting and finishing the mortar.
12. After 72 hours, carefully remove the polyethylene form and clean all patched joints with a jet of compressed air to remove all foreign material.

D. Major Spalls:
    1. Consider a joint damaged beneath the depth of the reinforcing mat as a major repair. Handle these major repairs individually under the direction of Engineer.

3.19 SEALING JOINTS

A. Fill and seal transverse expansion, contraction, construction, and longitudinal bulkhead construction joints with an approved hot-poured elastic type compound.

B. Pressure fill and seal longitudinal lane-tie joints with either an approved hot-poured or cold-applied elastic type compound. Do not place these sealing compounds when atmospheric or pavement temperatures fall below 50 degrees F or during rainy or foggy weather.

C. After completing the shoulders and curing the pavement, clean the joints and pavement surfaces on each side of the joints of all extraneous matter.
    1. Perform the cleaning by sandblasting or other methods approved by Engineer that effectively clean the concrete.
    2. Remove dust and sand present after sandblasting or cleaning with a jet of compressed air. Use hand tools to remove stones and other foreign materials from the joint groove.

D. Immediately after cleaning the joints with compressed air and drying the concrete surface in the joint, seal the joint with an approved hot-poured elastic type compound.

E. Melt the hot-poured compound in an approved double boiler type kettle. Do not use direct heating. Avoid using any sealing material heated beyond the safe heating temperature 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.

G. Engineer may require Contractor to modify Contractor's method of heating or of charging the heating unit with compound that will produce satisfactory results.

H. Pour from the melting kettle equipped with an approved pressure pump hose and nozzle.

I. When authorized by the 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.

J. Pour the sealing compound to fill the joint to 1/4 inch below the top of the pavement. Immediately remove any sealing compound spilled on the pavement surface.

K. After the first pour cools to pavement temperature and settles, make a second pour to bring the sealing compound to 1/4 inch below the pavement surface.

L. Do not permit traffic over the poured joint until the compound hardens sufficiently to resist pickup.

M. Cover the sealed joint with a 1-1/2 inches wide strip of paper or other approved means immediately after applying the compound to protect hot-poured and cold-applied sealing compound during curing and prevent pickup by traffic. Leave the paper strip in place until worn off by traffic.

3.20 TRAFFIC CONTROL

A. Provide measures necessary to protect and maintain traffic and to protect the Work in accordance with Section 01 50 00 - Temporary Facilities and Controls and with the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.).

3.21 PROTECTION AGAINST RAIN

A. Adequately protect the new concrete from rain effects before it hardens sufficiently.

B. Keep enough burlap or 6 mil polyethylene film available on the job site at all times to cover and protect one day's Work.

C. Stop all operations and begin covering when rain appears imminent.

D. Uncover the concrete as soon as the rain ceases and drag the surface burlap where necessary.

E. Apply curing compound to any areas where it has been disturbed or washed away. Protect the new concrete against rain at Contractor's expense.

3.22 COLD WEATHER PROTECTION

A. Keep a sufficient amount of clean, dry straw or hay, polyethylene film, or other approved materials on-site to cover at least one day's production whenever freezing temperatures threaten. Provide cold weather protection at Contractor's expense. Use temperature forecasts prepared by the local weather bureau, recognized as the Official Weather Bureau the local weather bureau, recognized as the Official Weather Bureau for the construction area. Use the predicted low temperature expected during the next 24 hours.

B. Do not charge frozen material into the mixer at any time.

C. Remove frost or ice from the forms and any steel used in the pavement before placing concrete.

D. Do not place concrete directly on a frozen subgrade. Cover the subgrade with a 12 inch layer of straw or hay to protect it against freezing. Remove the straw or hay from the finished subgrade immediately ahead of paving operations and pile it along the construction line for covering the finished pavement. Clean the subgrade of loose straw and prepare it in a manner satisfactory to Engineer before placing concrete. Use other covering materials approved by Engineer to prevent subgrade freezing.

E. Add calcium chloride to the mix to accelerate concrete hardening when the air temperature in the shade and away from artificial heat ranges between 40 and 45 degrees Fahrenheit at the rate approved by Engineer. Spread calcium chloride on the materials immediately before discharging them into the mixer drum. Use a method approved by the Engineer to measure the amount of dry calcium chloride added to each concrete batch. Do not place calcium chloride in direct contact with the cement.

F. Immediately after finishing the concrete and as soon as it hardens sufficiently, cover the pavement and keep the protective covering in place until the concrete develops a compressive strength of at least 3,000 psi or for a minimum period of 14 days or as approved by Engineer.

G. Place the protective covering around and over the forms, extending beyond the pavement edge by a distance at least equal to the required depth of covering.

H. 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.

I. Stop mixing and placing concrete each day in sufficient time to finish the concrete and place the required protective covering during daylight hours.

J. The requirements specified herein for the curing and protection of concrete in cold weather are minimum requirements, and Contractor will be responsible for the quality and strength of the concrete placed. Concrete damaged by frost action must be removed and replaced at Contractor's expense.

K. Between October 15 and May 15, when the predicted low temperature is to be below 35 degrees Fahrenheit at any time within 72 hours after placing the pavement, protect the pavement and keep the protective covering in place until the concrete develops a compressive strength of at least 3,000 psi or for a minimum of 14 days unless otherwise authorized by Engineer.

L. Special Protection:

1. Do not place pavement between October 15 and May 15 unless specifically provided for in the Contract Documents or authorized by Engineer. Do not place concrete when the predicted high temperature falls below the specified limit without written permission from the Engineer. Apply the following requirements when paving is permitted during this period:

    a. Maintain the concrete temperature between 50 and 85 degrees Fahrenheit when placing it on the subgrade.

    b. Heat the mixing water, aggregates, or both as required by Engineer to maintain a mix temperature between 50 and 85 degrees Fahrenheit. Heat the water and aggregates to no more than 150 degrees Fahrenheit.

        1) Heat aggregates using steam pipes under the aggregate piles, free steam discharged into the aggregate piles, or steam pipes in the batching bins.

        2) Control heating of the water and aggregates to prevent large temperature differences between batches.

    c. Contractor to make sure necessary materials for covering and protecting the concrete, equipment for heating water and aggregates when required, and calcium chloride are on the Project and available for immediate use before placing pavement when the predicted low temperature risks dropping below 35 degrees Fahrenheit.

    d. For predicted low temperatures from 35 to 25 degrees Fahrenheit, place either 1-layer of waterproof paper blankets or 12 inches of loose dry straw or hay.

    e. For predicted low temperatures of 25 to 20 degrees Fahrenheit, place 1-layer of waterproof paper blankets and 12 inches of loose dry straw or hay.

    f. For predicted low temperatures less than 20 degrees Fahrenheit the minimum requirement for cold weather protection will be 1-layer of waterproof paper blankets and 12 inches of loose dry straw or hay overlayed with a waterproof protective covering consisting of tarpaulins, paper blankets, polyethylene sheeting or other approved material.

2. Protect all concrete placed within the preceding 72 hours similarly when temperatures require special protection as specified above.

3. Continue special protection once started until design strength is reached per the above requirements unless warmer temperatures prevail for at least 48 hours. Obtain Engineer approval to eliminate special protection for such a period.

M. Provide protection of the new concrete against cold weather, including ordinary and special protection, at Contractor's expense.

3.23 CONCRETE TEMPERATURE LIMITATIONS

A. Do not place concrete when its temperature at the point of placement exceeds 90 degrees Fahrenheit.

3.24 CURB DROP

A. Provide curb drops for existing and future sidewalk ramps, approaches for existing driveways, and other locations determined by Engineer.

B. Install curb drops for sidewalks according to the current rules and regulations of Act 8, Michigan PA 1973, as amended. Center curb drops for drive approaches with the existing driveway at the property line.

C. Make the width of the residential curb drop equal to the width of the driveway at the property line plus four feet. Unless otherwise approved by Engineer, maintain a minimum width of 14 feet for the residential curb drop.

3.25 SHOULDERS

A. Construct the shoulders according to the lines, grades, and cross section shown on the Plans and as specified for the required shoulder material type. Sequence the shoulders with surfacing operations to complete them no more than 7 days after the curing period expires unless directed otherwise by Engineer.

B. Construct aggregate shoulders as specified under Section 32 11 23 - Aggregate Base Courses, when called for.

3.26 CLEANUP

A. Remove the fixed forms after the concrete gains sufficient strength, but not sooner than 12 hours, and immediately backfill the spaces on both sides with sound earth of topsoil quality.

B. Compact, level, and leave the backfill in a neat, workmanlike condition.

C. At a seasonally correct time approved by Engineer, the disturbed area must be raked, have topsoil placed thereon, and fertizized and seeded per the requirements of Section 32 92 19 - Seeding.

3.27 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.

3.28 MONUMENT BOXES

A. Preserve government, plat, and street intersection monuments within existing or proposed pavement by enclosing them in standard monument boxes.

B. Furnish and install monument box castings.

C. Adjust existing monument boxes to meet the proposed pavement elevation by removing the castings and resetting them to the required elevation.

D. Construct concrete bedding to support the monument box firmly in place.

E. Replace adjacent pavement, curb, or curb and gutter to the new elevation, condition, and construction type unless otherwise provided.

3.29 TESTING

A. During the course of the Work, Engineer may require the taking of standard test cores and cylinders, by a testing laboratory acceptable to Owner and approved by Engineer.

B. Charge Owner for making cylinders, drilling cores, and testing.

C. For each lane of Work:

1. Make at least one (1) cylinder for testing compressive strength for each 500 feet or fraction thereof, or as determined by Engineer.

2. Drill at least two (2) cores for testing compressive strength and checking thickness for each 500 feet or fraction thereof.

D. Conduct slump tests for Portland cement concrete consistency according to ASTM C143/C143M and ASTM C172/C172M.

E. Adjust the unit price for concrete based on the average of three (3) cores when test results on a core indicate a deficiency in thickness or compressive strength, or when test results on a cylinder indicate a deficiency in compressive strength, as follows:

1. Thickness:

Under Required Thickness	Percent of Reduction in Unit Price
0 to 1/4 inch	None
by more than 1/4 but not exceeding 1/2 inch	20
by more than 1/2 but not exceeding 1 inch	50
by more than 1 inch	Remove & Replace

2. Compressive Strength:

Under Required Compressive Strength	Percent of Reduction in Unit Price
0 to 150 psi	None
by more than 150 but not exceeding 300 psi	20
by more than 300 but not exceeding 500 psi	50
by more than 500 psi	Remove & Replace

3. Reduction in the unit price are additive, that is if an area is deficient by 3/8 inch and is under strength by 200 psi, the total reduction is 20% plus 20%, or a reduction of 40%.

4. Determine the area of a deficient core by drilling and testing two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it, when possible.

5. Charge the extra core drilling and testing to Contractor's expense.

END OF SECTION

SECTION 32 13 15
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 012200

B. Section 01 33 00 - Submittal Procedures

C. Section 31 11 00 - Clearing and Grubbing

D. Section 31 23 13 - Subgrade Preparation

E. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

A. Unless otherwise specified, the Work for this Section will conform to the applicable portions of the following:

1. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
2. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
3. ASTM C94/C94M Standard Specification for Ready-Mixed Concrete
4. ASTM C150/C150M - Standard Specification for Portland Cement
5. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
6. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
7. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
8. AASHTO T26 - Standard Method of Test for Determination of Organic Content in Soils by Loss on Ignition
9. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition.

1.04 SUBMITTALS

A. Obtain written permission for the use of all local disposal sites and furnish copies to the Engineer.

B. Provide, at the request of the Engineer, certification that the various materials to be used conform to the ASTM Standards referred to in the Specification.

1.05 TEST REPORTS

A. Provide 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 will be performed by a testing laboratory approved by the Engineer.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with the requirements for concrete installation due to outside ambient air temperatures specified under Part 3 of this Section.

1.07 PROTECTION

A. Comply with the requirements for protecting new Work against damage from rain, as specified under Part 3 of this Section.

B. Comply with the requirements for protecting new Work against damage from cold weather, as specified under Part 3 of this Section.

PART 2 PRODUCTS

2.01 CONCRETE

A. Concrete will conform to MDOT Section 1004, use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

B. USe ready-mixed concrete in accordance with ASTM C94/C94M, Alternate 2 unless a written request for other than ready-mixed concrete has been submitted, reviewed and approved by the Engineer.

C. Provide documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3,500 psi when tested under field conditions.

D. Mixes will contain a minimum of 25% Type F fly ash.

1. Water reducers, additional fly ash, ground granulated blast furnace slag (GGBFS), and other pozzolans, may be used when approved by the Engineer.

    a. Fly ash quantity will not exceed 40%;

    b. GGBFS quantity will not be less than 25% and not more than 40%;

    c. Maximum total replacement of cement will not exceed 40%;

    d. GGBFS and fly ash must replace cement on a pound for pound basis.

E. Use air-entraining Portland cement conforming to ASTM C150/C150M, Type 1A. If high-early strength concrete is desired, Type IIIA is required.

F. High-early concrete can be obtained for small areas by the addition of one sack of cement, Type 1A, per cubic yard of concrete (94 lbs/cyd).

G. Air content of the concrete will be 6.5% ± 1.5% by volume.

2.02 WATER

A. Water to be used for mixing and curing concrete will 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 test.

C. Water requiring testing will be tested in accordance with the current Method of Test for Quality of Water to be Used in Concrete in AASHTO T26, and as specified in MDOT, Section 911.

2.03 CONCRETE CURING COMPOUNDS

A. White membrane curing compound for curing concrete will conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 911.

2.04 PREMOLDED JOINT FILLER

A. Fiber joint filler for expansion joints will conform to ASTM D1751. Filler will be of the thickness, as specified herein or on the Plans, or as approved by the Engineer.

2.05 STEEL HOOK BOLTS

A. Hook bolts will conform to ASTM A706/A706M, or Grade 60 of ASTM A615/A615M, or ASTM A996/A996M. Hook bolts will be 5/8 inch (16 mm) diameter.

2.06 JOINT SEALANT

A. Hot-poured type joint sealant will conform to ASTM D6690, Type II, and as specified in MDOT Section 914.04.

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 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 the Engineer prior to any change.

3.03 FORMING

A. Forms will 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 will be the full depth of the concrete.

3.04 SIDEWALKS, SIDEWALK RAMPS, DRIVEWAYS, AND DRIVEWAY APPROACHES

A. Unless otherwise noted in the Contract Documents, sidewalks and sidewalk ramps will be 4 inches thick except at driveways, where the thickness of the sidewalks will be 6 inches.

B. Sidewalks will be 5 feet wide, unless otherwise noted on Plans, and slope 1/4 inch/ft towards the surface drainage side, which in general will be towards the center of the road. Sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1 foot from the property line, unless otherwise shown on the Plans or as determined by the Engineer.

C. Driveways and approaches will be 6 inches thick. The width of driveways and driveway approaches will be as specified on the Plans or as determined by the Engineer.

3.05 REMOVE CURB FOR CURB DROP

A. Construction of sidewalk ramps within street intersections where curbed pavement exists will 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, saw cut, to full depth of pavement, and remove a minimum of an 18 inch wide curb and gutter section. When mountable curbs are present, remove a 24 inch wide curb and gutter section for the construction of sidewalk ramp, as specified herein.

C. The length of curb and gutter removal will be determined by the Engineer in the field but will be at least as wide as the proposed sidewalk ramp plus 1 foot on each side.

D. The removed curb and gutter section will be replaced with material, equal to what was removed and the joint sealed with hot poured rubber asphalt.

E. Install 5/8 inch 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 the Engineer. Curbs that are cut or ground down that are not acceptable to the Engineer, will be removed and replaced at Contractor's expense.

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 in length.

B. Stake forms 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 will be placed so that the slab division joints will be straight and continuous.

D. Set forms for sidewalk ramps to provide a grade toward the centerline of the right-of-way in accordance with current standards. The grade must be uniform, except as may be necessary to eliminate short grade changes.

E. Oil forms before placing concrete. Forms will remain in place at least 12 hours after the concrete is placed. Ensure sufficient forms are 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 the Engineer in lieu of the construction system described above.

3.07 JOINTS

A. Transverse and longitudinal expansion and plane-of-weakness joints will be constructed at the locations specified herein, as indicated on the Plans, or as approved by the Engineer.

B. Place transverse expansion joints for the full width and depth of the new Work. The transverse expansion joints placed against any existing pavement must be a minimum of 6 inches deep, but no less than the thickness of the concrete being placed.

C. Longitudinal expansion joints must conform to the same requirements as transverse expansion joints.

D. Construct joints true to line with their faces perpendicular to the surface of the sidewalk. The top will be slightly below the finished surface of the sidewalk. Construct transverse joints at right angles to the centerline of the sidewalk, and longitudinal joints parallel to the centerline, or as determined by the Engineer.

E. Unless otherwise specified on the Plans or unless otherwise determined by the Engineer, when the sidewalk is constructed in partial width slabs, transverse joints in the succeeding slabs will be placed in line with like joints in the adjacent slab. Also, in the case of widening existing sidewalks, place transverse joints in line with like joint in the existing sidewalk.

F. Place transverse expansion joints, 1/2 inch thick, through the sidewalk at uniform intervals of not more than 50 feet and elsewhere as shown on the Plans, or as determined by the Engineer.

G. Place expansion joints, 1/2 inch thick, between the sidewalk and back of abutting parallel curbs, buildings or other rigid structures; concrete driveways and driveway approaches.

H. Place expansions joint between sidewalks and buildings 1 foot from the property line and parallel to it.

I. Place expansion joints, 1 inch thick, between sidewalk ramps or driveway approaches and the back of curbs.

J. Form plane-of-weakness joints every 5 feet using 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. The cut joints will not be less than 1/8 inch nor more than 1/4 inch in width and will be finished smooth and will be at right angles to the centerline of the sidewalk.

3.08 PLACING AND FINISHING CONCRETE

A. Place concrete on a prepared unfrozen, smooth, leveled, rolled and properly compacted base as indicated on the Plans. Moisten the surface of the subbase; no visible water is to be present prior to placement of the concrete.

B. Deposit concrete in a single layer, to the depth specified here in or shown on the Plans. Concrete will be thoroughly spaded or vibrated and compacted to fill in voids along the forms

and joints. Concrete will be struck off with a strike board until voids are removed and the surface has the required grade and cross section as indicated on the Plans.

C. Float the surface of the concrete produce a smooth surface free from irregularities. Round edges and joints with an edger having a 1/4 inch radius. Broom the surface of sidewalks, driveways and approaches to slightly roughen the surface.

D. Provide texture on the surface of sidewalk ramps using a coarse broom transversely to the ramp slope. The texture on sidewalk ramps will 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 side if slip-forming is use) must be completely coated and sealed with a uniform layer of white membrane curing compound. Do not thin the curing compound. Apply the curing compound a the rate of 1 gallon per 200 square fee of surface.

3.10 BARRICADES

A. Place suitable barricades and lights around newly poured sidewalks, sidewalk ramps, driveways, driveway approaches and curb and gutter section to protect the new Work from damage from pedestrians, vehicles and others until the concrete has hardened.

B. Leave barricades in place for a minimum of two (2) days, except for driveway approaches and curb and gutter section where barricades are to remain in place for a minimum of three (3) days.

C. Remove and replace concrete that suffers surface or structural damage at the Contractor's expense.

3.11 PROTECTION

A. Protect the new concrete from the effects of rain before the concrete has sufficiently hardened. Contractor will have available on the job site enough burlap or 6 mil polyethylene film to cover and protect the work.

1. When rain appears eminent, concrete operations will stop and personnel will begin covering. As soon as the rain ceases, uncover the concrete.

2. Apply curing compound to areas where the compound has been disturbed or washed away.

B. If concrete is placed between October 15 and May 15, provide a sufficient amount of clean, dry straw or hay to cover one day's production.

1. Place hay or straw a minimum of 12 inches if the temperature reaches 40 degrees Fahrenheit and is falling immediately after the curing compound is applied.

2. Place a 6 mil polyurethane film on concrete if the temperature is 30 degrees Fahrenheit and falling as soon as the surface moisture has disappeared, then covered with a minimum of 12 inches of straw or hay.

3. Whenever the temperature in the shade falls below 50 degrees Fahrenheit, the water, sand and coarse aggregate will be heated in that order sufficiently to maintain a uniform temperature of the concrete between 70 to 80 degrees Fahrenheit.

C. Do not place concrete when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit.

3.12 CLEANUP

A. Remove the fixed forms after the concrete has gained sufficient strength, but no sooner than within 12 hours, and immediately backfill the spaces on both sides with sound earth of topsoil quality. Compact backfill, level and leave in a neat condition.

B. At a seasonally correct time approved by the Engineer, rake the disturbed area then place topsoil. Fertilize and seed per the requirements of Section 32 92 19.

3.13 TESTING

A. Engineer may require that a minimum of two cores be drilled from the sidewalk for each 500 linear foot (or fraction thereof) section placed. At least one (1) core out of two (2) required will be taken from the sidewalk at the driveway.

B. One (1) core may be required for every 20 driveway approaches or sidewalk ramps installed.

C. Check cores for depth and compressive strength.

1. Core drilling and tests will be done by a testing laboratory designated by the Owner and at the expense of the Contractor.

2. Furnish two certified copies of the test results from the testing laboratory to the Engineer.

D. 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 will be made:

1. Thickness

Under Required Thickness	Percent of Reduction in Unit Price
0 to 1/4 inch	None
more than 1/4 but not exceeding 1/2 inch	20
more than 1/2 but not exceeding 1 inch	50
more than 1 inch	Remove & Replace

2. Compressive Strength

Under Required Compressive Strength	Percent of Reduction in Unit Price
o to 150 psi	None
more than 150 but not exceeding 300 psi	20
more than 300 but not exceeding 500 psi	50
more than 500 psi	Remove & Replace

E. The area of the deficient core will be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it when possible.

1. The extra core drilling and testing will be at the expense of the Contractor.

2. Reductions due to deficiencies in thickness or compressive strength are additive, that is, if an area is deficient by 3/8 inch and under strength by 200 psi, the total reduction is 20% plus 20% or 40% reduction.

END OF SECTION

SECTION 32 17 13
PARKING BUMPERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes parking bumper fabrication, delivery, storage, installation and anchoring as well as protection and restoration of damaged Work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 22 00 - Unit Prices

B. Section 32 12 16 - Bituminous Paving

C. Section 32 13 13 - Concrete Paving

1.03 REFERENCE STANDARDS

A. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. ASTM A1064/A1064M:

C. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition.

1.04 SUBMITTALS

A. Submit manufacturer's literature showing material types and sizes, fabrication methods and finishes.

1.05 PRODUCT STORAGE AND HANDLING

A. Store all parking bumper units in an area acceptable to the Engineer. Ensure the units are stored in a location and manner that protects them from damage due to construction operations or vandalism.

B. Lift parking bumpers using acceptable slings or other equipment that will prevent cracking, breaking, or chipping during handling. Do not drop the bumpers.

PART 2 PRODUCTS

2.01 CONCRETE

A. Ensure the concrete conforms to MDOT Section 1004, using 3,500 psi strength concrete, Type IA cement; MDOT 6A coarse aggregate, MDOT 2NS fine aggregate, 3 inch maximum slump, and no admixtures without the Engineer's approval.

2.02 CONCRETE REINFORCEMENT

A. Use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.

2.03 ANCHOR PINS

A. Use steel pins, as supplied by the manufacturer, to anchor parking bumpers. Ensure the pins have a minimum diameter of 9/16 inch and a length no less than the height of the bumper plus 12 inches.

2.04 FABRICATION AND MANUFACTURE

A. Factory cast precast concrete parking bumpers to the size and dimensions indicated on the Plans using the manufacturer's standard fabrication methods. Include reinforcing steel bars and ensure each unit has a minimum of two (2) cast-in or drilled anchor holes as specified.

B. Make all edges, corners, angles, and returns sharp and true, free from burrs or breaks, and ensure all plane surfaces are flat.

C. Steam or moist cure parking bumper units using the manufacturer's standard methods to achieve the specified compressive strength.

1. Provide standard type units with flat, solid bottoms.

2. Provide drain type units with flat, solid bottoms and slotted drainage openings as indicated on the Plans. Finish the concrete parking bumper units with a rough sand texture.

2.05 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include Nu-Cast Step and Supply Company, Redford, MI; American Vault and Concrete Products Corporation, Detroit, MI; Dura-Crete, Warren, MI; or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Place parking bumper units as nearly as possible to the locations and lines indicated on the Plans.

B. Use suitable skids, slings, straps, or other lifting devices that prevent damage or breakage of the units during unloading and placement. Do not drag, bump, or drop parking bumpers during installation.

C. Install the parking bumpers in a manner that protects both the paving and the bumpers at all times.

D. Secure parking bumpers in place at the locations shown on the Plans using methods recommended by the manufacturer. Use drilling equipment acceptable to the Engineer where drilling of pavement is required.

END OF SECTION

SECTION 32 17 23
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 012200

B. Section 01 33 00 - Submittal Procedures

1.03 REFERENCE STANDARDS

A. Conform the Work for this Section to the applicable portions of the following Standard Specifications, unless otherwise specified.

1. ASTM D4505: Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life
2. ASTM D4592: Standard Specification for Preformed Retroreflective Pavement Marking Tape for Limited Service Life
3. AASHTO M 247: Standard Specification for Glass Beads Used in Pavement Markings
4. AASHTO M 249: Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form)
5. AASHTO MP 24: Standard Specification for Waterborne White and Yellow Traffic Paints
6. FS TT-P-1952: Paint, Traffic And Airfield Marking, Waterborne
7. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Conform pavement markings to the current requirements of the Michigan Manual of Uniform Traffic Control Devices (MMUTCD) issued under provisions of the Michigan Vehicle Code, Act 300, PA 1949, as amended, where applicable.

B. ADA pavement markings will comply with State and Federal guidelines.

1.05 SUBMITTAL OF MANUFACTURER'S LITERATURE

A. Submit manufacturer's literature for all paints to be used in the Work. Ensure the literature includes paint type, texture, color, temperature limitations, recommended use, spreading rate, drying time, and cleanup instructions.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to the Project site in original, unopened waterproof containers. Ensure packaging containers bear intact and legible manufacturing labels.

B. Ensure the label contains the following information: name and address of the manufacturer, shipping point, trademark or trade name, kind of paint, formula, amount in U.S. gallons, date of manufacture, lot number, type of paint, and AASHTO Specification Number.

C. Store all materials in waterproof containers, under protective covering, off the ground and away from extreme heat or cold until ready for use.

D. Handle materials in accordance with the manufacturer's recommendations.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with the appropriate environmental limitations (air temperature, pavement temperature, and relative humidity) as outlined in MDOT Section 811.03.D.

PART 2 PRODUCTS

2.01 REGULAR DRY TRAFFIC MARKING PAINT

A. Ensure regular drying pavement marking paint in white and yellow colors complies with MDOT Section 920.

1. Select regular dry traffic paint from MDOT’s Qualified Products List.

2.02 WATERBORNE PAVEMENT MARKING PAINT

A. Ensure waterborne pavement marking material in white, yellow, and blue colors complies with FS TT-P-1952 (Type I, II, or III), AASHTO MP 24 and MDOT Section 920.

1. Select waterborne pavement marking paint from MDOT’s Qualified Products List.

2.03 THERMOPLASTIC PAVEMENT MARKINGS

A. Ensure hot-applied thermoplastic pavement markings in white and yellow colors conform to AASHTO M 249, white, yellow and blue thermoplastic striping materials (solid form), and MDOT Section 920.

1. Select hot-applied thermoplastic paving marking from MDOT’s Qualified Products List.

2.04 COLD PLASTIC PAVEMENT MARKINGS

A. Ensure preformed cold plastic pavement markings in white, yellow, and blue colors comply with ASTM D4505 and conform to MDOT Section 920.

1. Select cold-applied plastic pavement markings from MDOT’s Qualified Products List.

2.05 POLYUREA PAVEMENT MARKINGS

A. Ensure two-component, polyurea pavement marking material in white, yellow, and blue colors conforms to MDOT Section 920.

1. Select polyurea pavement marking material from MDOT’s Qualified Products List.

2.06 TEMPORARY PAVEMENT MARKING TAPE

A. Ensure temporary pavement markings comply with ASTM D4592, Type R and Type NR, and conform to MDOT Section 922.06.A.

1. Select temporary pavement markings from MDOT’s Qualified Products List.

2.07 GLASS BEADS

A. Ensure glass beads for reflectorizing white, yellow, and blue paint markings by the drop-in method on fresh paint stripes comply with AASHTO M 247 and conform to MDOT Section 920.02.

1. Select glass beads for use in pavement markings for the specified type of paint from MDOT's Qualified Products List.

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. Include the costs incurred for removing and disposing of unsuitable materials in preparation of surfaces to receive the new Work as incidental to the price paid for the pavement markings.

3.03 PERFORMANCE - GENERAL

A. Limit the pavement marking operation to the type of Work and the limits specified on the Plans. If additional area is required for storage of equipment or supplies, provide the Engineer with written permission from the property owner of the storage area, permitting the storage.

B. Conduct operations and use equipment in such a manner that traffic is maintained throughout the Project, unless otherwise specified on the Plans or approved by the Engineer.

C. Maintain traffic for Work within public rights-of-way and other areas as determined by the Engineer, in accordance with the Michigan Manual of Uniform Traffic Control Devices (MMUTCD). Costs incurred in maintaining traffic will be at Contractor's expense.

D. Equip the Contractor's equipment with sufficient paint capacity to enable sustained pavement marking operations, ensuring uniform application of paint and thermoplastic pavement markings.

1. Equip the machinery with mechanical or pressurized bead dispensers. Ensure the equipment is sufficient to accomplish the marking operations safely, efficiently, and in a workmanlike manner.

2. For parking lots and other small areas, approved portable equipment and use of hand methods will be allowed.

E. Use the color of the paint, and the width or type of markings as specified on the Plans or as directed by the Engineer.

F. Apply markings so they adhere adequately to the surface.

G. Apply markings in accordance with the applicable requirements of MDOT Section 811 for permanent pavement markings or MDOT Section 812.03 for temporary pavement markings.

1. Remove temporary pavement markings as incidental to the Project, unless otherwise specified.

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, will be the responsibility of Contractor and will be at his expense.

3.05 APPLICATION OF WATERBORNE MARKINGS

A. Apply waterborne paint when the air temperature is 50 degrees F or higher and the pavement is dry.

B. Contractor will 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.

1. Reapply lines at no additional expense to the Owner if applied lines are washed away due to rain.

C. Waterborne pavement marking materials may be placed immediately on new bituminous pavement.

1. Do not place waterborne pavement marking material before May 1 or after October 1.

D. Apply waterborne paint with an application thickness of 15-mil and 8-mil dry thickness. Add glass beads at the rate of 32 lbs 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 will be responsible for insuring that the pavement is free of excess moisture that may effect proper bonding prior to beginning work.

B. Document the testing for moisture and provide the results to the Engineer.

C. Start marking operations when the minimum ambient air temperature is 48 degrees F and rising. If the air temperature falls below 45 degrees F and continued cooling is expected, stop all work. The minimum pavement temperature is 50 degrees F.

D. Heat and apply thermoplastic material within the temperature range recommended by the manufacturer.

1. Do not place thermoplastic material before May 14 or after October 1.

3.07 APPLICATION OF POLYUREA PAVEMENT MARKINGS

A. Do not apply polyurea pavement markings over existing non-polyurea pavement markings.

B. Completely remove existing non-polyurea pavement markings before applying polyurea pavement markings.

C. Remove curing compounds from concrete pavement.

D. Apply at a 15 to 25-mil thickness. Ensure the pavement is clean and dry. The pavement temperature must be 40 degrees F or higher, unless otherwise approved by the Engineer.

3.08 TOLERANCES

A. Place new and/or retraced markings in their proper locations, with reasonable tolerance.

B. Obliterate incorrect or misplaced markings and remark them according to the Engineer's instructions.

C. Costs incurred to obliterate and remark incorrect or misplaced markings will be at Contractor's expense.

3.09 PROTECTION OF MARKINGS

A. Protect wet paint and thermoplastic pavement markings, with the Contractor responsible for all related costs.

3.10 WEATHER AND TIME LIMITATIONS

A. Do not place markings when rain is threatening or when the surface to be painted is wet.

B. Perform pavement marking between May 1 and November 1, unless otherwise approved in writing by the Engineer.

C. Do not apply markings when the air temperature is less than 50 degrees F, as determined by the Engineer.

END OF SECTION

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SECTION 32 31 00
FENCES AND GATES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the types of fencing work indicated on the Plans complete with layout of the Work, excavation and backfill, concrete foundation, fence framing and fabric, pickets and privacy slats, gates and hardware, and hardware adjustment and lubrication.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 012200

B. Section 01 33 00 - Submittal Procedures

C. Section 01 89 00 - Site Construction Performance Requirements

1.03 REFERENCE STANDARDS

A. Conform the Work of this Section to the applicable portions of the following Standards, unless otherwise specified.

1. ASTM A53/A53M:Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A116: Standard Specification for Metallic-Coated, Steel-Woven Wire Fence Fabric
3. ASTM A121: Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
4. ASTM A123/A123M: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5. ASTM A153/A153M: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A392: Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
7. ASTM A491: Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
8. ASTM A499: Standard Specification for Steel Bars and Shapes, Carbon Rolled from “T” Rails
9. ASTM A641/A641M: Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire
10. ASTM A780/A780M: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
11. ASTM A817: Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire
12. ASTM A853: Standard Specification for Steel Wire, Carbon, For General Use
13. ASTM C1107/C1107M: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

14. ASTM F537: Standard Specification for Design, Fabrication, and Installation of Fences Constructed of Wood and Related Materials
15. ASTM F567: Standard Practice for Installation of Chain-Link Fence
16. ASTM F668: Standard Specification for Polyvinyl Chloride (PVC), Polyolefin and Other Polymer- Coated Steel Chain Link Fence Fabric
17. ASTM F900: Standard Specification for Industrial and Commercial Swing Gates
18. ASTM F934: Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials
19. ASTM F1043: Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework
20. ASTM F1083: Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
21. ASTM F1184: Standard Specification for Industrial and Commercial Horizontal Slide Gates
22. ASTM F1910: Standard Specification for Long Barbed Tape Obstacles
23. AWPA M4: Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products
24. AWPA U1: Use Category System: User Specification for Treated Wood
25. CLFMI-PM 2445: Chain Link Fence Manufacturers Institute, Product Manual (latest edition)
26. FS - Federal Specifications
27. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition
28. NOMMA: National Ornamental & Miscellaneous Metals Association
29. PS 20: American Softwood Lumber Standard
30. SSPC-PA 1: Paint Application Specification No. 1: Shop, Field, And Maintenance Painting of Steel
31. U.S. Code Title 42, Section 300i-1: Tampering with Public Water Systems

1.04 SUBMITTALS

A. General:

1. Submit manufacturer's literature showing standard details of fence and gate materials.
2. Submit Shop Drawings showing details of fence and gate fabrication and installation. Include plans, elevations, sections, details, and attachments to other work.

B. Product Test Reports:

1. Chain Link Fence: Framework strength according to ASTM F1043, for tests performed by manufacturer and witnessed by a qualified testing agency.

2. Ornamental Fence: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard only if requested.

1.05 QUALITY ASSURANCE

A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.06 WARRANTY

A. General Warranty:

1. The Special Warranty specified in this Article does not deprive the Owner of other rights or remedies under the Contract Documents. It is in addition to, and runs concurrent with, other warranties made by the Contractor. The Contractor's obligations under the Contract Documents are not limited by the provisions of the specified Special Warranty.

B. Special Warranty:

1. Provide manufacturer’s written warranty, running to the benefit of the Owner, agreeing to correct, or at option of the Owner, remove or replace materials or equipment specified in this Section found to be defective during a period of five (5) years after the date of Substantial Completion.

a. Installer agrees to repair or replace components of fences and gates that fail in materials or workmanship within specified warranty period.

b. Failures include, but are not limited to, the following:

1) Failure to comply with performance requirements.

2) Deterioration of metals, metal finishes, and other materials beyond normal weathering.

PART 2 PRODUCTS

2.01 GENERAL

A. Fabricate framing members for fence and gate framing from the types and sizes of steel framing indicated on the Plans and as specified in this Section. At a minimum, ensure framing members conform to the requirements in Part 2 of this Section.

B. Coat framing members, posts, rails, and accessories with PVC when the fence fabric is PVC coated.

C. Use hot-dipped galvanized steel tubular materials for tubular sections, conforming to ASTM A53/A53M for weight and coating. Steel tubular framing may be welded or seamless steel pipe, reasonably straight and free from injurious defects. Remove burrs at the ends of the pipe. Ensure the average weight of the finished steel pipe is no less than 95% of the specified weight, including the weight of galvanizing.

D. Fabricate structural and roll-formed steel shapes conforming to ASTM A499, hot-dipped galvanized in accordance with ASTM A123/A123M. Use new rail steel billets of the specified weights and galvanized. Ensure the weight of the zinc coating on the actual surface averages no less than 2.0 oz per sft, with no individual specimen showing less than 1.8 oz per sft.

Include the weight of the zinc coating in the specified weight for structural and roll-formed shapes, except that any zinc galvanizing over 4.0 oz. per sft of surface will be deducted from the weight.

2.02 POSTS AND RAILS

A. Use round pipe or square roll-formed sections for posts, conforming to the dimensions and weights specified herein.

B. Hot-dip galvanize round posts with a minimum average zinc coating of 1.8 oz per sft, meeting ASTM F1083 for standard weight (Schedule 40) galvanized pipe.

C. Produce rolled form sections from steel with a minimum yield strength of 45,000 PSI, ensuring they meet the strength and protective coating requirements of ASTM F1043.

D. Intermediate Posts

1. Use round or square intermediate posts conforming to the following weights and dimensions (O.D.):

a. For fabric 6.0 feet or less: 1.9 inch diameter round weighing 2.72 lbs per ft

b. For fabric 7 - 10 feet: 2.375 inch diameter round, weighing 3.65 lbs per ft; or 2 inch square weighing 2.60 lbs per ft.

c. For fabric over 10 feet: 2.875 inch diameter round weighing 5.79 lbs per ft; or 2.5 inch square weighing 5.10 lbs per ft.

E. Terminal Posts, Angle Posts, Pull Posts and Brace Posts

1. Round or square conforming to the following weights and dimensions (O.D.):

a. For fabric 6.0 feet or less: 2.375 inch diameter round, weighing 3.65 lbs per ft; or 2 inch square weighing 2.60 lbs per ft.

b. For fabric 7 - 10 feet: 2.875 inch diameter round weighing 5.79 lbs per ft; or 2.5 inch square weighing 5.10 lbs per ft.

c. For fabric over : 2.375 inch diameter round weighing 8.65 lbs per ft; or 2.5 inch square weighing 5.10 lbs per ft.

F. Gate Posts

1. Use round or square gate posts conforming to the weights and dimensions (O.D.) specified in Table A.

G. Top Rail, Bottom Rail, and Middle Rail

1. Round pipe: 1.66 inch diameter weighing 2.27 lbs per ft.

2. Ensure top rail lengths are no less than 18 feet, fitted with couplings or swedged for connecting lengths into a continuous run. Use couplings no less than 6 inches with a minimum wall thickness of 0.07 inch, allowing for expansion and contraction of the rail.

2.03 BRACING TRUSS

A. Diagonal truss: 3/8 inch nominal diameter rod with adjustable take-up.

2.04 ACCESSORIES

A. Use malleable iron or heavy pressed steel for post tops, extension arms, stretcher bars, rail ends, and appurtenances, galvanized in accordance with ASTM A153/A153M.

B. Provide post tops on fences with a top rail that include a hole suitable for passing the top rail through the post top. Ensure the post top fits over the outside of the post with a weathertight closure.

C. Use extension arms for supporting barbed wire that are either single or "V" type, as shown on the Plans. Extend the arms from the top of the post at an angle of approximately 45 degrees, ensuring the arms are integral with the post tops. The extension arms must carry three (3) barbed wires, equally spaced, with the topmost wire approximately 12 inches above the fence fabric.

D. Use stretcher bars as one-piece lengths equal to the full height of the fence fabric. Secure them with bands approximately 1 inch wide, featuring beveled edges, to attach the stretcher bars to end, corner, pull, and gate posts.

2.05 WOVEN WIRE FABRIC

A. Fabricate woven wire fabric in accordance with the best commercial practices. Ensure the overall width of the fabric is no less than 46-1/2 inches. Space fabric stays uniformly on 6-1/4 inch centers maximum.

B. Ensure galvanized steel woven wire fabric conforms to ASTM A116, No. 11 Farm Fencing, Design Number 1047-6-11, Grade 60, Class I, Zinc Coating.

C. Ensure aluminum-coated steel woven wire fencing conforms to ASTM A116, No. 11 Farm Fencing, Design Number 1047-6-11, Class I, Aluminum Coating.

2.06 CHAIN LINK FABRIC

A. Ensure the fabric is zinc (galvanized) coated, vinyl coated, or aluminum coated. Galvanize zinc-coated fabric after weaving.

B. Unless otherwise indicated on the Plans or directed by the Engineer, use 11 gauge, zinc-coated steel chain link fabric, regardless of type. Make the mesh two 2 inch. Knuckle both selvages on fabric 72 inches in height and over. Knuckle the top selvage on fabric less than 72 inches in height.

C. Conform Zinc-Coated Steel Chain-Link Fence Fabric to ASTM A392, Class 2 Coating.

D. Conform Aluminum-Coated Steel Chain-Link Fence Fabric to ASTM A491, and ASTM A817.

E. Conform Vinyl-Coated Steel (Extruded Vinyl over Galvanized Steel Wire) Chain-Link Fence Fabric to ASTM F668, Class 2a.

F. Conform Fused Vinyl-Coated Steel (Thermally Fused Vinyl Coating over Galvanized Steel Wire) Chain-Link Fence Fabric to ASTM F668, Class 2b.

2.07 OUTRIGGERS AND BARBED WIRE

A. Extend chain link fence posts on the gate at SCS-2 and SCS-3 locations if the existing gate is removed, allowing installation of three (3) strands of barbed wire as previously provided on the existing gate.

B. Conform chain link fence barbed wire to ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and General Applications, or equivalent.

C. Fabricate barbed wire from 2-strand, 12-1/2 gauge zinc-coated steel wire (Type Z, Class 3) with 4-point, 14-gauge round barbs spaced on 5 inch centers, conforming to Design Number 12-4-5-14R of ASTM A121. Galvanize the wire after fabrication.

2.08 TENSION WIRE

A. Use No. 7 gauge ASTM A824 tension wire with a Type I aluminum coating, a Type II, Class 2 zinc coating, or hot-dip with a Type II, Class 1 galvanized coating followed by a thermally fused vinyl coating. Ensure the tension wire has a minimum breaking strength of 1950 pound-force.

2.09 FABRIC FASTENERS

A. Use No. 12 gauge minimum fasteners for securing fabric to framing members, galvanized, aluminum-coated, or vinyl-coated as compatible with the fabric.

B. Use 11-gauge minimum hog rings, galvanized, aluminum, or vinyl-coated as compatible with the fabric.

C. Ensure coatings for fasteners conform to the requirements of ASTM A641/A641M, Class III.

2.10 WOOD POSTS

A. Accept wood posts only when woven wire fencing is specified on the plans or in the Proposal. Use Cedar, Red Oak, White Oak, Beech, Hard Maple, White Ash, Yellow Birch, Norway Pine, Northern White Pine, or other species acceptable to the Engineer.

B. Cut posts from timber seasoned by stacking in a manner acceptable to the Engineer. Ensure the timber is at least No. 3 Grade Southern Pine.

2.11 WOOD FRAMING, PICKETS, AND GATES

A. Ensure framing pickets and gates used in woven wire fencing conform to the requirements of PS 20 or the specific application described in ASTM F537. Use wood bracing of Cedar Oak or other approved wood poles, not less than 4-1/2 inches in diameter.

2.12 WOOD PRESERVATIVES

A. Apply the applicable requirements of AWPA U1, Section 6, Commodity Specification A, Use Category 4B for all preservative pressure-treated wood fencing materials.

B. Ensure brush-coated treatment of wood fencing materials conforms to the applicable portions of AWPA M4.

C. Oil-born treatment of wood fencing materials is not acceptable.

2.13 METAL FASTENERS FOR WOVEN WIRE FENCING

A. Use corrosive-resistant metal fasteners in the construction and installation of woven wire fencing, conforming to ASTM F537 unless otherwise indicated on the Plans. Ensure staples are No. 9 gauge steel wire, 1-1/2 inches minimum for softwood and 1 inch minimum for hardwood.

2.14 PRIVACY SLATS

A. Use privacy slats of the type and sizes indicated on the Plans where shown.

B. Grade and finish wood for privacy slats as recommended by the California Redwood Association for landscaping wood.

2.15 GATES

A. Fabricate frames for gates from zinc-coated steel in accordance with ASTM F1043. Coat welded joints in accordance with Practice ASTM A780/A780M using a zinc-rich primer. Provide gates with intermediate braces and truss rods of sufficient strength to form a rigid frame without twist or sag. Ensure members do not sag in excess of the lesser of 1% of the gate leaf width or 2 inches.

B. Ensure gate frame members comply with Table B, at a minimum.

C. Use fabric for gates that matches the fabric used for fencing, unless otherwise indicated on the Plans. Install fabric with stretcher bars at vertical edges and tie wires at top and bottom edges.

D. Install stretcher bars to gate frame at not more than 15 inch centers. Attach hardware with approved fasteners that will provide security against removal or breakage.

E. Use non-lift-off type hinges, offset to permit a 180-degree gate opening. Ensure hinges are structurally capable of supporting the gate leaf and allow the gate to open and close without binding. Design hinges to permit the gate to swing a full 180 degrees.

F. Use a forked or plunger bar type latch with an integral padlock eye, ensuring it is operable from either side of the gate.

G. Provide a keeper where required that automatically engages the gate leaf and holds it in the open position until manually released. Install keepers on each gate leaf over 5 feet.

H. Provide double gates with mushroom-type or flat plate gate stops and anchors. Design stops to engage the center drop rod or plunger bar of both leaves.

I. Ensure sliding gates comply with ASTM F1184. Use horizontal slide gates supported only from above or cantilever slide gates spanning an opening without top or bottom support, as indicated on the plans. Supply cantilever slide gates with zinc-coated steel frames, using external or internal rollers per ASTM F1184.

2.16 CONCRETE

A. Conform concrete to MDOT Section 1004; use 3,000 psi strength; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without Engineer's approval.

PART 3 EXECUTION

3.01 FINAL GRADING

A. Verify that final grading in the area to receive fencing has been completed. Ensure grades are without irregularities that would interfere with the fence installation. Report any discrepancies in final grades that would affect the new Work to the Engineer. Do not commence Work until all unsatisfactory conditions have been corrected.

3.02 MEASUREMENT AND LAYOUT

A. Measure and layout the complete fence line as indicated on the Plans. Measure all dimensions for fence installation parallel to the surface of the ground.

B. Do all locating and marking of fencing post positions. Locate line posts at equal spacings, center to center, as indicated on the Plans and specified in this Section. Locate and mark corner post positions at changes in fencing runs exceeding 30 degrees.

3.03 INSTALLATION - GENERAL

A. Install fencing and gates to meet the requirements of ASTM F567 and CLFMI CLF 2445. Ensure all work follows best trade practices, demonstrates excellent workmanship, and is in a manner acceptable to the Engineer. Make sure the finished fence is plumb, taut, true to line and ground contour, and rigidly secured in position.

3.04 INSTALLATION OF WOVEN WIRE FENCE

A. Space line posts no more than 16.5 feet center to center. Space line posts adjacent to any end, corner, gate, or intermediate braced post no more than 10 feet, center-to-center.

B. Set posts in holes with a minimum depth of 4.5 feet, allowing a tolerance of ± 3 inches, provided the exposed portion of the post is not less than 4.3 feet. Set posts with the large end down, plumb on the side to receive fabric.

C. Install angle posts where a deflection in fence alignment exceeds 30 degrees. Install intersection posts at the line of intersecting fencing runs. Connect intersecting runs of fence to a common post.

D. Drive metal posts with a suitable driver acceptable to the Engineer. Ensure metal posts are driven to the proper depth, plumb, and in conformity with the fence lines indicated on the Plans. Remove and replace any metal posts bent or damaged during driving.

E. Set end, corner, gate, angle, intersection, and intermediate braced posts in concrete with a minimum diameter and depth of 18 inches.

1. Set braces in concrete with a minimum diameter and depth of 18 inches.

2. Brace corner, angle, and intermediate braced posts in both directions. Brace intersection posts in three (3) directions.

3. Securely fasten braces to the post near the top.

4. Set line posts in concrete at least 18 inches in diameter and 4.5 feet deep at all grade depressions and alignment angles.

F. Install woven wire fabric to the lines and levels indicated on the Plans. Stretch fabric taut and securely fasten it to each post, with the bottom approximately 2 inches above the ground. Wrap each horizontal strand of wire completely around the end, corner, gate, intermediate braced, or

angle post, and securely fasten by winding the end about the wire leading to the post. Do not use line posts as stretching anchorages.

G. Splice wire in woven wire fabric and barbed wire in a manner that develops the full strength of the wire. Ensure the distance between vertical stays adjacent to the splice matches that of the unspliced sections of the fabric. Place one (1) approved splice at the end of the roll of fence without regard to the distance from a post.

H. Securely fasten fabric to each metal post with at least six (6) wire clamps.

I. Attach fabric to each wood post with at least one (1) fastener for each horizontal strand and as many additional fasteners as required to secure the wire firmly to the post.

J. Top fabric with barbed wire as indicated on the Plans. Securely fasten barbed wire to each post.

K. Erect gates using methods acceptable to the Engineer in the locations shown on the Plans.

3.05 INSTALLATION OF CHAIN LINK FENCE

A. Set and brace posts for chain link fence as indicated on the Plans, as specified herein, or if not indicated, ensure installation meets the requirements of ASTM F567 and CLFMI CLF 2445.

B. Space line posts no more than ten 10 feet center-to-center. Install angle posts where a deflection of ten (10) degrees or more occurs in the fence alignment.

C. Space intermediate, braced posts at 660 foot intervals or midway between end posts, angle posts, or corner posts when the distance is less than 1,320 feet but more than 660 foot.

D. Set intersection (corner) posts in line with intersecting fences. Connect both intersecting fences to the common post.

E. Set posts in concrete. Ensure the depth of concrete footings for line posts is no less than 3.5 feet.

1. Ensure footing diameters are no less than 9 inches for line posts.

2. Set footing diameters for end, corner, angle, intersection, gate, and intermediate braced posts at 18 inches.

3. Fill holes for post foundations completely with concrete around the post.

F. Ensure all fences have at least a top rail and a bottom tension wire.

1. Install center and bottom rails on fences 10 feet or more in height, and where otherwise indicated on the plans. Securely connect bottom and center rails to posts using connections approved by the Engineer.

G. Pass the top rail through the line post tops to form a continuous brace from end to end of each stretch of fence fabric. Provide splice joints as indicated on the Plan. Use suitable ties or clips to attach the fabric securely to the top rail at intervals not exceeding 24 inches.

H. Secure the top, center, and bottom rails to gate, corner, pull, end, and line posts as indicated on the Plans.

I. Secure horizontal braces of fencing 6 feet high and over to all end, corner, angle, intersection, gate, and intermediate braced posts using suitable metal connections. Position braces midway between the top rail and ground, extending to the first line posts. Truss braces as indicated on the Plans.

J. Fit posts with post tops.

K. Install chain link fabric to the height indicated on the plans. Pull fabric taut and tie it to posts, rails, and tension wires. Secure fabric to framing using suitable metal bands, hogs, or clips. Space fasteners no more than 12 inches apart on posts and no more than 15 inches apart on the top rail.

1. Space hog rings for connecting fabric to tension wire no more than 24 inches apart.

L. Install extension arms as indicated on the Plans. Ensure intermediate extension arms have a hole for passage of the top rail. Position the extension arm to carry three (3) barbed wires, equally spaced, with the topmost barbed wire approximately 12 inches in or out from the fence line.

M. Provide one (1) stretcher bar for each gate and end post, and two (2) stretcher bars for each center and pull post. Thread bars through fabric and secure them to posts with metal bands spaced no more than 15 inches apart.

N. Fasten tie wires where shown and as required. Use U-shaped clips of wire securely fastened around pipe for clasping pipe and fabric. Bend ends of tie wire to minimize hazard to personnel and clothing.

O. Gates

1. Install gates of types and sizes and in locations indicated on the Plans.

2. Install ground-set items in concrete for anchorage as recommended by the manufacturer of the chain link fence.

3. Place the lower hinge of the gate on top of the concrete footing in which the gate post is set. Ensure the footing concrete extends up to the bottom of the lower hinge.

4. Set cone bolt sockets for double swing gates in concrete so that the plunger pin fits in the socket when the gate is in the closed position.

5. Erect gates to swing in the direction indicated. Install gate stops to limit the swing as shown on the Plans.

6. Hang gates plumb, level, and secure, ensuring full opening without interference.

P. Use privacy slats of the types and sizes indicated on the Plans. Secure slats to the fabric using suitable clinch-lock type fasteners acceptable to the Engineer. Attach slats to the fabric with suitable metal fasteners on 6 inch vertical centers.

3.06 ADJUSTMENT

A. After erection of fences, adjust all gate hardware for smooth and positive operation.

3.07 POST LEVELING

A. Cut off the tops of wood posts to the proper elevation after erecting the fences.

3.08 LUBRICATION

A. After completion of fence erection, lubricate moving parts of gate hardware to ensure smooth operation without binding.

3.09 TABLES

A. Table A - Dimensions and Weight of Gate Posts:

Gate Leaf Width	Outside Dimension	Minimum Weight
For Fabric Height 6 foot or less		
4 feet or less - round	2.375 inch	3.65 lbs per ft
4 feet or less - square	2 inch	2.6 lbs per ft
4 - 10 feet - round	2.875 inch	5.79 lbs per ft
4 - 10 feet - square	2.50 inch	5.10 lbs per ft
10 - 18 feet - round	4.0 inch	8.65 lbs per ft
10 - 18 feet - square	2.50 inch	5.10 lbs per ft
For Fabric Heights over 6 foot		
6 feet or less - round	2.875 inch	5.79 lbs per ft
6 feet or less - square	2.50 inch	5.10 lbs per ft
6 - 12 feet - round	4.0 inch	8.65 lbs per ft
6 - 12 feet - square	2.50 inch	5.10 lbs per ft
12 - 18 feet - round	6.625 inch	18.02 lbs per ft
Over 18 feet - round	8.625 inch	27.12 lbs per ft

B. Table B - Gate Frame Members, Dimensions and Weights:

Gate Frame Material	Outside Dimension	Minimum Weight
For Fabric Heights 6 foot or less		
Round Tubular Steel	1.66 inch	1.83 lbs per ft
Rectangular Tubular Steel	1.5 inch	1.84 lbs per ft
For Fabric Heights over 6 foot		
Round Tubular Steel	1.9 inch	2.28 lbs per ft
Rectangular Tubular Steel	2.0 inch	2.52 lbs per ft
Interior Bracing		
Round Tubular Steel	1.66 inch	1.83 lbs per ft
Rectangular Tubular Steel	1.5 inch	1.84 lbs per ft

END OF SECTION

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SECTION 32 90 00
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 22 00 - Unit Prices

B. Section 01 89 00 - Site Construction Performance Requirements

1.03 SOURCE QUALITY CONTROL

A. Ensure trees, shrubs, and ground cover comply with state and federal laws regarding 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 C33/C33M: Standard Specification for Concrete Aggregates

E. ASTM D4491/D4491M: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

F. ASTM D4533/D4533M: Standard Test Method for Trapezoid Tearing Strength of Geotextiles

G. ASTM D4632/D4632M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

H. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile

I. ASTM D4833/D4833M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

J. ASTM D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles

K. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition

1.05 SUBMITTALS

A. Submit certificates of inspection for plant diseases and insect infestation to the Engineer.

B. Submit a certified analysis of imported topsoil from each off-site source prior to delivery. Correct deficiencies at the 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. Inspect and accept all trees prior to planting. Elect either of the following options, as applicable:

B. For sources within 120 miles of the site, the Engineer will tag the trees at the source. Request, in writing, at least two (2) weeks prior to any desired inspection date, inspection and approval of the trees at the source. The Engineer will tag approved trees, and the tag must remain on the tree until planting and final inspection. Accompany the Engineer during the inspection.

1. Deliver the trees to the site. Tag approved trees with the Engineer’s approval, and ensure the tag remains on the tree until planting and final inspection. Remove rejected trees immediately from the site and bring in new trees for inspection and approval.

C. Subject plant material to approval by the Engineer at the site prior to planting.

1.07 PREPARATION OF SHIPMENTS

A. Label plant material clearly with species and variety. Securely attach the label or tag to each plant, displaying the scientific name. Unless otherwise shown on the Plans, ensure all plants are balled and burlapped or container-grown.

B. Complete all balling operations for balled and burlapped stock before "bud break" in preparation for spring planting. For fall planting of deciduous plants, begin balling operations only after the plants have started to "harden off."

C. Dig and pack stock with care immediately prior to shipment. Ensure plants are dug and transported to provide and retain a firm ball of earth.

D. Protect the roots carefully with wet straw, moss, or other material. Adequately shield the root balls from rain or sudden weather changes. Reject balled and burlapped plants if the balls of earth are loosened or broken, or if wrapped in synthetic or plastic material.

E. Ensure container plants have well-established roots in the soil mass and have grown in the container for at least one (1) growing season. Use containers 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. Reject container-grown stock if it is root-bound.

F. Transport all nursery stock in an enclosed or covered vehicle. Deliver plant material immediately prior to planting and keep it moist.

G. Plants will be rejected when the ball of earth surrounding the roots has been cracked or broken prior to or during the planting.

H. Reject plants if the burlap, stakes, or ropes required for transplanting are displaced prior to final acceptance.

1.08 STORAGE AND HANDLING

A. Keep the roots of plants moist and adequately protected with topsoil or another approved covering until planting.

B. Protect the trunks and branches of trees from injury during digging, loading, transporting, and planting. Reject trees that are injured.

1.09 PLANTING SEASON

A. Plant deciduous plants between March 1 and June 1, and from October 1 until the ground becomes freezes, unless unusual planting conditions exist or container-grown material is used, in which case the planting seasons may be altered.

1. When approved by the 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. Plant evergreen plants between March 1 and June 1.

1.10 GUARANTEE AND ACCEPTANCE

A. Warrant that all trees have been grown, transported, handled, and planted properly to ensure they are in a vigorous growing condition at the start of the establishment period.

B. Guarantee trees, shrubs, and ground cover for the establishment period(s). Replace any trees, shrubs, or ground cover showing defective growth, more than 20% dieback, disease, insect infestation, or other impairing defects with sound, healthy, vigorous plants at no additional expense to the Owner, in accordance with the plans and specifications.

C. Request final acceptance at the end of the Establishment Period. The Engineer and Owner will make final acceptance, provided the trees are healthy and all project requirements have been fulfilled.

1.11 EXPERIENCE AND QUALIFICATIONS

A. Ensure concrete conforms to MDOT Section 1004, using 3500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

B. Ensure the 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 the Contractor or Subcontractor is capable of completing the Work successfully, when requested by the Engineer, 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 the Contractor or Subcontractor being deemed unacceptable for this Work on this Project.

PART 2 PRODUCTS

2.01 TREES AND SHRUBS

A. Ensure all trees and shrubs conform to the requirements of AANLS and as specified herein.

B. Ensure plant material conforms to the sizes specified in the plant list or Proposal. All measurements, such as spread, ball size, number of canes, and quality designations, must comply with AAN “American Standard for Nursery Stock”.

C. Ensure plant material is typical for their species or variety, sound, healthy, vigorous, and free from plant diseases, insect pests, or their eggs. Ensure they have healthy, well-developed root systems.

D. Ball and burlap plants designated “B&B” must be dug with firm, natural balls of earth, sufficient in diameter and depth to encompass the fibrous and feeding root system for full recovery. Securely wrap balls with burlap and bind with cord. Reject any balled and burlapped plant if the ball is cracked or broken. Do not allow planting with rot-proof burlap or ties. Reject sand balls.

E. Ensure trees are nursery-grown stock, pruned to encourage single main stems, compact fibrous root systems, and symmetrical branching. Ensure uniform height and spread for trees of the same species. Keep all trees free from insects, diseases, mechanical injuries, or other objectionable features. Ensure root balls match the sizes specified in AANLS for the tree root system.

F. Ensure container-grown stock has been grown in containers for a minimum of one (1) growing season. Reject plants showing "Pot Bound" root ends.

G. Determine the caliper of trees less than 4 inch caliper at a point 6 inch above the ground when installed. Measure trees above 4 inch caliper at a point 12 inch above the ground.

H. Ensure ornamental trees and shrubs are well-formed with a crown typical of the species or variety. Provide low-branched crown types unless the Plans or Proposal specify a tree form or bush form. Ball and burlap material unless otherwise indicated.

I. Ensure plant stock has grown to the required size in a normal, progressive manner. Do not permit heading-back plants to meet the sizes called for on the Plans.

J. Provide ball and burlap or other adequate root protection for evergreen trees. Ensure tops are of a form typical to the species, not unnaturally sheared or color-treated. Apply anti-desiccant protection as needed for evergreen trees.

K. Ensure plant material is 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 the Engineer. Requests for substitutions and price adjustments due to substitutions must be submitted in accordance with the General Conditions.

2.02 MULCHING

A. Use mulching material as specified on the plans, selecting from one of the following options.

1. Compost:

a. Use mature/stabilized, humus-like compost derived from the aerobic decomposition of yard waste (e.g., grass clippings and leaves) or other designated compostable materials as defined in MCLA PA 641 as amended. Ensure compliance with all federal and state laws.

b. Ensure compost has a dark brown or black color, supports plant growth without the need for ongoing fertilizers or soil amendments, and has no objectionable odor. Ensure the mixture is free of glass, plastic, metal, and other contaminants, as well as viable

weed seeds and plant parts capable of reproducing. Handle the mixture in a way that produces no visible water or dust.

c. The manufacturer of the compost must provide test data and a statement to confirm that the following criteria are met by the compost provided for the project. The composition of the compost must fall within the following range of values:

Quality Parameter	Range of Value
Soil pH	6 to 7.5
Soluble Salts	2 to 5 mmho/cm
Carbon/Nitrogen Ratio	13 to 20 parts C to 1 part N
Inerts	< 1%
Organic matter	35 to 55 %
Nitrogen	1 to 2 %
Phosphorus	0.2 to 0.8 %
Potassium	0.5 to 1.5 %
Unit Weight	535 to 775 kg per cubic meter
Moisture Content	40 to 50 %
Particle Size	< 20 mm maximum
Water Holding Capacity	> 100%
Heavy Metals	None

d. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

e. Temperature: 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 104 degrees F for 5 days with a temperature exceeding 130 degrees F for at least 4 hours.

f. Pathogens and Trace Elements: 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 must 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.

1) Accompany the certification with a data sheet. Display the following on the data sheet:

(a) 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

(b) Organic content

(c) Inert contamination

(d) Soluble salts

(e) Carbon/Nitrogen ratio

(f) Proof of maturity/stability acceptable to the Michigan Department of Agriculture

2. Wood Chips:

   a. Ensure wood chips are the product of a mechanical chipper. Exclude twigs, chopped leaves, and pine needles from the chips. Determine the suitability of chip material and size through visual inspection by the Engineer. Produce wood chips from trees free of insects and diseases.

3. Shredded Bark:

   a. Ensure shredded bark consists of tree bark stripped and shredded from saw logs using a debarking machine. Produce shredded bark from trees free of insects and diseases. Make the material sufficiently fine and free from extraneous material to pass through a conventional mulch blower.

4. Double Shredded Bark:

   a. Process shredded bark mulch twice to create double-processed shredded bark mulch.

2.03 TOPSOIL

A. Ensure topsoil is fertile, friable, sandy clay loam without admixture of subsoil. Keep topsoil free of glass, stones larger than one inch in any dimension, weeds, undesirable grasses, and other extraneous materials. Maintain the following range of values for topsoil:

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 maximum mesh screen prior to delivery to the Project site.

   1. Have the Engineer review source and final screen results prior to releasing topsoil. Submit a certified analysis of the topsoil from each source to the Engineer.

   2. Place topsoil in a minimum thickness of 4 inch (100 mm) throughout, or as specified in the plans or Specifications.

C. Obtain a topsoil borrow pit source and secure necessary permits and agreements for the use of such borrow pits at own expense.

2.04 SAND

A. Use clean, coarse, ungraded sand for planting mixture that conforms to ASTM C33/C33M for fine aggregates.

2.05 FERTILIZER

A. Use Agriform 21-Gram Planting Tablets Plus Minors or Engineer approved equal for fertilizer. Ensure planting tablets are tightly compressed, long-lasting, and slow-release with an N-P-K analysis of 20-10-5. Apply according to manufacturer's recommendations and soil analysis.

2.06 PEAT

A. Use granulated raw Canadian peat or baled Canadian peat containing no more than 9% mineral on a dry basis. For ericaceous plants, use baled peat with a pH of 4.0.

2.07 LANDSCAPE WEED CONTROL FABRIC

A. Ensure weed barrier fabric consists of a geotextile fabric, spun-bonded polypropylene, non-woven fabric, and a UV stabilizer.

B. Ensure the fabric meets the following 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/D4632M
Elongation at Break	70%	ASTM D4632/D4632M
Puncture Strength	35 lbs.	ASTM D4833/D4833M
Trapezoidal Tear	50 lbs.	ASTM D4533/D4533M
Permittivity	1.2 $sec.^{-1}$	ASTM D4491/D4491M
Apparent Opening Size (equivalent Sieve)	60/70	ASTM D4751
Ultraviolet Stability	70% @ 500 hrs.	ASTM D4355/D4355M

2.08 STEEL LANDSCAPE EDGING

A. Comply with ASTM A36/A36M or ASTM A283/A283M, hot-rolled, standard flexible carbon steel landscape edging, fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately 30 inches apart to receive stakes. Double stake steel landscape edging at overlap joints, and design it to receive tapered steel stakes.

B. Ensure steel edge is 12ga steel, 4 inches wide, by 10 foot length, with 4 stakes. Apply a Sherwin Williams H68GT85 powder coat paint electrostatically and oven-bake it to a minimum thickness of 1.5 mils. Use green, brown, or black color as determined by the Owner.

C. Ensure steel stakes are tapered, 14 inches long, and finished to match the specified steel landscape edging. Design stakes specifically to anchor steel landscape edging in place and manufacture them by the same company that produces the steel landscape edging.

D. Furnish and install manufacturer's standard start/end sections, 90 degree corners, and splicers as required.

2.09 STAKES FOR GUYING AND BRACING

A. Use sound wood stakes of nominal 2 x 2 inch stock, approximately 30 inches in length for guying or of the required length for bracing. Point one end of the stakes by beveling on two (2) sides.

B. Use green metal T-section posts for bracing trees, without anchor plates. Ensure posts are at least 8 foot long and use them only where specified on the plans.

2.10 WIRE FOR GUYING AND BRACING

A. Ensure wire is new and free from bends or kinks.

B. Use No. 11 steel wire for guying trees 4 inches or less in diameter.

C. Use No. 9 galvanized steel wire for guying trees over 4 inches in diameter.

2.11 HOSE

A. Use new 1/2 inch reinforced rubber garden hose or steam hose with wire for guying trees.

2.12 PLASTIC GUYING AND BRACING MATERIAL

A. High density polyethylene, chain-lock type material, 1 inch wide with a breaking strength of 100 lbs minimum.

B. Flat, woven, webbing type 3/4 inch wide tape constructed of polypropylene with a breaking strength of 900 lbs in either white or olive green.

2.13 TREE BALLING BURLAP

A. Use untreated burlap or other material that will readily decompose for balling. Do not permit synthetic materials like nylon or plastic.

2.14 PLANTING MIXTURE

A. Mix 1/3 topsoil, 1/3 sand, and 1/3 peat for the planting mixture. Add fertilizer in the quantity recommended by the manufacturer. Ensure the planting mixture is free from sticks, stones, sod, clods, or other material that might leave pockets around the roots.

2.15 BIORETENTION PLANTING MIXTURE

A. Ensure bioretention planting mixture has a sandy loam, loamy sand, or loam texture per the USDA textural triangle. Limit clay content to a maximum of 5%.

B. Ensure the soil mixture has a pH between 5.5 and 6.5 and an organic content of 1.5 – 3.0%.

C. Ensure the soil mixture has an infiltration rate greater than 0.5 inches/hr.

D. Ensure the soil is a uniform mix, free of stones, glass, trumps, roots, or other similar objects larger than 1 inch.

E. Ensure no other material or substances are mixed or dumped with the bioretention mix that could harm plant growth or hinder planting or maintenance operations.

F. Ensure the planting mixture is free of Bermuda Grass, Quack grass, Johnson Grass, Mugwort, Nutsedge, Poison Ivy, Canadian Thistle, Tearhub, or other noxious weeds.

2.16 ACCEPTABLE MANUFACTURERS

A. Use 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. Stake all plant locations and confirm the locations and types of plants with the 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. Do not begin excavation until the stakeout of tree and/or shrub locations is acceptable to the Engineer.

B. Stake enough planting locations for two weeks of work. Arrange periodic site meetings with the Engineer to review the work completed in the prior two weeks and the staking for the next two weeks. Notify the Engineer at least three (3) working days prior to the desired date for inspection of staking.

C. Accurately stake plant material locations according to the plans. Stake trees 36” high above finished grade and paint them a bright color to ensure clear visibility for inspection. Use different colors to distinguish between types of material, e.g., evergreen trees, canopy trees, flowering trees. Stake shrubs, perennials, and ground covers 18 inches high above finished grade and paint them white. Place stakes at the perimeter and at the bed line 30 feet on center. Have the Engineer review the locations and make changes as necessary.

3.03 PLANTING

A. Set balled and burlapped plants plumb. Excavate tree pits as shown on the plans. Dispose of subsoil dug from pits, trenches, and beds.

B. Plant to correct grades and alignment. Set all plants so that, when settled, they bear the same relation to finish grade as before being transplanted. Do not permit any filling around trunks or stems.

C. Excavate tree pits and beds at the start of the Work. Request inspection and approval by the Engineer. Obtain approval before backfilling occurs.

D. Set the root ball on a compacted base as detailed. Cut away burlap from the top 1/3 of the root ball and remove all ropes, wires, and other materials securing the ball.

E. Completely remove plastic tape and/or plastic fabric from the root ball during the planting operation. Also, remove all "rot proof" or treated burlap.

F. Plant container-grown plants as specified for balled and burlapped stock. For non-plantable containers, remove the container only at planting time. For plantable type containers, sever the container sides in multiple places and remove the upper half during the planting operation. Protect tree roots during the severing and removal process.

G. Once the plant is properly set, backfill the pit with planting mixture, gradually filling, tamping, and settling with water. Do not use frozen or muddy soil for backfilling. Place the backfill to an elevation flush with the ground and the rootball, creating a saucer near the edge of the hole to capture water.

H. Apply Engineer-approved superphosphate fertilizer over the planting mixture during fall planting, following the manufacturer’s instructions for the rate.

I. Spray all evergreen plant material with Engineer-approved anti-desiccant immediately following planting and during final seasonal watering, according to the manufacturer’s instructions and limitations.

3.04 MULCHING

A. Place mulching material over the plant hole area to a depth of 5 - 6 inches or as specified on the plans after backfilling. Thoroughly soak all mulched areas. After watering, rake all mulched areas and leave them in a complete and finished manner.

B. Apply 3 inches of mulch to perennial areas or as specified on the plans. Mulch these areas first, then plant ground cover through the mulch.

C. Mulch planting beds with a 4 inches cover as shown on the drawings and details, unless otherwise indicated. Ensure mulch depths are 4 inches at the time of inspection.

D. Construct an earth saucer or berm halfway around each plant on the down slope side for plants located on slopes. Ensure the saucer or berm has an inside diameter equal to the planting hole and a maximum height of 6 inches. Dig a trench on the down slope side and fill it with planting mixture to allow for drainage.

3.05 BRACING AND GUYING

A. Only evergreen trees equal to or larger than 5 feet high and deciduous trees with a caliper equal to or larger than 2 inches 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.

1. Brace or guy trees immediately after planting if required.

2. Brace all plants requiring support with a minimum of two (2) stakes. Drive stakes to avoid the ball and place them no closer than 1 foot (300 mm) from the trunk.

3. Drive stakes to a depth that firmly anchors the plant, but no less than 1 foot below the bottom of the planting hole. Position the wide side of the stake facing the trunk of the plant.

4. Extend stakes to within 4 inches of the lowest plant's main branches. Firmly attach the top of the stake to the trunk using steel wire or plastic guying and bracing material.

5. When using steel wire, place it to form a figure eight (8) around the stake and trunk. Encase portions of the wire around the trunk in water hose of sufficient length to contain the wire loop. Ensure the enclosed trunk loops do not restrict normal trunk growth.

6. Position stakes on opposite sides of the trunks and secure them to the trunk at approximately 2/3 of the plant's height. Tie warning tape or ribbon to the wiring between the tree and the stake.

3.06 PRUNING

A. Prune new plants as determined by the Engineer. Ensure all pruning is done by workmen experienced in this type of work and is completed prior to planting. Do not permit the use of hedge shears for pruning. Perform pruning in accordance with the best standard practices.

B. Prune deciduous trees to balance the loss of roots while retaining the natural form of the tree type.

C. Prune evergreen trees only to remove broken or damaged branches.

D. Make cuts flush, leaving no stubs. Paint all cuts over 3/4 inch in diameter with tree paint.

E. Notify the Engineer at least one (1) week prior to pruning operations.

3.07 WATERING, FERTILIZING AND CULTIVATING

A. Thoroughly soak all plants after planting. After watering, rake all beds and leave them in a complete and finished manner.

B. Water, fertilize, and cultivate during the Establishment Period. Include all necessary measures to establish and maintain plants in a vigorous and healthy growing condition throughout the entire Establishment Period.

C. Manually water the plants a minimum of once a week or as necessary to keep them thriving 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 the Contractor is relying upon, it is the responsibility of the Contractor to ensure that the irrigation system is functioning properly.

1. Notify the Engineer or the Owner immediately if the Contractor concludes that the irrigation system is not working properly, so it can be fixed in a timely manner.

2. However, the 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 the 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. Provide winter protection by spraying all evergreen trees and shrubs with an anti-desiccant emulsion type agent in late fall, at the manufacturer's recommended rate, to prevent winter desiccation. Also, perform late fall watering if required by a dry season.

H. At the season's first watering, apply an Engineer -approved organic timed-release, balanced fertilizer to the ground around the tree at the rate instructed by the manufacturer. Alternatively, use pre-packaged, controlled-release fertilizer packets. Apply one (1) 2 oz packet of fertilizer for every 1 inch caliper of tree, or one (1) 2 oz packet for every shrub.

I. During the first and second waterings of the growing season, apply a nitrogen-enriched solution containing available nitrogen at a rate of 8.5 lbs/1000 gallons of water (42 pounds of 20-0-0, or 18 pounds of 45-0-0, fertilizer per 1,000 gallons of water). Do not apply any fertilizer after July 7.

J. During the establishment period(s) outlined in the Contract Documents, perform all required watering, cultivating, pruning, fertilizing, weeding, and other necessary work to keep the planted material vigorously growing, sound, and healthy. Repair or replace any guying or bracing that is damaged, destroyed, or broken. Spray any plant material that becomes diseased or infested with insects.

K. Repair or replace any trees that are blown over, knocked down, uprooted, or otherwise become impaired or defective.

L. Replace any plant material that is not in good physical condition, has more than 20% die back, shows defective growth, disease, signs of insect infestation, or any other impairing defects during the Establishment Periods.

M. Repair or replace any plant material damaged or impaired by wind, rain, snow, ice, sleet, sun, heat, drought, or any other weather-related occurrences.

N. Include the costs for all labor, material, and equipment necessary to carry out the provisions of this Article in the Contractor's bid price for planting trees, unless otherwise indicated in the Proposal. Notify the Engineer prior to beginning any work called for under this Article.

O. Remove and dispose of the guying material, wrapping material, identification tags, and inspection tags off the project at the end of the Establishment Period, unless otherwise determined by the Engineer. Replenish the mulch around all the plants to the required depth of 5 - 6 inches.

3.08 ESTABLISHMENT PERIOD

A. Begin the Establishment Period on the day of written acceptance of the installation of the trees, shrubs, bulbs, ground cover, or other plant material. Start each subsequent establishment period on the same day of the succeeding year(s). Ensure the Establishment Period lasts a minimum of one year unless otherwise indicated in the Contract Documents.

3.09 SCHEDULES

A. Follow the general planting location, type, and size of tree or shrub as indicated on the Plans. Obtain approval from the Engineer for any substitutions of plant material or alterations in plant sizes or specifications prior to ordering.

3.10 STEEL LANDSCAPE EDGING

A. Install steel landscape edging where indicated on the Drawings, following the manufacturer’s recommendations. Anchor with steel stakes spaced approximately 30 inches on-center, driven below the top elevation of the edging, or at every stake pocket location in landscape edging sections designed to receive stakes. Position stakes 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 the Engineer. Provide the Engineer with the opportunity to review the layouts.

C. Set top of edging flush with finish grade. Set top of stake 1/2 inch below top of edging.

D. Replace edging sections damaged by construction operations.

END OF SECTION

SECTION 32 92 19
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 012200

B. Section 01 33 00 - Submittal Procedures

C. Section 01 89 00 - Site Construction Performance Requirements

1.03 REQUIREMENTS OF REGULATORY AGENCIES

A. Comply with the applicable requirements of the Michigan Seed Law, Act 329, PA of 1965, as amended.

B. Comply with the applicable requirements of the AOSA Rules for Testing Seeds.

C. Supply chemical fertilizer in suitable bags with the net weight of the contents and guaranteed analysis shown on the container. Accompany bulk shipments with an analysis and net weight certification of the shipment.

1. Accompany custom mixed fertilizers with 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 (P2O5), and total available Potash (K2O).

1.04 SOURCE QUALITY CONTROL

A. Test the seed mixture for purity and germination by the Seed Producer within nine (9) months of sowing.

1.05 REFERENCE STANDARDS

1. AOSA RULES - Association of Official Seed Analysts

2. ASTM C602: Standard Specification for Agricultural Liming Materials

3. ASTM D977: Standard Specification for Emulsified Asphalt

4. 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.

B. Where required, submit test reports for all seed proposed for use in the Work to the Engineer, showing results of purity and germination tests, compliance with regulatory agencies, dates and location of tests.

C. Perform soil tests -1 per designated area - to confirm the fertilizer and lime necessary for the site. Limit the amount of fertilizer and lime to what is absolutely necessary to ensure optimal growth.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in their original, unopened containers. Mark containers clearly with the name of the manufacturer, brand name, trade name or generic name of material, warranty of analysis, net weight of contents, and date of packaging, where applicable.

B. Deliver seed to the site in durable bags, tagged or labeled with the date of tests, warranty of purity and germination analysis, name, lot number, and net weight of contents.

C. Deliver commercial fertilizers to the site of the Work in original unopened bags. Ensure bags do not exceed 100 lbs net weight each and are clearly marked with guaranteed analysis in a conspicuous location on each bag.

D. Store material at the Project site, under shelter, off the ground, and protect it from damage by moisture, temperature, exposure to elements, vandalism, or any other action that might impair its use.

E. Handle materials proposed for use in the Work in a manner that protects both the material and the personnel involved. Handle seed to protect the mixture from contamination or deterioration.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Seeding is limited to the periods between April 20 and June 1, and August 10 to October 10 and after for as long as weather permits preparation of the seed bed without irrigation and the ground is not frozen. 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 newly seeded areas during the progress of the Work and until completion of the turf establishment period.

B. Protect adjacent construction from topsoil spills and perform such cleanup of affected surfaces before it becomes compacted by traffic.

1.10 FINAL ACCEPTANCE

A. Establish a dense cover of seeded grass on all disturbed areas and maintain these areas until final acceptance of the Work by the Engineer. The Engineer will inspect the turf to ensure the

grass seed is well established, weed-free, and in a growing, vigorous condition. Re-seed areas that do not meet the Engineer's approval at the Contractor's expense.

PART 2 PRODUCTS

2.01 SEED

A. Use certified, mature, clean, dry, new crop seed products suitable for the specified applications. Ensure seed and seeding mixtures have the percentages of purity, germination, and proportions, by weight, as indicated in Table 1.

Table 1 - Seeding Mixtures

Kind	Seeds		Mixture Proportions (%)			
	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		

B. Use the specific mixture for the type of soil on the Project and the location of the seeding per Table 2, unless otherwise indicated on the Plans or designated by the Engineer.

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 lbs/acre
TUF	All Types	Urban Freeway, Blvds, City Streets	250 lbs/acre
TGM	Medium to Heavy	All	250 lbs/acre
THM	Loamy to Heavy	Home and Business Turf	250 lbs/acre

C. Hydroseed with a blend of seed, fertilizer, and hydromulch.

2.02 MULCHING MATERIAL

A. Straw:

1. Small grain straw or grass or marsh hay acceptable to the Engineer.

B. Wood Excelsior:

1. Green wood fibers, baled or blanket of type and manufacture acceptable to the Engineer.

2. Make wood excelsior from green timber fiber, baled to weigh 80 to 90 pounds at the time of manufacture.

3. Make wood excelsior blankets from a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. Ensure the fabric net has a mesh size not exceeding 1-1/2 x 3 inch and is woven from cotton cord, twisted paper cord, or a synthetic, biodegradable fiber.

4. Produce blankets in the form of a tightly compressed roll 36 ±1 inch wide and approximately 120 feet long. Ensure the blanket has a fiber net on the outside of the fiber mat.

5. Ensure the blanket roll weight, when manufactured, averages 85 lbs ± 10%.

6. Place separator sheets of 40-pound Kraft paper at the beginning and end of each roll to facilitate unrolling and handling at the job site. Ensure the Kraft paper sheet at the end of each roll also forms 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 the Engineer.

2. Make the net from a biodegradable mesh with openings not exceeding 1-1/2 x 3 inch.

3. Furnish the net in widths of not less than 35 inches.

D. Proprietary Mulch Material:

1. Biodegradable natural and/or synthetic materials suitably fabricated and acceptable to the 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 25 to1 ratio of water to adhesive with 25 lbs of recycled newsprint as a tracer.

D. Recycled Newsprint:

1. Mix 7 lbs of newsprint with 7 gallons of water.

E. Guar Gum:

1. Mix 1 lb of dry adhesive with 26.5 gallons of water with 5 lbs of recycled newsprint as a tracer.

2.04 FERTILIZER

A. Use a standard commercial grade fertilizer, conforming to state regulations, of the type recommended for grasses. Ensure the fertilizer contains slow-release nitrogen amounting to 75% of the nitrogen available.

B. Ensure the fertilizer is uniform in composition, free-flowing, and suitable for application with the selected method.

C. Use fertilizer for hydraulic seeding that is soluble or ground to a fineness that permits complete suspension of all insoluble particles in the slurry.

2.05 AGRICULTURAL LIMING MATERIALS

A. Ensure burnt lime (quick lime), hydrated lime, limestone (calcite and dolomite), marble shells, and by-products conform to the requirements of ASTM C602.

2.06 WATER

A. Free of matter harmful to plant growth.

2.07 STAPLES

A. Use wire staples for holding mulching materials in place that are no less than 6 inches long, made of No. 11 (U.S. Steel Gage) steel wire or longer.

2.08 TOPSOIL

A. Use fertile, friable, sandy clay loam topsoil without admixture of subsoil. Ensure topsoil is free of glass, stones greater than 1 inch in any dimension, weeds, undesirable grasses, and other extraneous materials. Ensure the topsoil meets the following range of values:

Quality Parameter	Range of Value
Soil pH	5.0 to 7.5
Soluble Salts	500 ppm max
organic content	5 to 30 %
silt content	35% to 50%
clay content	5% to 10%
USDA Soil Classification	Loam or Sandy Loam
deleterious mat'l*	5% max
*rocks, gravel, stones, 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 maximum mesh screen prior to delivery to the Project site.

C. Have the Engineer review the source and final screen results prior to the release of topsoil.

D. Submit a certified analysis of the topsoil from each source to the Engineer.

E. Place topsoil in a minimum thickness of 3 inch throughout, or as specified in the Plans or Specifications.

F. Obtain the topsoil borrow pit source and secure all necessary permits and agreements for the use of such borrow pits at the Contractor's expense.

2.09 IMPROVED TOPSOIL

A. Make improved topsoil from a mixture of 2/3 topsoil and 1/3 compost. Ensure the mixture has a dark brown or black color, is capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments, and has no objectionable odor.

2.10 COMPOST

A. Use mature/stabilized, humus-like compost derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other designated compostable materials, in compliance with all federal and state laws. Ensure the mixture is free of objectionable odors, glass, plastic, metal, and other contaminants, as well as viable weed seeds and other plant parts capable of reproducing. Handle the mixture so that no visible water or dust is produced.

B. Ensure the manufacturer of the compost maintains annual test data and a statement on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, showing that the following criteria are met by the compost provided for the project.

C. Ensure the composition of the compost falls within the following range of values:

Quality Parameter	Range of Value
Soil pH	6 to 7.5
Soluble Salts	2 to 5 mmho/cm
Carbon/Nitrogen Ratio	13 to 20 parts Carbon to 1 part Nitrogen
Inerts	< 1%
Organic matter	35 to 55 %
Nitrogen	1 to 2 %
Phosphorus	0.2 to 0.8 %
Potassium	0.5 to 1.5 %
Unit Weight	535 to 775 Kg/m3
Moisture Content	40 to 50 %
Particle Size	< 20 mm maximum
Water Holding Capacity	> 100%
Heavy Metals	None

1. Maturity/Stabilization: An acceptable test that can demonstrate Maturity/Stability.

2. 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.

3. Pathogens and Trace Elements: Meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.

4. Certify that the compost meets EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93, Rules and Regulations, to comply with the annual filing requirements.

5. Include a data sheet with the certification.

    a. Ensure the data sheet shows the following:

    b. 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

c. Organic content

6. Inert contamination

a. Soluble salts

b. Carbon/Nitrogen ratio

c. Proof of maturity/stability acceptable 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.

B. Rake or loosen the surface of the subgrade immediately prior to covering with topsoil to a minimum depth of 2 inch to facilitate bonding between the subsoil and topsoil.

3.02 PREPARATION OF SOIL

A. Bring the existing soil to a friable condition by harrowing or loosening and mixing to a depth of at least 4 inches after the areas to be seeded have been brought to the required grade and properly trimmed and cleaned up.

B. Thoroughly break lumps and clods. If the area to be seeded has been prepared and covered with a layer of topsoil as specified under Part 3 of this Section, this operation is not required.

3.03 PREPARATION OF MULCH MATERIAL

A. Prepare the mulched area for seeding by discing, using a spike-toothed harrow, or by other means acceptable to the Engineer when the seed is to be sown through mulch that has been in place for more than two (2) weeks or is held in place by a surface-applied coating of asphalt emulsion or other adhesive.

3.04 PLACING AND SPREADING TOPSOIL

A. Place and spread topsoil over the area designated on the Plans, or as determined by the Engineer, to a depth of 4 inches or to the depth specified on the plans.

B. Place topsoil to a depth sufficiently greater than that shown on the Plans or specified, so that, after natural settlement or rolling, the completed Work conforms to the lines, grades, and elevations shown on the Plans.

C. Complete the spreading of topsoil in a manner that allows seeding to proceed without additional moving of topsoil. Consider topsoil furnished and placed as incidental to seeding unless otherwise specified in the Proposal.

D. Rake and remove large earth lumps, rocks, roots, debris, or other foreign matter from the topsoiled area and legally dispose of them.

3.05 FERTILIZING

A. Apply chemical fertilizer to the prepared soil surfaces at a minimum rate of 660 lbs per acre of 12-12-12 fertilizer, or at such other rate of another fertilizer mixture that yields 240 lbs per acre of chemical nutrient.

B. Disc, harrow, or rake dry fertilizers thoroughly into the soil to a minimum depth of not less than 1 inch.

C. When hydraulic seeders are used for sowing seed, spread one-half of the recommended rate of fertilizer in combination with the sowing, and incorporate the balance into the soil prior to seeding. In all other cases, incorporate fertilizer into the soil before starting any seeding.

3.06 SEEDING

A. Sow seed at the rate specified in Table 2. Seed the area in the presence of an inspector using a mechanical spreader, hydraulic seeder, or broadcasting. Use the broadcasting method only in areas inaccessible to mechanical spreading equipment. Do not seed during winds above 15 mph.

B. Water topsoil to a depth of 4 inches at least 48 hours prior to seeding operations to obtain a loose, friable seed bed. Vary the time and depth of watering operations as directed by the Engineer to accommodate varying site conditions.

C. Broadcast seed materials by spreading one-half of the specified amount of seed in one direction, then broadcast the remaining one-half of the seed at right angles to the first seeding pattern using the same broadcast method.

D. Broadcast at the rate specified herein or per the written recommendations of the Producer of the seed material used.

E. Roll seeded area with roller weighing a maximum of 150 lbs per foot of width.

F. Perform hydroseeding using suitably acceptable hydraulic seeding equipment and a homogeneous slurry solution of water, seed, fertilizer, and suitable mulch material as approved by the Engineer. Distribute the seed slurry mixture uniformly at a rate approved by the Engineer for the seeding and/or mulch materials used to suit the seed application rate. Apply seed at a rate of 300 lbs per acre.

3.07 MULCHING

A. Place mulch material on areas that have been or are to be seeded. Ensure the mulch is placed loosely enough to allow sunlight penetration and air circulation, but thick enough to shade the ground, reduce water evaporation, and prevent erosion by wind or water. Secure the mulch with suitably acceptable anchoring material.

B. For surfaces and slopes on which power equipment can be operated, satisfactory mulching materials include the following:

1. Small grain wheat straw or grass hay applied at 1-1/2 to 2 tons per acre with disc packer, asphalt or netting tie-down.

2. Wood chips applied at 6 to 9 tons per acre.

3. Asphalt emulsion alone at 600 to 1,200 gallons per acre. (This application is suitable for limited periods of time and where trampling by either people or animals will not occur.)

C. For surfaces and slopes where power equipment cannot be operated, satisfactory mulching materials include the following:

1. Straw or grass hay applied at 1-1/2 to 2 tons per acre, anchored with asphalt or netting tie-down.

2. Asphalt emulsion alone at 600 to 1,200 gallons per acre. (Limited to areas where tracking is not a problem.)

D. Anchor straw or hay mulch by the methods as specified herein.

E. Wood chips will not need anchoring when used on workable slopes.

F. Anchor commercially manufactured netting and/or fiberglass materials according to the manufacturer's printed instructions for the material used.

G. 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 3 inches.

H. 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.

1. Apply emulsified asphalt at 200 gal per acre.

2. Do not apply emulsified asphalt during freezing weather since it contains approximately 50% water.

3. Apply liquid (cut back) asphalt at approximately 485 gal per acre.

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. Remove fiberglass mulch before seeding due to its permanence. Take care to prevent fiberglass filaments from becoming entwined or wound around shafts of power mowers or other power equipment.

E. Dispose of acceptable proprietary netting and erosion control materials in accordance with the manufacturer's printed instructions for the material used, prior to any seeding operations.

3.09 TURF ESTABLISHMENT

A. Water seeded areas whenever excessive drying is evident during the establishment period. Water in a manner that prevents erosion from excessive quantities, and ensure the watering equipment is of a type that prevents damage to the cultivated surfaces.

B. Take responsibility for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.

C. Mow the seeded areas with mowing equipment acceptable to the Engineer to a height of 2 inches whenever the average grass height reaches four 4 inches. Remove cut grass when the amount is heavy to prevent destruction of the underlying grass.

D. Mow or, in the case of rank growths, uproot, rake, and legally dispose of weeds or other undesirable vegetation that threaten to smother the planted species.

E. Reseed and mulch areas larger than 4 sq inches not having a dense, uniform, vigorous stand of grass acceptable to the Engineer.

F. Extend the establishment period from the time of seeding until the seeded area has a uniform stand of grass acceptable to the Engineer. The minimum period is 30 days.

G. If after 60 days from the initial seeding a dense, uniform, vigorous stand of grass has not been established by the Contractor, the Owner may reseed the defective areas and all costs will be deducted from the Contractor’s payments.

END OF SECTION

SECTION 33 01 30.11
TELEVISION INSPECTION OF SEWERS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section provides for the color closed-circuit television (CCTV) inspection and electronic recording of existing sewers for the purpose of locating and observing the condition and possible extraneous connections.

1. The Work is to be performed by current NASSCO PACP certified operators, with current PACP coding, and delivered entirely in electronic format.

2. Note that CCTV software compatibility with the Owner's software and databases is required. Submit and obtain approval for a Pre-Inspection deliverable before starting work. See "Software Compatibility" below.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 22 00 - Unit Prices

B. Section 01 50 00 - Temporary Facilities and Controls

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 33 01 30.30 - Sanitary Sewerage Flow Control

E. Section 33 01 30.41 - Cleaning of Sanitary Sewerage Utilities

1.03 QUALITY ASSURANCE

A. Conform the work for this Section to the applicable portions of the following standard specifications, unless otherwise specified.

1. NASSCO - National Association of Sewer Service Companies

2. PACP - Pipeline Assessment Certification Program

B. Qualifications

1. Ensure all CCTV operators are NASSCO-PACP certified.

2. Use the latest version of the NASSCO-PACP Certified Access Database, unless otherwise approved by the Engineer.

3. Ensure the CCTV software is current and NASSCO-PACP Certified.

4. CCTV inspections (Video and Data Collected) will be delivered entirely in digital format.

1.04 SOFTWARE COMPATIBILITY

A. Upon award of the Contract, inspect at least three (3) segments or 1,000 feet of pipe using CCTV and submit the data to the Owner. Verify that the CCTV database is compatible with the Owner's PACP Data Management software, GIS integration software, and that the deliverables are acceptable to the Owner.

B. The Owner will verify the acceptability of the deliverables within five (5) business days of receipt. Do not begin work on the Project until this software compatibility has been approved.

1.05 SCHEDULE OF WORK

A. Submit a schedule to the Owner prior to beginning television inspection, outlining the sequence of sewer lines designated to be televised.

1.06 FINAL SUBMITTALS

A. Electronic Inspection:

1. Conform the work to the latest version of NASSCO, Pipeline Assessment and Certification Program (PACP) standards. Document the work with NASSCO PACP CCTV Reports, NASSCO PACP database, logs, electronic reports, etc., noting defects and observations encountered during the inspection.

2. The importance of accurate distance measurements is emphasized to enable location of the defects for rehabilitation work.

3. Include the following in the Electronic Television Inspection:

   a. Protruding services with extent of protrusion

   b. Location of broken and/or collapsed pipes with beginning and ending distance, extent of damage, etc.

   c. Percent of Ovality in deformed pipes

   d. Percent of restriction for sewers with root intrusion, mineral deposits, etc.

4. Include complete and accurate PACP mandatory header information and report coding for all sections of sewer in the CCTV inspections. In addition to the required header information, provide the following additional details for this Project:

   a. Time

   b. Pipe section reference

   c. Pipe lining

   d. Total Length

   e. Length surveyed

5. Submit the data on a single drive, as approved by the Owner, and ensure it is properly identified with the Project, location, time, and date in a manner acceptable to the Owner.

B. Electronic Video Inspection Recordings:

1. Record the CCTV inspection to provide an electronic visual and audio record of problem areas in the lines, allowing for replay. Ensure the entire inspection is recorded in a PACP-approved electronic format and submitted with electronic links between the data and the video.

C. Database Software:

1. Provide database in a read-only format using PACP approved software. Also provide the read only version of software used for collection and encoding data, and for report preparation. Videos and photos must also be in a readable format with standard PACP approved inspection management software.

D. GIS Integration:

1. Submit shapefiles of the television and inspection records. The shapefiles must include points along the mainline sewer indicating the location of factory taps, roots, failed joints, or any other feature where a PACP code is recorded as part of the sewer and manhole inspection.

2. The shapefiles must include the following information: manhole number, observation date, observation time, PACP Code, PACP score, remarks or notes, name and certification number of the inspector, report sheet number, video number, and Client name/location.

3. In addition, hyperlink pipe reports, screenshots or photos of the observations (factory taps, joints, plugs, etc.), and videos to the corresponding features in the shapefiles.

1.07 JOB CONDITIONS

A. Sewer Flow Control:

1. When the sewer line depth of flow at the upstream manhole of the sewer section being worked exceeds the maximum allowable for television inspection, reduce the flow to the level shown below by operating pump stations, plugging or blocking the flow, or by pumping and bypassing the flow as specified. Ensure sewer flow control is in accordance with Section 33 01 30.30 - Sanitary Sewerage Flow Control.

2. Ensure the depth of flow does not exceed the following levels for the respective pipe sizes, as measured in the manhole, when performing television inspection.

a. Maximum Depth of Flow for Television Inspection of sewer

1) 20% of pipe diameter

2) 25% of pipe diameter

3) 30% of pipe diameter

b. Plugging or Blocking

c. Insert a sewer line plug upstream of the section being worked. Ensure the plug is designed to release all or any portion of the sewage as needed. During CCTV inspection, reduce the flow to within the specified limits. After completing the work, restore the flow to normal.

d. Pumping and Bypassing

e. When pumping and bypassing is required, supply the pumps, conduits, and other equipment necessary to divert the flow of sewage around the manhole section where work is to be performed.

f. Ensure the bypass system has sufficient capacity to handle both the existing flow and any additional flow that may occur during a rainstorm.

g. The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system.

h. Equip engines with noise-reducing features if pumping is required on a 24-hour basis, to keep noise to a minimum.

B. Flood Prevention:

1. When flow in a sewer line is plugged, blocked, bypassed, or in any other way restricted, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

1.08 VERIFICATION

A. Verify that arrangements for pedestrian and equipment access to structures within rear yard easements have been made, while considering the rights of adjacent property owners.

PART 2 PRODUCTS

2.01 TELEVISION CAMERA AND EQUIPMENT

A. Use a television camera specifically designed and constructed for inspection. Ensure the camera is color, pan, tilt, and zoom, or a sidewall scanning (panoramic) camera designed and constructed for sewer inspection.

B. Provide lighting for the camera that ensures a clear picture of the entire periphery of the pipe. Make the camera operable in 100% humidity conditions.

C. Ensure the camera, monitor, and other components of the video system produce picture quality satisfactory to the Engineer. Remove any unsatisfactory equipment, and make no payment for an unsatisfactory inspection.

D. Emphasize the importance of accurate distance measurements. Measure the location of defects above ground using a meter device. Disallow markings on the cable or similar methods that require interpolation for manhole depth. Check the accuracy of the distance meter using a walking meter, roll-a-tape, or other suitable devices, ensuring accuracy within ± 2 feet.

PART 3 EXECUTION

3.01 PREPARATION

A. Locating the Work:

1. Locate all structures and note the sewer diameter and direction of flow. Notify the Owner of any detrimental access, structure, or sewer conditions that may adversely affect the progress of the Work.

2. Identify manholes not shown on the maps issued for the Project, including the exact location, distance, and direction of adjoining manholes, sizes of connecting sewers, and submit this information in writing to the Engineer. Similarly, identify and locate any manholes that are not found or found in a location different from what’s shown on the maps.

3. Include the following location data for found or misidentified manholes:

4. State plane coordinates to horizontal accuracy of ±3 feet or less

5. Addresses as applicable with location at address (ie.: back yard, front yard in right-of-way, etc.).

B. Cleaning Sewers:

1. Clean each sewer line in accordance with Section 33 01 30.41 - Cleaning of Sanitary Sewerage Utilities before televising the existing sewers.

3.02 PERFORMANCE

A. Inspect the sewer sections by means of closed-circuit television after cleaning. Perform the inspection one sewer section at a time, ensuring the flow in the section being inspected is suitably controlled as specified.

B. Move the camera through the line in the direction of the flow (downstream), except when not physically possible or during a reverse inspection.

C. Limit the maximum rate of travel to 30 feet per minute, unless otherwise approved by the Engineer. Ensure the speed of travel is slow enough to inspect each pipe joint, tee connection, structural deterioration, inflow and infiltration (I&I) source, and deposits.

D. Pause the camera, pan, and visually inspect all service connections, maintenance defects, structural defects, miscellaneous abnormal sewer conditions, and any areas necessary for proper documentation of the sewer's condition. If using a sidewall scanning camera, pausing and panning of each lateral is unnecessary if the image clearly depicts the inside of the lateral for post-processing.

E. Set up the equipment to perform the inspection from the opposite manhole (Reverse Inspection) if the television camera cannot pass through the entire section of sewer from manhole to manhole during the inspection operation.

1. Consider the inspection complete if the television camera cannot pass through the entire section of sewer during a reverse inspection.

2. Complete root cutting, deposit cutting, or cutting of intruding services (upon approval by the Engineer prior to beginning the Work) before considering the television inspection complete.

F. Position the camera in the line so that it stays as near to the center of the line as possible.

G. Ensure the image quality is adequate for post-inspection coding. Repeat the inspection at the Contractor’s expense if the image quality is unsuitable for any reason.

H. Notify the Engineer in writing of any observed defects that may compromise the structural integrity or cause damage to the pipe, explaining the reasons why continued CCTV inspection would be harmful.

I. Record only during times of good visibility. Disallow recording during periods of visible fog or steam in the sewer, or when the camera lens is dirty, coated, or underwater (as outlined below), unless otherwise authorized by the Owner.

J. Ensure television inspection reports are within ± two (2) feet of the measured linear footage between manholes along the existing sewer centerline, from the start of the pipe to the end of the pipe.

K. Owner and PACP required header information must be fully and accurately entered on all CCTV reports. Work not following these specifications may be rejected for payment and the Contractor may be required to re do the work.

L. Provide a PACP certified operator on site at all times during the entire CCTV inspection. If video coding is done separately from the actual recording, ensure both the onsite operator and the individual performing the PACP coding are PACP certified.

M. Redo any portion of the video inspection recording of insufficient quality, as determined by the Engineerr, at no additional cost to the Owner.

3.03 MAINTAINING TRAFFIC, RESTORATION, AND PROTECTION OF EXISTING IMPROVEMENTS

A. Maintain traffic at all times in accordance with Section 01 50 00 - Temporary Facilities and Controls.

1. Furnish, erect, and maintain all signs, barricades, lights, and traffic regulators in accordance with the current "Michigan Manual of Uniform Traffic Control Devices." Provide all flagmen and watchmen necessary to maintain and safeguard traffic during the Work. Make furnishing, installing, and maintaining traffic control devices incidental to the Project.

B. Restore any damage to existing improvements, including fences, utilities, landscaping, lighting, lawns, trees, structures, or any other items, to their original condition in accordance with Section 01 89 00 - Site Construction Performance Requirements.

3.04 USE OF PREMISES

A. Do not trespass upon or disturb private property without first obtaining written permission from the property owner. Provide a copy of such written permission to the Owner prior to accessing the site.

B. Work equipment around poles, trees, or other obstructions at the Contractor's own expense.

C. Obtain any additional working area as necessary at the Contractor's responsibility.

D. Restore such property to its original condition, at no additional expense, to the satisfaction of the Owner. Take photographs and/or videos of existing properties before disturbing any property and provide a copy to the Owner.

E. Remove, remove and replace, or restore items within the street right-of-way or sewer easement as directed by the Owner.

F. Ensure all employees wear a badge or visible identification while on the project site or within private property. Make sure the identification is worn so that it is easily recognized and readable to the public.

END OF SECTION

SECTION 33 01 30.30
SANITARY SEWERAGE FLOW CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide materials, labor, equipment, and services necessary to control sanitary sewer flow during internal television (TV) inspection and sewer cleaning operations.

1. Limited sewage flow is acceptable for TV inspection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 11 00 - Summary of Work

B. Section 33 01 30.11 - Television Inspection of Sewers

C. Section 33 01 30.41 - Cleaning of Sanitary Sewerage Utilities

1.03 SUBMITTALS

A. Submit shop drawings and complete design data showing methods and equipment to be used in sewer bypassing and dewatering. Include the following information:

1. Indicate location of temporary sewer plugs and bypass discharge lines on Drawings.

2. Capacities of pumps, prime movers, and standby equipment.

3. Standby power source.

4. Traffic control plan.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Provide temporary pumps, conduits, and other equipment to bypass sewer flow.

1. Equip engines with mufflers and/or enclose to keep noise level less than 50 decibels, or 10 decibels above ambient noise levels when measured at building closest to noise source.

2. Provide pumps and bypass lines of adequate capacity and size to handle flows.

B. Maintain sufficient equipment and materials on site to ensure continuous and successful operation of bypass and dewatering systems.

1. Keep standby pumps fueled and operational at all times.

2. Maintain on site sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping, and other parts or system hardware to ensure immediate repair or modification of any part of system as necessary.

C. Provide piping, joints and accessories designed to withstand at least twice the maximum system pressure, or 50 pounds per square inch (psi), whichever is greater.

PART 3 EXECUTION

3.01 PROTECTION

A. Discharge bypass flow to a sanitary sewer approved by the Engineer in areas where flows are bypassed. Do not allow bypassing to ground surface, receiving waters, storm drains, or any bypassing that may result in groundwater contamination or potential health hazards.

B. In the event sewage accidentally drains into drainage system or street, immediately stop overflow, notify Owner and Engineer immediately, and take necessary action to clean up and disinfect spillage to satisfaction of Owner.

1. If sewage is spilled onto public or private property, wash down, clean up, and disinfect spillage to satisfaction of Owner.

2. Immediately report overflows to Owner.

3.02 APPLICATION

A. Plugging or Blocking: Insert sewer line plug into line upstream of section being worked. Design plug so that all or any portion of sewage can be released.

1. If sewer flow control is required for TV inspection, reduce flow to comply with requirements specified in Section 33 01 30.11 - Television Inspection of Sewers.

2. After cleaning, inspection, or rehabilitation work has been completed, restore flow to normal.

B. Pumping and Bypassing: When pumping and bypassing is required, provide pumps, conduits, and other equipment to divert flow of sewage around manhole section in which work is to be performed.

1. Ensure the bypass system has sufficient capacity to handle both existing flow and any additional flow that may occur during peak flow periods or from precipitation.

2. Construct bypass system of material to prevent leakage during pumping operation.

3.03 CLEANING

A. Keep premises free from accumulations of waste materials, rubbish, and other debris resulting from Work.

B. Remove waste materials, rubbish, and debris from and about premises.

C. Remove tools, construction equipment and machinery, and surplus materials.

D. Restore to original condition portions of site not designated for alterations by Contract Documents.

E. When bypass pumping operations are complete, drain piping into sanitary sewer prior to disassembly.

END OF SECTION

SECTION 33 01 30.41
CLEANING OF SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide materials, labor, equipment, and services necessary for sewer line cleaning, manhole cleaning, and internal obstruction removal.

1. Remove sediment, rocks, debris, roots, grease accumulations, and obstructions from the length of sewer and manholes to be lined. Perform hydraulic root cutting and/or grinding/cutting of protruding break-in service connections.

2. Remove grease, scale, encrustation, and loose mortar from the sewer and manhole walls in the vicinity of the lining to prevent any foreign intrusion that could cause imperfections in the lining, such as bumps, folds, or dimples.

3. Use high-pressure water washing or other methods approved by the Engineer for sewer cleaning.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 01 30.11 - Television Inspection of Sewers

B. Section 33 01 30.82 - Liners for Wastewater Structures

C. Section 33 01 30.30 - Sanitary Sewerage Flow Control

1.03 SUBMITTALS

A. Methods:

1. Submit a letter identifying the methods to be used for removing sediment, debris, grease, scale, encrustations, loose concrete, roots, and break-in connections throughout the section of sewer to be cleaned. Include the following:

a. Detailed explanation of cleaning process.

b. Schedule of activities.

c. References where identified cleaning method(s) has been used successfully in the past by the Contractor.

d. List of the actions to mitigate impact to Owner during cleaning operation.

B. Schedule:

1. Submit a schedule outlining the sequence of operations the Contractor proposes to follow. Obtain approval from the Owner before starting work. Provide both original and updated schedules to the Owner electronically.

2. The schedule shall:

a. use a time-scaled logic diagram format;

b. provide a level of detail of activities that are clear and concisely communicate of the plan of work; and

c. at a minimum, include initial mobilization, start-up, cleaning and televising, and any resultant point repairs in the schedule.

3. The software used for producing the schedules must have the capability to tailor the form and format of schedules, and accompanying reports, to the Owner's requirements.

4. Owner may require additional updates to the schedule as changes occur. These additional updates will be submitted to Engineer within 24 hours of the request.

5. Changes to the schedule are subject to approval of the Owner.

PART 2 PRODUCTS

2.01 MATERIALS

A. Do not use chemicals without written approval of the Professional. Do not use chemical which may be considered hazardous or detrimental to organisms or equipment of wastewater treatment plant.

2.02 EQUIPMENT

A. High-Velocity Hydraulic (Hydro-Cleaning) Equipment: Ensure the equipment is capable of removing dirt, grease, rocks, sand, roots, and other materials and obstructions from sewer lines and manholes.

B. Equip the system with two or more high-velocity nozzles. Ensure the nozzles can produce scouring action from 15 to 45 degrees in all designated line sizes, with the ability to adjust from fine spray to solid stream.

C. Ensure the equipment carries its own water tank, auxiliary engines, and high-pressure water pump.

D. Combination Unit Pump: Capable of pumping at least 80 gallons per minute (300 liters per minute) at 2,000 psi (13.8 MPa), measured at beginning of hose reel.

E. Water Pump: Able to run at 2,000 psi (13.8 MPa) while pulling full vacuum, completely independent from vacuum system, with ability to vary vacuum without affecting water pressure.

2.03 WATER

A. When water from fire hydrants is necessary, apply to Owner for permission to use potable water source. When Contractor has been authorized to take water from fire hydrants:

B. Conserve water and avoid using it unnecessarily.

C. Use only Owner-approved fire hydrant wrenches and shut-off valves.

D. Maintain a visible air gap between the discharge of the fire hose and the Contractor's water storage tank. Ensure the air gap is visible from the ground surface.

1. If an air gap is not possible, provide a backflow preventer approved by they Owner.

2.04 DO NOT OBSTRUCT ANY FIRE HYDRANT EXCEPT WHEN REFILLING EMPTY WATER TANKS.

A. Provide temporary piping, valves, certified reduced pressure backflow preventers, equipment, and other items for handling potable water and wastewater, all approved by the Owner.

B. Do not utilize water source until it has been approved for use by Owner.

PART 3 EXECUTION

3.01 GENERAL

A. Clean the sewer and associated manholes, including drop connections and benches, to remove Deposits Settled (DS) and prepare the sewer for televising. Use an unlimited number of passes with a hydraulic flusher to remove all loose debris and collect it for removal in the downstream manhole. Remove all debris from the sewer, including debris washed into service connections (excluding known pre-existing conditions), drop connections, or the bench wall of the manholes. Note that this task does not include root cutting, deposit removal, or grinding of protruding service connections.

B. Perform cleaning while the line segments are in service, without the need for plugging or flow diversion unless previously approved by the Engineer. If necessary, schedule the work to be performed late at night between 11:00 PM and 6:00 AM. Do not begin late-night cleaning work until the Contractor has received approval from the Owner for a nighttime traffic control plan submitted by the Contractor.

3.02 MAINTENANCE OF TRAFFIC

A. Maintain "local" traffic at all times and notify the proper authorities regarding road closures. Obtain all permits required for maintenance of traffic.

B. Contractor must not begin work until standard barricades and warning signs are in an acceptable position and the markers and signs conform to the traffic control plans detailed in the Contract Drawings and the latest edition of the Michigan Manual of Uniform Traffic Control Devices, and all applicable state and local requirements of the agency having authority over the roadways, or as directed by the Professional. Contractor assumes all responsibilities and liabilities regarding strict adherence to applicable sections for the maintenance of traffic and public safety as set forth in the Michigan Manual of Uniform Traffic Control Devices, and other applicable regulations. Traffic control devices must be in place prior to starting work.

C. Maintain local traffic at all times during all phases of the project, causing the least inconvenience to abutting property owners. Construct, maintain, and remove temporary driveways, temporary roadways, or run-arounds as necessary to provide vehicular access to and from abutting properties, as directed by the Owner and/or Engineer.

D. Keep the portion of the pavement not affected by the work clear of all material and equipment. If traffic must be blocked (in emergencies only), notify the nearest fire, police, and service departments.

E. Include the cost of maintenance of traffic as incidental to the contract, with no separate payment unless otherwise indicated.

3.03 EXISTING UTILITIES

A. Contractor must take the necessary precautions for the protection of any utility encountered on the project or the restoration of any utility damaged during the work.

B. Notify all public or private service corporations with wire, poles, pipes, conduit, manholes, or other structures that may be affected by the excavation at least 48 hours before breaking ground. This includes all affected structures not shown on the plans. Notify owners of underground utilities that are members of the state's one-call service by calling, and contact non-member underground utility owners directly.

C. Perform maintenance, repair, and replacement of existing utilities in accordance with the rules and regulations of the utility companies having jurisdiction.

D. Repair and reconnect existing storm sewers, driveway drains, surface drain pipes, and other property removed or damaged during construction, as directed by the Owner, at no additional cost.

3.04 MAINTAINING FLOW

A. It will be the responsibility of Contractor, throughout the tenure of this Contract, to provide and maintain sufficient flow at all times to pass any flash of flow and prevent any backwater flooding due to obstruction caused by cleaning equipment.

B. Stay aware of flow conditions and identify potential access problems to sewer access points.

3.05 SEWER CLEANING

A. Provide equipment specifically designed and constructed for sewer cleaning. Collect and remove solids and debris resulting from the cleaning operation from the downstream manhole, disposing of them at a site selected by the Owner and approved by the appropriate jurisdictional personnel. Under no circumstances dump sewage solids onto the surface, street, or into ditches, inlets, or storm drains.

B. Use the manufacturer's recommended size tools for the various pipe sizes. Utilize equipment recommended by the manufacturer to protect the manhole and pipe, such as pull-in slant jack rollers, roller and yoke assemblies, roller manhole jacks, and similar tools.

C. Clean designated sewer lines using approved methods and equipment.

1. Maintain a CCTV camera in the sewer during all cleaning operations to verify that the cleaning equipment is not damaging the public sewer. Use CCTV equipment in accordance with Section 33 01 30.11 - Television Inspection of Sewers.

2. Remove internal obstructions such as roots or gaskets by trenchless techniques when obstruction encountered prevents further pipe cleaning.

    a. Provide special attention during cleaning operation to assure almost complete removal of roots from joints.

    b. Procedures to remove internal obstructions may include use of equipment such as rodding machines, root saws, bucket machines and winches using root cutters, porcupines, and jet machines equipped with hydraulically driven cutters.

3. If cleaning of entire section cannot be successfully performed from one manhole, set up equipment at other manhole and attempt cleaning again.

a. If successful cleaning cannot be performed or equipment fails to traverse entire sewer line section, it will be assumed that major blockage exists.

b. Temporarily suspend cleaning effort and immediately notify Owner and Engineer.

c. Upon removal of obstruction, complete cleaning operation.

4. Employ satisfactory precautions to protect sewer line from damage that might be inflicted by improper use of cleaning equipment.

a. Immediately notify Owner and Engineer if fresh soil, pieces of pipe, or other visible signs of potential problems occur during cleaning operation.

b. Ensure that water pressure created does not cause damage due to flooding of property being served by sewer section(s) involved.

5. Contractor is required to submit documentation of the work that is performed and the type of debris removed, as well as landfill permits and disposal documentation.

3.06 MANHOLE CLEANING

A. Include entire manhole interior, including manhole benches and walls. Incorporate into line cleaning operation by scouring walls with high velocity nozzle after pipe segment cleaning operation is complete.

3.07 REMOVAL OF DEBRIS

A. Trap and remove sludge, dirt, rocks, sand, grease, and other solids or semi-solid materials resulting from cleaning operations at the downstream manhole of the section being cleaned.

B. Do not pass materials from manhole section to manhole section that could cause line stoppage, accumulations of sand in wet wells, or damage to pumping equipment.

C. Remove solids or semi-solid material from the wastewater collection system during the cleaning operation and dispose of them in a lawful manner. Do not discharge sewage or solids removed from downstream manholes onto streets, or into ditches, catch basins, or storm drains.

3.08 PROPERTY DAMAGE

A. Immediately investigate any and all reports of sewage backing up into fixtures served by the sewer section being cleaned or televised.

B. Notify both the Owner and Engineer immediately if any damage to private or public property occurs due to activities related to this contract. Make repairs and/or clean the property immediately, within a timeframe acceptable to the Owner.

3.09 CLEANUP

A. Keep the work area uncluttered by frequently removing debris. Remove all debris and unused material, leaving the area in a condition similar to its state before any work was performed.

END OF SECTION

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SECTION 33 01 30.82
LINERS FOR WASTEWATER STRUCTURES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work described herein details a complete program for wastewater structures lining and rehabilitation. Such structures may include manholes, pump stations, lift stations, junction boxes or other concrete facilities that may need protection from corrosive materials. This specification details the methods, procedures, materials and equipment required to produce a completed system that will provide a corrosion resistant liner that restores the surface profile and eliminates water infiltration and exfiltration.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 33 01 30.41 - Cleaning of Sanitary Sewerage Utilities

B. Section 33 01 30.30 - Sanitary Sewerage Flow Control

1.03 REFERENCE STANDARDS

A. ASTM D7234 - Adhesion

B. ASTM D412 - Tensile Strength (PSI)

C. ASTM D412 - Elongation (%)

D. ASTM D624 - Tear Strength (PLI)

E. ASTM D2240 - Hardness

F. ASTM D522/D522M - Flexibility (1/8” mandrel)

G. ASTM D4060 - Taber Abrasion (mg loss)

1.04 SUBMITTALS

A. Submit materials and procedures required to establish compliance with the specifications to Owner/Engineer for review/approval upon request. Include at least the following in submittals:

1. Technical Data Sheet on each product used.
2. Safety Data Sheet (SDS) for each product used.
3. Manufacturer’s Certification of Applicator.
4. Certified Applicator Minimum Qualifications.
5. Descriptive literature, bulletins and or catalogs of materials.
6. Work procedures including flow diversion plan, method of repair, etc.
7. Material and method for repair of leaks or cracks in the structure.
8. Applicator and Manufacturer warranty forms.

1.05 QUALITY ASSURANCE

A. Choose a manufacturer of the lining system for wastewater structures that specializes in designing and manufacturing corrosion protection materials and/or systems for wastewater structures.

B. Ensure the applicator (company performing the installation) is fully trained in leak repair, surface preparation, and application of the lining system.

C. Ensure the materials/products are suitable for installation in a wastewater environment without any deterioration of the liner.

D. Train the applicator and provide a letter of certification from the manufacturer for handling, mixing, application, and inspection of the liner system as described herein.

E. Furnish and coordinate materials and installation by the manufacturer/certified applicator to ensure total unit responsibility.

1.06 WARRANTY

A. The liner must be installed in accordance with manufacturer's instructions by an applicator certified by manufacturer. Executed 10-year applicator and manufacturer warranties are to be provided upon completion of work.

1. Applicator and manufacturer must warrant the liner system installation against failure for a period of 10 years from the installation date.

B. Applicator must correct failures any time prior to 10 years after the installation date.

1. Failure will be deemed to have occurred if the protective liner fails to:

a. Prevent the internal corrosion of the structure, or

b. Prevent groundwater infiltration. Failure does not include damage resulting from mechanical force or the presence of chemical substances not customarily present or used in wastewater structures, defects in the workmanship or devises of others upon which the wastewater structure functions or act of God.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Design and manufacture materials for lining wastewater structures to withstand the severe effects of a wastewater environment. Ensure the manufacturer of the corrosion protection products has at least 10 years of experience in producing the lining products utilized, and that the products have a satisfactory installation record.

B. Use high-quality equipment for installing lining materials, as recommended by the manufacturer.

C. Utilize a multi-layer 'stress skin panel' liner system for wastewater structures as described below:

1. Liner:

a. Moisture Barrier: Apply a moisture barrier using a sprayable, solvent-free, two-component polymeric modified polymer (silicone modified polyurea), developed specifically for the corrosive wastewater environment.

b. Surfacer: Use a polyurethane/polymeric blend foam, a low viscosity, two-component foam with flame retardants, to create a polyurethane rigid structure foam.

c. Final Corrosion Barrier: Apply a modified polymer (silicone modified polyurea) as a sprayable, solvent-free, two-component polymeric moisture/chemical barrier, specifically developed for the corrosive wastewater environment.

2. Ensure the total thickness of the multi-layer liner system is a minimum of 500 mils.

D. Use the product SPECTRASHIELD, manufactured by CCI Spectrum, Inc.

PART 3 EXECUTION

3.01 INITIAL INSPECTION

A. Applicator must take appropriate action to comply with all local, state, and federal regulations including those set forth by OSHA, EPA, the Owner and any other applicable authorities.

B. Perform an initial inspection of the structure before conducting any work to determine the need for protection against hazardous gases or oxygen-depleted atmosphere and the need for flow control or flow diversion.

C. If required, submit a plan for flow control or bypass to the owner/engineer for approval prior to conducting the work.

D. Ensure new concrete structures have endured a minimum of 28 days since manufacture before commencing installation of the liner system.

3.02 SURFACE PREPARATION

A. The surface preparation program will include checking the atmosphere for hydrogen sulfide, methane, low oxygen, or other gases, approved flow control equipment, and surface preparation equipment.

B. Prepare the surface for standard manhole structures according to the manufacturer’s recommendations, which may include high-pressure water cleaning, to provide a surface compatible for the installation of the liner system.

C. Prepare the surface and apply methods for other structures according to the manufacturer’s recommendations, which may include high-pressure water cleaning, hydro blasting, abrasive blasting, grinding, or detergent water cleaning, to provide a surface compatible for the installation of the liner system.

D. Ensure the surface preparation method produces a cleaned, abraded, and sound surface with no evidence of laitance, loose concrete, loose brick, loose mortar, contaminants, or debris, and displays a surface profile suitable for applying the liner system in accordance with the manufacturer’s recommendations.

E. After completion of surface preparation, perform the seven point check list, inspecting for:

1. Leaks

2. Cracks

3. Holes

4. Exposed Rebar
5. Ring and Cover condition
6. Invert Condition
7. Inlet and Outlet Pipe Condition

F. After the defects in the structure are identified, repair all leaks and severe cracks with Spectra-Grout, or other methods approved by the manufacturer.

G. Prime the surface upon completion of leak and crack repair in accordance with the manufacturer's recommendations.

3.03 MATERIAL INSTALLATION

A. Follow the manufacturer's recommendations for application procedures, including materials handling, mixing, environmental controls during application, safety, and spray equipment.

B. Use spray equipment specifically designed to accurately ratio and apply the liner system.

C. Apply the multi-component liner system in strict accordance with the manufacturer's recommendations. Ensure the final installation has a minimum total thickness of 500 mils. Affix a permanent identification and date of work performed to the structure in a readily visible location.

D. If requested a final written report may be provided to Owner/Engineer detailing the location, date of work and description of the work.

3.04 FINAL INSPECTION

A. Ensure the final liner system is completely free of pinholes or voids.

B. Ensure the liner thickness meets the minimum value described herein.

C. Allow visual inspection by Owner/Engineer. Mark and repair any deficiencies noted in the finished liner system according to the manufacturer's recommended procedures.

END OF SECTION

SECTION 33 05 07
UTILITY HORIZONTAL DIRECTIONAL BORING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The work specified in this Section consists of furnishing and installing underground utilities using the horizontal directional drilling (HDD) method of installation, also commonly referred to as directional boring. This work will include services, equipment, materials, and labor for the complete and proper installation; testing; restoration of underground utilities; environmental protection; and restoration.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 22 00 - Unit Prices

B. Section 01 89 00 - Site Construction Performance Requirements

C. Section 31 23 16 - Structural Excavation and Backfill

D. Section 31 23 19 - Dewatering

E. Section 31 23 33 - Trenching and Backfilling

F. Section 33 14 00 - Water Utility Distribution Piping

1.03 QUALITY ASSURANCE

A. Contractor will be responsible for the complete design of all methods used for directional boring including the implementation of all materials, tools, labor, and equipment proposed for use in the Work. Requirements set forth in this document specify a wide range of procedural precautions necessary to ensure that the very basic, essential aspects of a proper directional bore installation are adequately controlled. Adherence to the specifications contained herein, or the Engineer's approval of any aspect of any directional bore operation covered by this specification, will in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the work authorized under the Contract.

B. Requirements of Regulatory Agencies:

1. Federal, State, and Local Regulations:

    a. Conform to the requirements of all federal, state, and local regulatory agencies having jurisdiction.

2. Permits and Inspections:

    a. Where applicable, obtain and pay for permits and inspections for pipe directional boring operations as required by PA 451, State of Michigan, 1994, and all government and private agencies having jurisdiction. No additional compensation will be allowed because of the Contractor's failure to obtain and pay for such permits and inspections. Be aware of and conform with Owner-obtained permits.

3. Occupation Health and Safety Requirements:

a. Conform to the requirements of the Michigan State Department of Labor, Construction Safety Standards Commission Construction Standard, Part 14; Tunnels, Shafts, Caissons and Cofferdams, and the Michigan State Department of Public Health, Occupational Health Standards Commission, Occupational Health Standards, Part 2; Tunnels, Shafts, Caissons and Cofferdams.

1.04 REFERENCE STANDARDS

A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

B. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

C. ASTM C139 - Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes

D. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

E. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

F. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings

G. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

H. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

I. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

J. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

K. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

L. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing

M. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings

N. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

O. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

P. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

Q. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast

R. AWWA C153/A21.53 - Ductile-Iron Compact Fittings

S. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

T. AWWA C651 - Disinfecting Water Mains

U. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

V. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

W. NSF 14 - Plastics Piping System Components and Related Materials

X. Michigan Department of Transportation, Standard Specifications for Construction, latest edition

Y. AWWA MANUAL M55: PE Pipe - Design and Installation, latest edition

1.05 SUBMITTALS

A. Prior to beginning Work, Contractor will prepare and submit to the Engineer for review, detailed plans and shop drawings showing the limits of the proposed directional boring Work; the materials, equipment and methods of construction proposed for use; the connection including all thrust blocking and bracing of the directionally bored carrier pipe to other pipe; the location of shafts, pits and/or approach tunnels to be constructed; the locations of existing utilities; the proposed bore path, and methods to be implemented for protection of personnel, excavations and adjacent structures, property and utilities.

B. Prior to beginning directional boring operations, submit copies of permits and inspection records obtained from state and local authorities having jurisdiction as described under Part 1 of this Section.

1.06 QUALIFICATIONS

A. Contractor will have actively engaged in the installation of pipe using directional drilling for a minimum of seven (7) years and have installed a minimum of 35,000 feet.

B. Field supervisory personnel employed by the Contractor will have at least 7 years' experience in the performance of the work and tasks as stated in the Contract Documents.

C. Polyethylene pipe jointing wil be performed by personnel trained in the use of butt-fusion joining equipment and electro-fusion joining equipment. Training will be performed by a qualified representative of the joining equipment and documented in writing.

1.07 JOB CONDITIONS

A. Where soil conditions or obstructions are encountered that prevent the completion of pipe directional boring Work started or in progress, develop and submit to the Engineer for review alternate methods of performing the Work as described under Part 1 of this Section. Perform no additional Work until completion of review by the Engineer of the alternate method proposed.

B. Protection

1. Provide structures, safety equipment and professional services required to provide for the health and safety of the general public and of personnel involved in pipe directional boring Work in accordance with the requirements of the regulatory agencies having jurisdiction.

2. Take measures necessary to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, drains, sewers, utilities, structures, and appurtenances from damage due to pipe directional boring Work. Responsibility and payment for correction of such damage will be the sole responsibility of Contractor.

3. Pothole existing underground utilities including sanitary sewers, sanitary leads, storm sewers, water mains, water services, gas mains, gas services, telephone lines, cable television lines, oil lines, etc. to ascertain the clearance between the existing utilities and the pipe to be bored and to ensure the pipe boring will not adversely affect the existing utilities. Potholing is required and will not be paid for separately unless otherwise specified in the Proposal.

PART 2 PRODUCTS

2.01 GENERAL

A. Directional drilling equipment will consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing and delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations and trained and competent personnel to operate the system. Equipment will be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2.02 DRILLING RIG

A. Directional drilling machine will consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine will be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system will be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system will be free of leaks. Rig will have a system to monitor and record maximum pull-back pressure during pull-back operations. The rig will be grounded during drilling and pull-back operations.

1. Contractor wil continuously monitor and record drilling fluid pressures and flow rates. Fluid pressures shall be monitored at the pumps and within the bore at a point no more than 20 feet behind the bit, during pilot bore operations.

    a. Maximum allowable drilling rates to allow for proper suspension and removal of cuttings and conditioning of the bore shall be calculated for the pilot bore and each reaming pass and shall not be exceeded.

    b. At no time during the drilling process will the drilling fluid pressures be permitted to exceed one-half of the calculated maximum allowable pressure of the overlying strata.

2.03 DRILLING SYSTEM

A. The drill head will be steerable by changing its rotation and will provide the necessary cutting surfaces and drilling fluid jets.

B. Mud motors will be of adequate power to turn the required drilling tools.

C. Drilling system will be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

2.04 GUIDANCE SYSTEM

A. Magnetic Guidance System (MGS) or proven gyroscopic system will be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation. The guidance will be capable of tracking at depths up to one hundred feet and in any soil condition, including hard rock.

B. The MGS will enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The guidance system will be accurate to +/- 2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet and accurate within 18-inches horizontally.

C. The MGS will be of a proven type and will be operated by personnel trained and experienced with this system. MGS operator will be aware of magnetic anomalies on the surface of the drill path and will consider such influences in the operation of the guidance system if using a magnetic system.

2.05 DRILLING FLUID (MUD) SYSTEM

A. A self-contained, closed, drilling fluid mixing system will be of sufficient size to mix and deliver drilling fluid. Mixing system will continually agitate the drilling fluid during drilling operations.

B. Drilling Fluids:

1. Drilling fluid will be composed of clean water and appropriate additives including bentonite clay. Water will be from an authorized source with a pH of 8.5 to 10. Water of a lower pH or with excessive calcium will be treated with the appropriate amount of sodium carbonate or equal. The water and additives will be mixed thoroughly and be absent of clumps or clods. No potentially hazardous material may be used in drilling fluid.

2. The mud pumping system will be of an adequate capacity for delivering the drilling fluid at a constant pressure suitable for the Work. The delivery system will have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe will be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations will be contained and conveyed to the drilling fluid recycling system. A berm, a minimum of 12-inches high, will be maintained around drill rigs, drilling fluid mixing system, entry and exit pits and drilling fluid recycling system to prevent spills. Pumps and or vacuum truck(s) of sufficient size will be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.

3. The drilling fluid recycling system will separate sand, dirt and other solids from the drilling fluid to render the drilling fluid re-usable. Spoils separated from the drilling fluid will be stockpiled for later use or disposal.

2.06 OTHER EQUIPMENT

A. Pipe rollers will be of sufficient size to fully support the weight of the pipe while being hydro-tested and during pull-back operations. Sufficient number of rollers will used to prevent excess sagging of pipe.

2.07 PVC WATER MAIN PIPE SYSTEM

A. Pipe:

1. For pipe size in sizes 4-inches through 60-inches in diameter, pipe will be AWWA C900, fusible, PVC, DR 18 (235 psi), ductile iron pipe size.

2. PVC pipe materials must be listed and approved for use with potable water under ANSI/NSF 14 and NSF 61. The exterior wall print line of PVC pipe must bear the AWWA C906 and the “NSF-pw” identification.

3. Pipe will be Certa-lok C900/RJ or Engineer approved equal. Pipe will be Underground Solutions, Fusible C-900 or Engineer approved equal.

B. Material: PVC per ASTM D1784

C. Cell Classification: 445474C per ASTM D3350

D. Fittings:

1. Fittings (tees, crosses, bends, sleeves, etc.) and plugs, where shown on the Plans, will be ductile iron compact fittings, restrained, mechanical joint type, with a pressure rating of 350 psi (2.4 MPa), conforming to AWWA C153/A21.53, and AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

   a. Joining fittings to HDPE pipe will use fused mechanical joint adapters with ductile iron backup rings.

   b. Fittings on PVC water main will be restrained joint for PVC pipe designed for a working pressure of 200 psi.

      1) Restraint will be provided by a clamping ring with serration to provide positive restraint around the full circumference of the pipe.

      2) Coating on wedge assemblies and related parts will be two coats of heat cured liquid thermoset epoxy.

      3) Coating on casting bodies will be electrostatically applied and heat cured polyester.

      4) Acceptable manufacturers for PVC restrained fittings include:

         (a) EBAA Iron – Megalug Series 15MJ00 (up to 12”) (above 12” Series 2000PV) or approved equal.

2. Ductile Iron, ANSI A21.10 and A21.11, flanged type joint with 1/8 inch thick rubber gasket and flange ring, full-body, Class 250, with double thickness cement mortar lining.

E. Pipe Joints:

1. Non-Metallic, restrained joint couplings with high-strength, flexible, thermoplastic spline retainers. Retainers will be inserted into mating precision machined grooves in the pipe and coupling to provide full 360-degree restraint. Couplings will be designed for use at the rated pressures of the pipe and will incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477.

2. Butt fusion or electrofusion welded.

F. Water Service Saddles:

1. Electrofusion corporation saddles with 1-inch brass outlet threads and brass corporation stops.

2. Stainless Steel, full circle, double bolt service saddle with spring washers and 1-inch brass outlet threads and designated by the manufacturer in writing as specifically approved for use on HDPE pipe; with brass corporation stops.

3. Bronze, full circle saddles with AWWA tapered thread outlet of the size indicated. Ford S90-series, Mueller H-1300 series or Engineer approved equal. No U-Bolt type saddles are allowed.

G. Restraining Harness:

1. Ductile Iron, epoxy coated with serrated split rings on each end. EBBA Iron Series 1500 or Engineer approved equal.

H. Allowable Leakage:

1. Pipe will be tested at 150 psi for 1 hour per ASTM F2164. Leakage allowance for fused PVC pipe joints is zero. The leakage allowance per joint for gasketed fittings (based upon 150 psi test pressure) is as follows:

Size	6"	8"	10"	12"	14"
Gal / Hour	0.010	0.013	0.017	0.020	0.023

2.08 PVC FORCE MAIN PIPE SYSTEM

A. PVC, AWWA C900, DR-21 (200 psi) ductile iron pipe size.

2.09 HDPE WATER MAIN PIPE SYSTEM

A. Pipe:

1. AWWA C906, DR 11 (Pressure Class 200), Ductile Iron Pipe size. All HDPE materials must be listed and approved for use with potable water under NSF 14. AWWA C906 and the “NSF-pw” identification.

B. Material: PE4710

C. Cell Classification: 445474C per ASTM D3350

D. Fittings:

1. Ductile iron fittings (where shown on the Plans) will be mechanical joint, ductile iron compact fittings conforming to AWWA C153/A21.53, with rubber gasket joints conforming to AWWA C111/A21.11, with double thickness cement mortal lining and coal tar epoxy coating on the outside of the fittings. Joining ductile iron fittings to HDPE pipe will use fused mechanical joint adapters with ductile iron backup rings.

2. HDPE Fittings (tees, crosses, bends, etc.) and plugs will be Butt Heat Fusion Type, DR 11, per ASTM D3261 or Electrofusion Type, per ASTM F1055. Compression fittings are not allowed.

E. Pipe Joints: Butt Fusion Welded or Electrofusion Welded.

F. Valves and Hydrants:

1. As specified in Section 33 1100, Water Utility Distribution Piping.

2. Hydrant leads from the hydrant tee to the hydrant will be ductile iron pipe, AWWA C151, Class 54, PC 350, unless indicated otherwise on the plans.

a. Fittings for joining PVC C900 pipe to hydrant lead will be restrained joint for PVC pipe designed for a working pressure of 200 psi.

G. Water Service Taps:

1. Electrofusion corporation saddles with 1-inch brass outlet threads and brass corporation stops.

2. Stainless Steel, full circle, double bolt service saddle with spring washers and 1-inch brass outlet threads and designated by the manufacturer in writing as specifically approved for use on HDPE pipe; with brass corporation stops.

H. Allowable Leakage:

1. Pipe will be tested at 150 psi for 1 hours per ASTM F2164. Leakage allowance for fused HDPE pipe joints is zero. The leakage allowance per joint for gasketed fittings (based upon 150 psi test pressure) is as follows:

Size	**6"**	**8"**	**10"**	**12"**	**14"**
Gal / Hour	0.010	0.013	0.017	0.020	0.023

2.10 HDPE FORCE MAIN PIPE SYSTEM

A. Pipe:

1. Polyethylene, Nominal IPS OD, DR-11, Pressure Rating 200 psi, pipe less then 3-inch diameter will be in accordance with ASTM D3035 , pipe 3-inches and larger will be per ASTM F714.

B. Material: PE 4710

C. Cell Classification: PE 345464C per ASTM D3350

D. Joints: Heat Fusion Bonding, ASTM D2657 or Electrofusion Welded

E. Fittings:

1. Fittings (tees, crosses, bends, sleeves, etc.) and plugs, where shown on the Plans, will be Butt Heat Fusion Type, DR 11, per ASTM D3261 or Electrofusion Type, per ASTM F1055. Fittings for joining HDPE pipe to ductile iron or PVC AWWA C900 pipe or fittings will use fused mechanical joint adapters with ductile iron backup rings.

F. Allowable Leakage:

1. Allowable Leakage: Pipe will be tested at 150 psi for 1 hours per ASTM F2164. Leakage allowance for fused HDPE pipe joints is zero. The leakage allowance per joint for gasketed fittings (based upon 150 psi test pressure) is as follows:

Pipe Diameter	6"	8"	10"	12"	14"
Gal / Hour	0.010	0.013	0.017	0.020	0.023

2.11 TRACER WIRE

A. Reinforced 7 x 7 stranded copper clad steel wire with 50 mil High Density Polyethylene insulation. Continuous copper cladding metallurgically bonded to a steel core through a continuous solid cladding process. Bare wire 0.208-inch O.D., 4700 pounds breaking strength. Wire to be Copperhead® or equal.

2.12 OTHER MATERIALS

A. Concrete:

1. Concrete will conform to MDOT Section 1004, use Grade 3000 concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

B. Concrete Reinforcement:

1. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.

C. Concrete Block:

1. Block cast from Portland cement sand, gravel or crushed stone, of uniform and compact texture, free from cracks or warpage and with square corners conforming to ASTM C139.

PART 3 EXECUTION

3.01 VERIFICATION

A. Prior to performing directional boring operations, verify grades, lines and levels to which the new Work is to be installed. Directional boring Work that requires adjustment of grades, lines and levels after Work has started will be at the expense of the Contractor performing the Work.

B. Prior to beginning directional boring Work, contact the local one call system for locating buried utilities (811). Also contact the local municipalities who may not be part of the one call system, to mark their buried facilities. Excavate or pothole to verify in the field the location and elevation of existing active utilities and structures scheduled to remain and requiring protection from damage because of the Work. Existing utilities will include gas mains and services, water mains and services, sanitary sewers and house leads, oil lines, telephone lines and services, cable television lines and services, electric lines and services, and any other similar buried utilities.

C. Plan and plot a bore path and submit bore path to Engineer in accordance with Part 1 of this Section. Notify the Engineer where existing utilities directly affect the progress or performance of the Work. Contractor is responsible for excavation or potholing necessary to determine the elevation of existing utilities that cross the proposed water main at no additional cost to the Project unless otherwise indicated in the Proposal.

3.02 PREPARATION

A. Layout of the Work:

1. Stake, mark, and layout the Work using suitable stakes and markers to facilitate verification of grades, lines, levels, and locations of the Work to be performed in a manner acceptable to the Engineer.

2. From reference points established by the Engineer on the surface of the ground, carry line and grade down to the bottom of any shafts or boring pits. Perform the Work to the line and grades established using methods acceptable to the Engineer. Protect such reference points throughout the progress of the Work.

B. Examination of Materials:

1. Prior to performing directional boring Work, examine new pipe for damage due to fabrication, shipment, or handling. Inspect pipe for cracks, breaks, bends, dents, broken ends, or other damage which might affect the structural integrity, performance requirements, or jointing as shown on the Plans, specified herein or as directed by the Engineer. Defective pipe will be rejected by the Engineer and will be removed from the Work and replaced with acceptable pipe at the expense of the Contractor.

C. Notifications:

1. Prior to performing directional boring Work, Contractor will notify applicable inspecting agencies under Part 1 of this Section, of Work Schedule with a minimum of two (2) working days' notice.

3.03 INSTALLATION

A. Except for the method of installation (directional boring versus open cut), the pipe will be installed per requirements of Section 33 14 00 - Water Utility Distribution Piping.

B. Sheeting, Shoring, and Bracing:

1. Furnish, install and maintaining throughout the progress of the Work, such sheeting, shoring, and bracing in tunnels, shafts, pits and trenches as may be required for safety of workmen, for protection of the Work and adjacent structures, and for issuance of applicable agency permits. Sheeting, shoring, and bracing will be removed after completion of the Work unless otherwise indicated on the Plans or directed by the Engineer.

2. Design of earth supports will be the responsibility of the Contractor and will be as required by the nature of the soils encountered. Supports will be dimensioned and spaced as to prevent caving, loss of earth or squeezing within the neat lines of the excavation. Supports will effectively restrain movement of the adjacent soil.

3. The sheeting of pits along roads will be required if the leading edge of the pits falls within the one-on-one zone of influence from the shoulder point or curb and gutter edge.

C. Excavation:

1. Excavate as required to perform directional boring Work to the grades, lines and levels indicated on the Plans and as specified herein.

2. Construct approach trenches, pits and shafts of sufficient length and width to accommodate the equipment being used, the pipe units to be placed and the manpower working. Provide guide timbers or rails in the bottom of the trenches, pits and shafts for keeping the Work on line and grade.

D. Pipe:

1. Construction:

a. Use the types and sizes shown on the Plans. Contractor will construct the pipe on the surface in the area indicated on the Plans. Use care to not damage pipe, joints or joint material. Coiled HDPE pipe will be re-rounded before using.

2. Connection to Structures and Existing Water Mains:

a. Connecting HDPE pipe to manholes will be accomplished by butt fusion welding a flange adapter to the end of the pipe and fully embedding the flange adapter to the inside manhole wall.

b. Final connections of HDPE pipe to existing water mains will be made after the new HDPE pipe has been allowed to relax for a minimum of 24 hours. Connections of HDPE pipe to existing water mains will consist of a full-circle Flex Restraint Collar fused to the HDPE pipe embedded in a 30” x 30” concrete thrust block poured to undisturbed earth placed a maximum of 5-feet from the connection point.

3. Hydrostatic Testing:

a. The pipe will be hydrostatically tested twice for leakage, including a preliminary test after the pipe has been constructed on the surface, and an acceptance test after the pipe has been installed in the drilled hole. Contractor will furnish the pump, pipe connection, valves and other necessary apparatus including gauges, meters, and personnel necessary for conducting the test.

1) Hydrostatic testing for HDPE pipe will be in accordance with ASTM F2164.

2) Hydrostatic testing for PVC pipe will be in accordance with AWWA C605.

3) Before applying the test pressure, air willll be expelled from the pipe. If necessary to accomplish this, taps will be made at points of higher elevation and afterwards plugged.

4) Allow the test section to equalize to a common temperature and pressure. Gradually increase pressure to required test pressure.

5) HDPE pipe will be held at the test pressure for 4 hours prior to beginning the test to allow for stabilization of expansion of the pipe under test pressure.

6) Full pressure will be held for the length of time as specified in Part 2 of this Section.

7) Faulty pipe fitting, valves or other accessories which permit leaks during testing will be replaced by the Contractor with sound material and the test will be repeated until specified requirements are met.

8) If no visual leakage is observed, and pressure during the test phase remains steady (within 5% of the test phase pressure) for the entire test period, a passing test is indicated.

9) The maximum permissible leakage measured by water meter from the section of main tested under pressure, will not exceed the rate as specified in Part 2 of this Section.

10) If retesting is necessary, depressurize the test section and correct faults or leaks in the test section.

11) Test sections will not exceed 2,000 feet. In the event more than 2,000 feet of water main is tested, the permissible leakage will remain at the amount determined for 2,000 feet of pipe.

4. Water for Testing:

   a. Water for testing will be obtained from a potable water supply. Contractor will provide water required at Contractor's own expense and Contractor will make the necessary arrangements with the authority which controls the source of water system for water. Contractor will be governed in using the water by the rules and regulations imposed thereon by said authority.

   b. Contractor will provide and remove temporary connections between the source water system and the mains constructed under this Contract. Temporary connections will meet the approval of the Engineer, the authority controlling the source water system, and public health authorities having jurisdiction.

5. Installation:

   a. After satisfactory hydrostatic testing, the Contractor will install pipe with continuous pullback until the pipe is in place as indicated on the plans. No connections to the pipe will be made for a period of 24 hours after the continuous pullback has been completed.

6. Installing Fittings (fire hydrants, gate valves, tees, crosses, etc.):

   a. Where required, fittings will be cut into the new pipe after it is bored and allowed to relax sufficiently. The new pipe will be excavated and precision cut.

   b. Prior to cutting fusible PVC the pipe, the pipe will be scored around the full circumference of the pipe as recommended by the manufacturer to prevent the pipe from splitting.

   c. Fittings will be installed on the new pipe with cutting in sleeves. Mechanical joints will be the restrained type suitable for PVC C900 pipe.

   d. Connections of HDPE pipe to mechanical joint fittings will use mechanical joint adapters with ductile iron backup rings fusion welded to each end of the pipe.

7. Disinfection:

   a. Water main will be disinfected per AWWA C651. Bacteriological analysis and sampling will be in accordance with AWWA C651 and Section 33 14 00 - Water Utility Distribution Piping.

   b. For HDPE pipe, disinfection with solutions containing chlorine will not contain more than 12.5% active chlorine.

8. Water Services Connections:

    a. Water services connections greater than 1 inch installed on directional bored fusible PVC pipe will be:

        1) a tee cut into the pipe as noted above, or,

        2) a service saddle inside of a restraining harness to relieve the axial stress and keep the pipe from splitting when tapped. Contractor will verify dimensions of service saddle and restraining harness prior to construction.

    b. Water services connections will be:

        1) For HDPE pipes, electrofusion corporation saddle with 1-inch brass outlet threads and brass corporation stops as noted above.

        2) For HDPE pipe, stainless steel, full circle, double bolt service saddle with spring washers and 1-inch brass outlet threads and brass corporation stop. Saddle will be designated by the manufacturer in writing as specifically approved for use on HDPE pipe.

9. Tracer Wire:

    a. Tracer wire will be installed end to end or structure to structure for directionally drilled pipe. Contractor will ensure integrity of the wire is not compromised during pull back. Dis-continuity of the wire will require a new, continuous wire being pulled in over the path of the water main.

3.04 DRILL PATH SURVEY

A. Entire drill path will be accurately surveyed with entry and exit stakes placed in the appropriate locations within the areas indicated on Drawings. If Contractor is using a magnetic guidance system, drill path will be surveyed for surface geo-magnetic variations or anomalies. Submit completed bore path complete with line and grade references and pulling loads imposed to Engineer at completion of directional boring Work.

3.05 DRILLING PROCEDURE

A. Pilot hole will be drilled on bore path with no deviations greater than 5% of depth over a length of 100 feet. In the event that pilot does deviate from bore path more than 5% of depth in 100 feet, Contractor will notify Engineer and Engineer may require Contractor to pull-back and re-drill from the location along bore path before the deviation.

B. In the event that a drilling fluid fracture ("frac out"), inadvertent drilling fluid returns, or drilling fluid loss occurring during pilot hole drilling operations, Contractor will cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a March funnel and then wait another 30 minutes. If mud fracture or returns loss continues, Contractor will cease operations and notify Engineer. Engineer and Contractor will discuss additional options and work will then proceed accordingly.

C. Upon successful completion of pilot hole, Contractor will ream bore hole to the minimum amount necessary to accommodate outside diameter of pipe. Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.

D. After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole using a swivel in front of the pipe. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole. During pull-back operations Contractor will not apply more than the maximum safe pipe pull pressure at any time.

E. In the event that pipe becomes stuck, Contractor will cease pulling operations to allow any potential hydro-lock to subside and will commence pulling operations. If pipe remains stuck, Contractor will notify Engineer. Engineer and Contractor will discuss options and then work will proceed accordingly.

3.06 PULLING LOADS

A. The maximum allowable tensile load imposed on the pipeline pull section will not exceed the following amounts:

1. Allowable Tensile Load:

Normal Size (inches)	HDPE (lbs)	PVC (lbs)
1-1/4	860	
2	1,875	
3	4,072	
4	6,879	10,600
6	14,215	21,900
8	24,455	37,800
10	36,788	56,500
12	52,025	80,800
14	69,895	108,000
16	90,399	139,000
18	113,536	175,000
20	139,306	210,000
24	198,748	300,000
30	305,748	

B. The amount of pull applied to the pipe will be controlled and limited by devices such as hydraulic pressure regulator or a load sensor between the pulling equipment and the pipe.

3.07 PIPE TESTING

A. Following successful pull-back of pipe, Contractor will hydrostatic test the pipe per the requirements of this Section. After successful completion of hydrostatic test, pipe will pigged dry.

B. After completion of hydrostatic test and before connection to the water supply, the pipe will be chlorinated and tested per the requirements of AWWA C651 and Section 33 14 00 - Water Utility Distribution Piping.

3.08 BACKFILLING

A. After the pipe has been installed and approved by the Engineer, the Contractor will backfill the entrance/exit pits, approach trenches or shafts. The entrance/exit pits, approach trenches or shafts and other excavations, will be considered as open cut trench and will be backfilled as

specified in Section 31 23 33 - Trenching and Backfilling. Special backfill will apply where they exceed the maximum allowable trench width.

3.09 ACCEPTANCE AND INSPECTION

A. Contractor will maintain line and grade and will provide the Engineer with as-built location at five-foot intervals. If unable to maintain line and grade or to maintain directional boring operations, Contractor will propose alternate methods of construction as specified under Part 1 of this Section to complete the Work.

B. Water main will be inspected and accepted under Section 33 14 00 - Water Utility Distribution Piping.

C. If excavation or installation Work done by the Contractor is to be abandoned or not completed, the Contractor will fill voids and spaces caused by the abandoned Work, as directed by the Engineer.

3.10 RECORD KEEPING, AS-BUILTS

A. Contractor will maintain a daily project log of drilling operations and a guidance system log with a copy given to Engineer at completion of project. As-built drawings will be certified as to accuracy by Contractor.

END OF SECTION

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SECTION 33 05 09
PIPE BURSTING PRE-CHLORINATED HDPE PIPE FOR WATER MAIN

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section describes pre-chlorinated high-density polyethylene (HDPE) pipe, including acceptable fusion technique and practice, safe handling and storage, and installation of the pipe by pipe bursting methods.

B. The pipe is intended to be installed in sections that can be completed on a daily basis; such that all water services are reconnected to the new main and no section of water main and no water services out of service more than 10 hours.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 31 23 16 - Structural Excavation and Backfill

C. Section 33 14 00 - Water Utility Distribution Piping

1.03 REFERENCE STANDARDS

A. Conform to the applicable portions of the following Standards for the Work:

1. ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
2. ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
3. ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
4. ASTM F2164: Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
5. AWWA C111/A21.11: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
6. AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast
7. AWWA C153/A21.53: Ductile-Iron Compact Fittings
8. AWWA C651: Disinfecting Water Mains
9. AWWA C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
10. AWWA C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks
11. AWWA M23: PVC Pipe—Design and Installation
12. AWWA C622: Pipe Bursting of Potable water mains 4-36 in.

1.04 DESCRIPTION

A. Pipe bursting water mains using Pre-Chlorinated HDPE Pipe will repeat the method, outlined below for each section of pipe being rehabilitated. These processes may be performed in series or in parallel with other sections of pipe within the job; however, each section will require these steps.

1. Deliver notice of service outage to each affected property owner in advance of work.
2. Chlorinate a length of product pipe to yield passing test results for potable water per AWWA C651, Regulatory Authority, and City standards. Collect and test two consecutive bacteriological samples 24 hours apart, and report as “Non-detect” from a certified lab before pipe installation.
3. Hydrostatic test of the pipe section per ASTM F2164 requirements.
4. Excavate a Burst Pit at one end of the section down to pipe grade for placement of the pipe bursting equipment.
5. Excavate an Insertion Pit at the opposite end of the section down to pipe grade for initial entry of the rod string.
6. Excavate service connection pits.
7. Isolate the section to be rehabilitated from the rest of the system so as to maintain pressure integrity of the system as well as preventing any backflow of chlorinated solution or non-potable water into the system.
8. Excavate and remove bends, tees and valves from the host pipe.
9. Assemble rod string feed it through the host pipe from Insertion Pit to Bursting Pit.
10. Attach bursting tools and new water main pipe to rod end at Bursting Pit.
11. Pull rod string back while simultaneously bursting existing pipe and pulling the new water main into the void.
12. Reattach service connections to the newly installed main. Close water services at stop box until main has been super-chlorinated and flushed to prevent resident exposure to high doses of chlorine.
13. Super-chlorinate the main for 15 minutes to 300 ppm. Use a de-chlorination unit to neutralize residual chlorine during flushing. Flush the newly installed main with potable water. After flushing, collect bacteriological samples at each sample site and confirm the absence of coliforms through laboratory analysis.
14. Inspect for leaks at new connections.
15. Make final connection of the new water main to the existing water system.
16. Issue a 24-hour “Boil Water” advisory to all residents in the affected area.
17. Feed the new water main from only one direction until the water is confirmed to be total coliform free.

B. It should be noted that items “7” through “17” are to be accomplished within a single 10-hour day to eliminate the need for any temporary services. The length of pipe to be burst per run (day) should be chosen to conform to this time frame. Items "4" through "6" (excavation items) may be performed one day prior to bursting operations to expedite process.

1.05 REQUIREMENTS

A. Provide a structurally sound, leak-proof, monolithic water main pipe for all piping identified for installation by pipe bursting methods. Assemble individual pipe lengths by butt-fusion unless otherwise specified. Fuse connecting fittings to the piping as required. Perform pressure testing and bacteriological testing on the full length of the pipe and obtain approval from the Engineer before bursting and installing the pipe.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Ensure the Contractor has documented experience of at least 3 years and 50,000 linear feet of pipe bursting with any material, as well as a minimum of 5,000 linear feet of successful pipe bursting with Pre-Chlorinated HDPE water main systems installations in the U.S. before bidding.

2. Submit certification from the pipe bursting equipment manufacturer to the Engineer before the preconstruction meeting, confirming that the company is fully trained in the use of the pipe bursting system.

3. Perform fusible HDPE pipe jointing with personnel trained and certified by the pipe manufacturer in butt-fusion and electro-fusion equipment, following the manufacturer’s recommended methods for new pipe connections. Ensure all personnel involved in installation are trained in proper handling and installation of the HDPE pipe.

4. Contractor must coordinate with the Engineer to establish a schedule indicating the linear feet of pipe bursting installation feasible in a day, based on existing conditions.

B. Fusion Technician Requirements:

1. Ensure the Fusion Technician is fully qualified by the pipe supplier to install fusible HDPE pipe of the type(s) and size(s) being used. Maintain qualification as current on the actual date of fusion performance on the project.

1.07 SUBMITTALS

A. Product Data:

1. Name of the pipe manufacturer and a list of the piping and quantities to be provided by manufacturer.

2. Product data and pipe supplier data indicating conformance with this specification and applicable standards, including written documentation regarding any intended variance from this specification and applicable standards. This will include experience of pipe supplier by years and number of projects; warranty information; and independent laboratory testing certification.

3. Pipe certification and testing in conformance with this specification and applicable standards indicating conformance from the pipe extruder per AWWA C906.

B. Fusion Report:

1. Prepare a fusion report for each fusion joint performed on the project, including any rejected joints. The Fusion Technician's joint report must include the following specific requirements:

a. Pipe Size and Dimensions

b. Machine Size

c. Fusion Technician Identification

d. Job Identification Number

e. Fusion Number

f. Fusion, Heating, and Drag Pressure Settings

g. Heat Plate Temperature

h. Time Stamp

i. Heating and Cool Down Time of Fusion

j. Ambient Temperature

1.08 JOB CONDITIONS

A. Soil Conditions:

1. Where soil conditions or obstructions are encountered that prevent the completion of pipe bursting Work started or in progress, develop and submit to the Engineer for review alternate methods of performing the Work. Perform no additional Work until completion of review by the Engineer of the alternate method proposed.

B. Protection:

1. Personnel:

a. Provide structures, safety equipment and professional services required to provide for the health and safety of the general public and of personnel involved in pipe bursting Work in accordance with the requirements of the regulatory agencies having jurisdiction.

2. Property, Utilities, and Structures:

a. Take all necessary measures to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, drains, sewers, utilities, structures, and appurtenances from damage caused by pipe bursting work. The Contractor. will bear full responsibility and cover the cost for correcting any such damage.

3. Potholing:

a. Pothole existing underground utilities including sanitary sewers, sanitary leads, storm sewers, water mains, water services, gas mains, gas services, telephone lines, cable television lines, oil lines, etc. to ascertain the clearance between the utilities and the pipe to be burst and to ensure the pipe bursting will not adversely affect the existing utilities. Potholing is required and will not be paid for separately unless otherwise specified in the Proposal.

PART 2 PRODUCTS

2.01 HDPE WATER MAIN PIPE SYSTEMS

A. Pipe: AWWA C906, DR 11 (Pressure Class 200), Ductile Iron Pipe size. All HDPE materials must be listed and approved for use with potable water under ANSI/NSF standard 14. The exterior wall print line of all HDPE pipe must bear the AWWA C906 and the “NSF-pw” identification.

B. Material: PE 4710

C. Cell Classification: 445474C per ASTM D3350

D. Fittings:

1. Use mechanical joint, ductile iron compact fittings conforming to AWWA C153/A21.53 for ductile iron fittings, as shown on the plans. Ensure rubber gasket joints comply with AWWA C111/A21.11. Apply double thickness cement mortar lining and coal tar epoxy coating to the outside of the fittings. For joining ductile iron fittings to HDPE pipe, use fused Mechanical Joint Adapters with ductile iron backup rings.

2. Use Butt Heat Fusion Type HDPE fittings (tees, crosses, bends, etc.) and plugs, DR 11, per ASTM D3261, or Electrofusion Type fittings per ASTM F1055. Do not use compression fittings.

E. Pipe Joints: Butt Fusion Welded or Electrofusion Welded.

F. Valves and Hydrants:

1. As specified in Section 33 14 00 - Water Utility Distribution Piping.

2. Use Ductile Iron Pipe for hydrant leads from the hydrant tee to the hydrant, AWWA C151/A21.51, Class 54, with polyethylene encasement; or PVC, AWWA C900 pipe with restrained joints, DR 18 (235 psi); unless indicated otherwise on the plans.Join Ductile Iron or PVC pipe to the hydrant tee or gate valves using Mechanical Joint Adapters with Ductile Iron Backup rings.

3. Use HDPE for hydrant leads from the hydrant tee to the hydrant. Install Mechanical Joint Adapters with Ductile Iron Backup rings at the hydrant shoe.

G. Water Service Taps:

1. Electrofusion corporation saddles with 1-inch AWWA standard threads and brass corporation stops.

2. Stainless Steel, full circle, double bolt service saddle with spring washers and 1-inch brass outlet threads and designated by the manufacturer in writing as specifically approved for use on HDPE pipe; with brass corporation stops.

H. Allowable Leakage: Test the pipe at 150 psi for 1 hour per ASTM F2164. Allow zero leakage for fused HDPE pipe joints. Allow the following leakage per joint for gasketed fittings (based on a 150 psi test pressure):

Size	6"	8"	10"	12"	14"
Gal / Hr	0.010	0.013	0.017	0.020	0.023

2.02 FUSION JOINTS

A. Assemble HDPE pipe lengths in the field with butt-fused joints unless specified otherwise. Follow the pipe supplier's written instructions for this procedure.

B. Ensure joint strength equals the pipe strength as demonstrated by testing requirements. Complete all fusion joints according to this specification.

2.03 TRACER WIRE

A. Reinforced 7 x 7 stranded copper clad steel wire with 50 mil High Density Polyethylene insulation. Continuous copper cladding metallurgically bonded to a steel core through a continuous solid cladding process. Bare wire 0.208-inch O.D., 4700 pounds breaking strength. Wire to be Copperhead® or equal.

2.04 CONNECTIONS AND FITTINGS

A. Connection Hardware:

1. Use non-corrosive, high-strength, low-alloy steel bolts and nuts for buried service, meeting the characteristics specified in AWWA C111/A21.11, regardless of any other protective coating.

2.05 PIPE BURSTING SYSTEM EQUIPMENT

A. General:

1. Design and manufacture the pipe bursting system to force its way through the existing line by fragmenting the pipe and compressing the broken pieces into the surrounding soil as it progresses. Ensure the bursting unit generates sufficient force to burst and compact the existing pipeline, allowing for the insertion of the HDPE pipe.

B. Allowable Types of Pipe Bursting Systems:

1. Static Pipe Bursting Systems:

a. Characterize static pipe bursting systems with a tapered or blunt-nosed pull head that is pulled through the host pipe, breaking it by applying radial pressure. The host pipe fails by 'hoop' tensile stress applied by the head, fragmenting and pushing the broken pieces into the surrounding bedding and soil as the pull head progresses.

b. Follow the pull head with an expansion head that further pushes the fragmented pipe into the surrounding soil and bedding, expanding the diameter to allow the insertion of the HDPE pipe behind it. Do not use the pipe pull head, attached directly to the HDPE pipe, to expand or increase the diameter of the host pipe or the fragmented host pipe.

c. Pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

2. Hydraulic Pipe Bursting Systems:

    a. Equip hydraulic pipe bursting systems with a pull head featuring hydraulically actuated ‘petals’ that break the host pipe by applying radial pressure. The head applies hoop tensile stress to the host pipe, causing it to fail, fragment, and push the pieces into the surrounding bedding and soil as the pull head progresses.

    b. Follow the pull head with an expansion head that further pushes the fragmented pipe into the surrounding soil and bedding, expanding it to a diameter that permits the insertion of the HDPE pipe. Never use the pipe pull head, which is attached directly to the HDPE pipe, to expand or otherwise increase the diameter of the host pipe or fragmented host pipe.

    c. Pull head may be advanced by a hydraulic or winching mechanism, and may be connected by means of a cable, chain, or rod.

C. Pneumatic or percussive bursting systems are not be allowed.

PART 3 EXECUTION

3.01 DELIVERY AND OFF-LOADING

A. Bundle or package pipes in a way that ensures adequate protection of the ends during transportation to the site. Replace any pipe damaged in shipment at the Contractor's expense.

B. Inspect each pipe shipment prior to unloading to check for load shift or damage. Reject and remove any damaged pipe from the project site.

C. Check each pipe shipment for quantity, proper pipe size, color, and type.

D. Load, off-load, and handle pipe according to AWWA M23. Ensure pipe is not dropped or damaged. Reject and remove any damaged pipe from the project site.

3.02 JOINT FUSING

A. HDPE pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier’s recommendations.

B. Record and log each joint fusion using an electronic monitoring device (data logger) attached to the fusion machine. Submit joint fusion data to the Engineer in accordance with this specification.

C. Use only appropriately sized and outfitted fusion machines approved by the pipe supplier for the fusion process. Ensure fusion machines incorporate the following properties and elements:

1. Heat Plate: Ensure heat plates are in good condition with no deep gouges or scratches within the pipe circle being fused. Keep plates clean and free from contamination. Verify heater controls function properly, and check that the cord and plug are in good condition. Use appropriately sized heat plates capable of maintaining a uniform and consistent heat profile and temperature for the pipe being fused, following the pipe supplier’s recommendations.

2. Carriage: Ensure the carriage travels smoothly with no binding at less than 50 psi. Keep jaws in good condition with proper inserts for the pipe size being fused. Install insert pins without causing any interference to carriage travel.

3. General Machine: Inspect the machine body for defects, missing parts, or potential safety issues before fusion.

4. Datalogger: Use the current version of the pipe supplier's recommended software. Ensure the handheld wireless unit is stored in a protective case. Keep the datalogger operations and maintenance manual with the unit at all times. For extended fusion periods, provide an independent 110V power source to extend battery life.

D. Provide the following additional equipment specifically required for the fusion process:

1. Pipe rollers shall be used for support of pipe to either side of the machine

2. Provide a weather protection canopy that allows full machine motion of the heat plate, fusion assembly, and carriage for fusion in inclement and/or windy weather.

3. Keep the fusion machine operations and maintenance manual with the fusion machine at all times.

4. Facing blades specifically designed for cutting HDPE pipe.

E. Joint Recording:

1. Record and log each fusion joint using an electronic monitoring device (data logger) connected to the fusion machine. Generate the fusion data logging and joint report through software specifically developed for the butt-fusion of thermoplastic pipe. Ensure the software registers and records the parameters required by the manufacturer and specifications. Log any data not captured by the data logger manually and include it in the Fusion Technician's joint report.

3.03 VERIFICATION

A. Grades, Lines, and Levels:

1. Prior to performing any pipe bursting operations, verify the grades, lines and levels to which the new Work is to be installed. Any Work required to adjust grades, lines and levels after Work has started will be at the expense of the Contractor performing the Work.

B. Potholing - Verifying Existing Structures and Utilities:

1. Prior to beginning any pipe bursting Work, contact the local one call system for locating buried utilities. Also contact the local municipalities, who may not be part of the one call system, to mark their buried facilities.

2. Excavate or pothole to verify the location and elevation of existing active utilities and structures that will remain and require protection from damage during the work. Ensure that verification includes, but is not limited to, gas mains, water mains, sanitary sewers, house leads, oil lines, telephone lines, cable television lines, electric lines, and any other similar buried utilities.

a. Where the vertical separation between the water main and the existing utility is less than 18-inches, excavate and lower the water main to maintain 18-inches of separation.

3. Determine amount of “humping” expected due to existing soil conditions and size of pipe burst. Notify the Engineer where existing utilities may be adversely affected due to the progress or performance of the Work.

4. Ensure excavation or potholing is conducted to determine the elevation of existing utilities crossing the proposed water main. This must be done at no additional cost to the project unless otherwise specified in the proposal. If needed, excavate existing utilities to relieve transient loading and prevent damage during the bursting operation.

5. Excavate and remove valves and fittings as necessary to complete the Work. Break out and excavate concrete encasements and thrust blocks before starting the Work.

3.04 EXCAVATION AND ACCESS PITS

A. Ensure the pit length maintains the minimum bending radius for the HDPE pipe as per the pipe supplier's specifications. Follow sheeting, shoring, and bracing requirements in accordance with Section 31 23 16 - Structural Excavation and Backfill.

B. Perform pit excavations at all points where the HDPE pipe will be inserted into the existing pipeline. Where possible, align access pit excavations with host pipe lateral connection points, valves, hydrants, or other appurtenance installations.

C. Locate the pits to minimize their number, maximize the footage of the new pipe installed in a single pull, and maintain access to all properties.

D. Complete the work within existing street rights-of-way or utility easements. Keep open excavations secure at all times with appropriate lights, signs, barricades, construction tape, etc.

E. Support the pipe on rollers or other approved friction-decreasing implements during joining and insertion to prevent overstressing or critical abrasion before or during installation.

3.05 TESTING

A. Hydrostatic Testing:

1. Hydrostatically test the pipe for leakage after jointing on the surface and before installation in the burst hole. Provide the pump, pipe, connections, hydrants, fittings, valves, necessary apparatus, gauges, meters, and all personnel required for conducting the test.

2. Expel all air from the pipe before applying the test pressure. If needed, make taps at higher elevation points and plug them afterward.

3. Allow the test section to equalize to a common temperature and pressure. Gradually increase pressure to required test pressure.

4. Hold the HDPE pipe at the test pressure for 4 hours prior to starting the test to allow for stabilization of the pipe’s expansion under the applied pressure.

5. Hold the full pressure for 1 hour.

6. Replace any faulty pipe fittings, valves, or accessories that permit leaks during testing with sound materials. Repeat the test until specified requirements are met.

7. If no visual leakage is observed, and pressure during the test phase remains steady (within 5 % of the test phase pressure) for the entire test period, a passing test is indicated.

8. Ensure the maximum permissible leakage measured by the water meter from the section of the main tested under pressure does not exceed the rate specified in Part 2 of this Section.

9. If retesting is necessary, depressurize the test section and correct any faults or leaks in the test section.

10. Test sections will normally not exceed 2,000 feet and in the event more than 2,000 feet of water main is tested, the permissible leakage will remain at the amount determined for 2,000 feet of pipe.

11. Water for testing shall be obtained from a potable water supply. The 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.

12. Provide and remove temporary connections between the source water system and the mains constructed under this Contract. Ensure all temporary connections meet the approval of the Engineer, the authority controlling the water source, and Public Health authorities having jurisdiction.

B. Disinfection:

1. Disinfect the pipe for pipe bursting twice: once before installation and once after installation. Disinfect the pipe before installation and after pressure testing in accordance with AWWA C651 requirements. After installation, re-chlorinate the pipe using a slug method. Ensure that disinfection solutions containing chlorine do not exceed 12.5% active chlorine.

2. Disinfect the water main after completing hydrostatic testing and flushing of the new water main. Follow AWWA C651 guidelines to disinfect the entire piping system by introducing a chlorine-water solution throughout the water main piping. Apply the liquid mixture using a solution-feed chlorinating device.

3. Install the corporation stop and feed chlorine solution through it at the beginning of the main or valved section. Let a slow flow of water enter the main near the chlorine solution injection point, ensuring the chlorine dosage of the incoming water is at least 25 parts per million.

4. Maintain an open discharge at the far end of the section being chlorinated. Continue introducing the chlorine solution and water until the water discharged at the far end carries the required dosage of chlorine.

5. Open each outlet from the main as it fills with chlorinated water. Draw off sufficient water to ensure the full dosage of chlorine reaches each outlet.

6. Keep chlorine-treated water in the main for at least 24 hours. At the end of that period, ensure the chlorine residual at pipe extremities and other representative points is at least 10 ppm. If the residual is less than 10 ppm, reapply chlorine and repeat the retention period until the required 10 ppm residual is achieved.

7. Repeat the chlorination procedure if the initial treatment of any section of the mains is deemed ineffective by the Engineer. Continue until tests confirm that water sampled from the new mains meets the required standards.

8. Super-chlorinate the main with 300 mg/l of chlorine solution for 15 minutes after installation. Prevent back pressure that may cause reversal of flow in the chlorinated main. Maintain the pressure in the main to ensure chlorinated water does not flow into other sections of the main or the water system.

9. After installation and chlorination by the super-chlorination, the water main will be flushed and another bacteriological sample will be drawn and analyzed in accordance with AWWA C651.

10. Collect water samples and arrange for analyses at own expense. Ensure the testing laboratory and sample collection meet the approval of public health authorities having jurisdiction.

C. Bacteriological Analysis:

1. Collect not less than two (2) consecutive water samples taken 24 hours apart for bacteriological analysis prior to placing a water main in service. Ensure each analysis shows results meeting state and local drinking water standards.

2. Contractor, collect water samples and arrange for analyses at own expense. Collect samples in accordance with AWWA C651. Ensure the testing laboratory and sample collection meet the approval of the public agency having jurisdiction.

3.06 NOTIFICATION

A. Notify the Owner and all water users affected by the work a minimum of seven days before beginning work. Deliver a written notice on Owner letterhead to each user.

1. Advise the user that the water system will be temporarily shut down. Include details on the date, time, length, and duration of the water service interruption.

2. Ensure every user receives notification. Include telephone number(s) for contacting the Contractor at any time, day or night.

B. Provide a second written notice to the affected water users one working day prior to the actual water service interruption. Do not shut off water services for more than 10 hours unless approved by the Engineer.

C. Issue a precautionary "Boil Water" advisory to all water users at the completion of the installation. Hand deliver the advisory to all water consumers on the line. Keep the "Boil Water" advisory in effect until all pipe bursting in the entire section is completed and the last bacteriological sample is reported as "Non-detect" from a certified lab.

3.07 PROTECTION OF PRE-CHLORINATED PIPE

A. Give high priority to maintaining sanitary conditions within the water main before and after pipe bursting. Keep the pipe ends sealed at all times. Do not make connections in standing water; pump or bail out the water before making the connection or unsealing the pipe. Excavate areas under connections below the pipe invert.

B. Before joining a surface and before any special surface preparation to accommodate that joining, external surfaces should be clean and dry. Dust may be removed by wiping with clean, lint free cloth. Heavier deposits must be washed from the surface with soap and water and dried with a clean, lint free cloth.

C. If the interior of the pipe is exposed to any foreign matter, carry out one of the two following remedies:

1. Complete chlorination per AWWA C651 specifications for buried pipe.

2. Localized contamination at the end of the pipe may be removed and the contaminated interior surface of the pipe wiped with a solution of 1 to 5% hypochlorite disinfecting solution.

3.08 INSTALLATION

A. Concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head.

B. HDPE pipe will be installed in a manner so as not to exceed the recommended bending radius.

C. Where HDPE pipe is installed by pulling in tension, the recommended Safe Pulling Force, according to the pipe supplier, will not be exceeded.

D. Insert new HDPE pipe immediately behind the bursting head in accordance with the pipe supplier’s recommended procedures. Use bursting equipment specifically designed and manufactured for the type of insertion process being used.

E. It is the Contractor’s responsibility to determine safe and feasible upsizing parameters with the existing size of host pipe, and size of proposed pipe bursting pull-in pipe, and the existing conditions under which the pipe is being installed.

F. Remove and replace any pipe damaged or over-stressed by the Contractor during installation at no additional cost to the Owner.

3.09 INSTALLATION ACCEPTANCE AND CLEANUP

A. Inspect the first six feet of HDPE pipe pulled into the receiving pit behind the pull head for damage. Depending on the gouging, abrading, or damage, accept, de-rate, reinstall, or reject the pipe as determined by the Engineer.

B. Return the project site to a condition equal to or better than its pre-construction state. Backfill and compact all excavations according to the drawings, specifications, and jurisdictional standards. Repair all pavement and hardscape per applicable jurisdictional standards, remove excess materials from the site, and re-landscape disturbed areas.

C. Remediate any evidence of surface upheaval immediately. Verify that all utilities, structures, and surface features in the project area are sound. Repair any damage to the satisfaction of the Owner of the damaged facility.

3.10 INSTALLING FITTINGS FOR FIRE HYDRANTS, GATE VALVES, TEES, CROSSES, ETC.

A. Cut fittings into the new pipe where required after boring and allowing it to relax sufficiently. Excavate the new pipe and make a precision cut.

1. Use fused mechanical joint adapters and fully restrained mechanical joint fittings for all connections to PVC, Asbestos Cement, or Ductile Iron water mains or appurtenances.

3.11 CONNECTION TO MAIN

A. Make final connections of HDPE pipe to existing water mains after allowing the new HDPE pipe to relax for a minimum of 24 hours.

B. Make connections of HDPE pipe to existing water mains using a full-circle Flex Restraint Collar fused to the HDPE pipe. Embed the collar in a 30” x 30” concrete thrust block poured to undisturbed earth, placed a maximum of 5 feet from the connection point.

C. Fully flush the section of newly installed pipe with a de-chlorination unit and ascorbic acid to neutralize the residual chlorine before making the connection. After flushing, connect the newly installed section to the main at both ends and reinstate service.

D. After the new main is placed in service and before the boil water advisory is rescinded, only one of the isolating valves on either side of the new pipe should be open. This will allow the pipe to be placed in service while not allowing the water from the new pipe to enter other parts of the distribution system. The other valve may be opened once the water has been determined total coliform free.

3.12 SERVICE CONNECTIONS

A. Connect service connections on the existing water main, which is to be burst or taken out of service due to this project, to the new main at the end of each day. Do not allow water services to be out of service for more than 10 hours.

B. After installing the new HDPE pipe, the Contractor is responsible for reconnecting existing water services. Use service leads of the size indicated in the plans and proposal. Tap the service connections to the new main line with electro-fusion corporation saddles and brass corporation stops, unless otherwise approved by the Engineer.

3.13 THRUST BLOCKS

A. Thrust blocks and thrust restrainers are required at all water main fittings.

END OF SECTION

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SECTION 33 05 13
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 04 05 11 - Mortaring and Grouting

B. Section 31 23 16 - Structural Excavation and Backfill

C. Section 31 23 19 - Dewatering

D. Section 31 23 33 - 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, conform to the applicable portions of the following Standard Specifications for the Work of this Section:

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. Submit the following in accordance with Section 01 77 00 - Closeout Procedures:

1. Manufacturer's field reports.

B. 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 C890 "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 C923/C923M "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. Design the top slab of all manholes or vaults to withstand an H-20 truck loading.

F. Ensure the minimum manhole or vault base slab thickness is eight (8) inches for depths up to twenty-five (25) feet and twelve (12) inches for depths over twenty-five (25) feet.

G. Ensure manholes and vaults are designed to resist buoyancy from flooding with a high groundwater table elevation at the top of the precast concrete structure. Maintain a factor of safety against buoyancy of 1.20. Provide buoyancy calculations with the submittal.

H. Design walls backfilled with cohesive soil for an equivalent horizontal fluid at-rest soil pressure of 135 pounds per square foot (psf) per foot of wall height, specifically for walls below the groundwater table.

I. Design walls backfilled with granular soil for an equivalent horizontal fluid at-rest soil pressure of 125 psf per foot of wall height, specifically for walls below the groundwater 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 05 11.
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/A48M, 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/A48M, 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. Pipe to Manhole/vault Connection:

1. Unless noted otherwise on the Contract Drawings, use a resilient type connector, in accordance with ASTM C923/C923M , 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 Engineer.

C. 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.

D. Manufacturers:

1. Canusa - WrapidSeal Manhole Encapsulation System

2. Cretex Specialty Products - External Manhole Seal

3. 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 23 33 - Trenching and Backfilling and on the Contract Drawings.

B. Topsoil Fill Type: S3 or S4 as specified in Section 31 23 33 and on the Contract Drawings.

C. Soil Backfill from Above Pipe to Finish Grade: Soil Type S1 or S2, as specified in Section 31 23 33 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 23 16 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. Place and compact surrounding backfill material to ensure sufficient and equal side pressure on the manhole or vault.

5. Backfill excavations for manholes, vaults and drainage structures in accordance with Section 31 23 16.

6. Form and place manhole cylinder or vault wall plumb and level, to correct dimensions and elevations.

7. Connect pipe with flexible rubber joints as shown on the Contract Drawings.

8. Set cover frames and covers level without tipping, to correct elevations.
9. Install chimney seals per manufacturer’s instructions and Contract Drawings.
10. Coordinate with other sections of Work to provide correct size, shape, elevation, and location.
11. Use manufacturer's recommended method, procedure and equipment for handling, installing, and connecting the manholes or vaults.

3.04 STANDARD PRECAST 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 31 23 16 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:

C. 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.

D. 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.

E. 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 (Use equivalent volume for testing vaults):

Depth (feet)	48" Dia. MH	60" Dia. MH	72" Dia. MH	96" Dia. MH
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
+2	+5	+6.5	+8	+9.5

F. 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. 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 in the Contract Drawings.

END OF SECTION

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SECTION 33 14 00
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, flushing and chlorination of water main piping systems.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 012200

B. Section 01 33 00 - Submittal Procedures

C. Section 01 77 00 - Closeout Procedures

D. Section 31 23 16 - Structural Excavation and Backfill

E. Section 31 23 19 - Dewatering

F. Section 31 23 33 - 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.

B. Ensure water main piping and appurtenances are NSF 61 certified. Stamp the certification on the exterior wall of the pipe/appurtenance.

1.04 REFERENCE STANDARDS

A. Conform the Work of this Section to the applicable portions of the following Standard Specifications, unless otherwise specified:

1. ASTM A48/A48M - Standard Specification for Gray Iron Castings
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
5. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
6. ASTM B88 - Standard Specification for Seamless Copper Water Tube
7. ASTM B98/B98M - Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes

8. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
9. ASTM B766 - Standard Specification for Electrodeposited Coatings of Cadmium
10. ASTM C55 - Standard Specification for Concrete Building Brick
11. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete
12. ASTM C139 - Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
13. ASTM C150/C150M - Standard Specification for Portland Cement
14. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
15. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements
16. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
17. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
18. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
19. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
20. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
21. AWWA C104/A21.4 - Cement–Mortar Lining for Ductile-Iron Pipe and Fittings
22. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
23. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems
24. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast
25. AWWA C153/A21.53 - Ductile-Iron Compact Fittings
26. AWWA C200 - Steel Water Pipe, 6 In. (150 mm) and Larger
27. AWWA C205 - Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied
28. AWWA C207 - Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
29. AWWA C209 - Tape Coatings for Steel Water Pipe and Fittings
30. AWWA C210 - Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
31. AWWA C218 - Liquid Coatings for Aboveground Steel Water Pipe and Fittings

32. AWWA C222 - Polyurethane Coatings and Linings for Steel Water Pipe and Fittings
33. AWWA C300 - Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
34. AWWA C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
35. AWWA C504 - Rubber-Seated Butterfly Valves
36. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
37. AWWA C602 - Cement–Mortar Lining of Water Pipelines in Place-4 In. (100 mm) and Larger
38. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
39. AWWA C651 - Disinfecting Water Mains
40. AWWA C800 - Underground Service Line Valves and Fittings
41. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
42. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service
43. AWWA C909: Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger
44. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition.
45. NSF 14 - Plastics Piping System Components and Related Materials
46. NSF 61 - Drinking Water System Components - Health Effects

1.05 SUBMITTALS

A. Tabulated Laying Schedule:

1. Submit a Tabulated Laying Schedule to the Engineer when using concrete water main pipe in the water main Work. Include stationing, deflection, elevation, slope, and a description of the pieces. Do not start pipe manufacture until the Engineer has reviewed the laying schedule.

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. Keep a complete schedule of all tapping outlets installed in concrete water main piping and submit it to the Engineer at the end of each water main piping section or on the last day of each week, whichever occurs first.

D. Affidavits:

1. Submit the manufacturer’s affidavit of compliance with the Contract Documents to the Engineer. The affidavit must 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

E. Restrained Joints:

1. Submit manufacturer’s data for restrained joint pipe and fittings for the Engineer’s review.

F. Testing Plan:

1. Submit a plan detailing flushing limits of pipe to be tested, bleed down points, proposed water source, and water disposal method and location. The plan should include proposed disinfection chemical and dechlornation method, as well as how the chemical will be introduced into the pipe and how the treated water will be dechlorinated prior to disposal.

1.06 CLOSEOUT PROCEDURES

A. Submit the following in accordance with Section 01 77 00:

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 Part 3 of this specification.

1.07 DELIVERY OF MATERIALS

A. Provide two (2) percent of prestressed concrete pipe lengths to be delivered as short pieces, each 10 feet or less. These short pieces must be in addition to those required under the Tabulated Laying Schedule.

1.08 STORAGE OF MATERIALS

A. Store pipe in a manner that minimizes infiltration of dirt, debris, and other extraneous materials.

B. Do not stack piping materials higher than 4 feet. Provide suitable racks, chairs, and other supports 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 prevent damage from freezing. Keep hydrants, valves, wells, their accessories, and appurtenances in their original containers until ready for installation.

D. Protect gaskets, glands, joint, and sealing materials from ultraviolet or ozone attack by storing them in suitable enclosures, away from sunlight, atmosphere, and weather, until ready for installation.

1.09 HANDLING OF MATERIALS

A. Load and unload piping using suitably approved hoists and skidding. Do not drop, bump, or allow piping to impact against itself. Reject any damaged piping.

B. Use lifting devices suited to the Work and ensure they protect surfaces from damage.

PART 2 PRODUCTS

2.01 GENERAL

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. Do not construe these Articles as allowing any alternate type of material other than what is indicated on the Plans or elsewhere in the Specifications.

2.02 DUCTILE IRON PIPE SYSTEM

A. Use Ductile Iron Pipe that meets AWWA C151/A21.51, with cement mortar lining inside and a 1-mil (25 µm) minimum thickness asphaltic coating outside. Ensure the pipe has a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans or specified in the Proposal.

B. Use compression gasket type mechanical joints for ductile iron pipe, conforming to AWWA C111/A21.11. Do not allow slots with the same width as the diameter of the bolt holes in mechanical joints on the bell flange.

C. Use push-on, compression gasket type joints that conform to AWWA C111/A21.11. Mark the spigot of the pipe to visually determine when the spigot is fully seated in the bell of the adjoining section.

D. Use ductile iron compact fittings and plugs with mechanical joints, pressure rating of 350 psi, conforming to AWWA C153/A21.53. Ensure rubber gasket joints conform to AWWA C111/A21.11. Apply double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.

E. Use flexible ball and retainer type joints that are boltless, locking, and capable of being deflected up to 15 degrees.

F. Ensure cement mortar linings for ductile iron pipe conform to the requirements of AWWA C104/A21.4 at the specified thickness. Set the lining permanently before applying any additional pipe coating.

2.03 PRESTRESSED CONCRETE PRESSURE PIPE SYSTEMS

A. Use prestressed concrete, embedded cylinder type concrete piping with a 175 psi plus d-load design pressure, conforming to AWWA C301. Apply a seal coat in accordance with AWWA C104/A21.4 as applicable.

B. Use push-on, steel ring, gasket type joints for concrete pipe, conforming to AWWA C300 or AWWA C301.

C. Use fittings that conform to AWWA C300, Type A, with concrete or mortar lining and reinforced concrete or mortar exterior covering. For Type B, use cut and welded steel plate, mortar coated on both interior and exterior.

D. Seal coat concrete pipe with bitumastic concrete penetrant conforming to AWWA C104/A21.4. Apply after pipe has cured.

2.04 POLYVINYL CHLORIDE (PVC) PIPING SYSTEMS

A. Use rigid polyvinyl chloride bell and spigot type pressure pipe and couplings, size 4 inches and larger, that conform to AWWA C900, Pressure Class 235, DR 18, unless otherwise indicated in the Contract Documents.

B. Use rigid polyvinyl chloride bell and spigot type pressure pipe and couplings, smaller than 4 inches, that conform to ASTM D2241, SDR 21, pressure class 200.

C. Use molecularly oriented polyvinyl chloride (PVCO) pipe, sizes 4 to 24 inches, that conform to AWWA C909, pressure class 200, unless otherwise indicated in the Contract Documents. Allow PVCO pipe only when specifically called for in the Contract Documents.

D. Use compounds for PVC pipe and components that are suitable for potable water products as required by NSF 14 and NSF 61. Stamp the exterior pipe wall with NSF-pw. Mark the spigot end of the pipe to visually confirm when the spigot is fully seated in the bell of the adjoining pipe.

E. Use joints for PVC pipe that are push-on or mechanical elastomeric gasket type, conforming to ASTM D3139.

F. Allow PVC fittings only when called for on the Plans. When permitted, use 4-inch and larger PVC fittings and plugs with a 200-pound (1380 kPa) Pressure Class, conforming toAWWA C900, in the types and sizes indicated on the Plans. Use ASTM D2241 for PVC fittings smaller than 4 inches, when permitted.

G. Use ductile iron fittings and plugs for PVC pipe, unless specified otherwise, in accordance with the specifications for Ductile Iron Pipe Systems in Part 2.

H. Use elastomeric seal type gaskets for PVC pipe, conforming to ASTM F477.

I. Use manufacturer’s standard nontoxic pipe joint lubricants, conforming to AWWA C900.

2.05 RESTRAINED JOINTS

A. Follow the specifications for restrained joints as outlined in the Plans or Specifications.

1. Design restrained joints for ductile iron pipe and fittings to handle a working pressure of 350 psi. Ensure joints allow for deflection after assembly. Use one of the following methods for restraints:

    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. Design restrained joints for PVC water main pipe to handle a working pressure of 200 psi. Provide restraint across the joint where the restrained portion connects to fittings, using a clamping ring anchored to the fitting with T-head bolts or stainless-steel rods.

    a. Incorporate clamping rings with serrations on the inside surface in restraining devices for PVC water main pipe to provide positive restraint on the outside surface. Ensure full support around the circumference of the pipe to maintain its roundness.

    b. Apply two coats of heat-cured liquid thermoset epoxy on wedge assemblies and related parts. Coat casting bodies with electrostatically applied and heat-cured polyester.

2.06 POLYETHYLENE ENCASEMENT

A. Use 4 mil high-density, cross-laminated polyethylene film or 8 mil linear low-density polyethylene film for encasement, as per AWWA C105/A21.5.

2.07 VALVES AND HYDRANTS

A. Butterfly Valves:

1. Use rubber-seated tight-closing butterfly valves that conform to the latest revision of AWWA C504.

2. Class 150 Valves (Non-Cyclic Applications)

3. Use flangeless wafer body style valves, suitable for ANSI 150-pound flanges. Ensure the bodies are cast iron and rated at 175 psi. All flangeless wafer valve bodies must have bolt guides to center the body in the pipeline.

4. Furnish valves with self-lubricated bearings made of TFE-coated stainless steel. Provide shaft seals to prevent leakage and protect bearings from internal or external corrosion.

5. Use reinforced resilient valve seats that are field replaceable. Ensure seats also serve as body liners to prevent flow from contacting the body casting.

    a. Design seats with flange sealing to ensure a positive seal without the need for flange gaskets.

    b. Use Buna-N or EPDM seats suitable for potable water applications.

6. Use one-piece 316 stainless steel shafts with a diameter suitable for the specified service conditions.
7. Finish grind shafts to minimize bearing and shaft seal wear. Install a non-adjustable thrust collar on shafts of valves 12 inches and larger.
    a. Equip shaft seals with a stuffing box and pull-down packing gland. Provide self-adjusting “V” type packing for the seals.
8. Make discs from aluminum bronze. Use Type 316 stainless steel for the disc-to-shaft connections.
9. Machine pins, shafts, and discs of all valves individually for complete interchangeability.
10. Provide valves with field-interchangeable manual or powered actuators as required. Design the actuator-to-shaft connection to shear and prevent internal valve damage if the disc closes on foreign material in the pipeline.
11. Factory Testing: Conduct tests on each valve according to the Manufacturer’s Quality Control procedures.
12. Mark butterfly valves with the valve size, manufacturer’s mark, year of manufacture, and class.
13. Manufacturer: Use valves from DeZurik, Val-Matic, Clow, or an approved equal.

B. Gate Valves:
    1. Insert community standard here

C. Fire Hydrants:
    1. Insert community standard here

D. Air Release Valves:
    1. Use air release valves with an ASTM A126 Class B cast iron body and cover. The valves must have a threaded inlet connection as shown on the plans or listed in the schedule and a 1/2 inch NPT outlet connection.
    2. Equip the valve body with a 2 inch NPT plugged port near the base for cleanout of large solids. Install a 1/2 inch NPT connection near the top and a 1 inch NPT port near the bottom for the installation of flushing attachments.
    3. Use an 18-8 stainless steel float and a replaceable seat made of Buna-N or another suitable material. Ensure the internal linkage mechanism is 18-8 stainless steel; plastic or bronze materials are not acceptable.
    4. Design the linkage mechanism to be removable from the cover without disassembling the mechanism.
    5. Design the valve with a 3/16 inch diameter stainless steel orifice for working pressures up to 150 psi. Ensure the valve closes drop-tight.
    6. Design the valve to automatically exhaust accumulated air from a fluid system while maintaining pressure and operation.

7. Equip each valve installed below grade with a flood-safe kit to prevent inflow during submerged conditions.

2.08 TAPPING SLEEVES

A. Use cast iron or ductile iron tapping sleeves with a pressure rating of 250 psi, mechanical joint sleeves conforming to AWWA C153/A21.53. Furnish the sleeves complete with valves, stops, caps, plugs, and joint accessories as indicated on the Plan. The sleeve must be of a 2-section type.

B. When approved by the Owner, use tapping sleeves made of 18-8 Type 304 stainless steel with a full circumference band, bolts, nuts, and washers. Ensure the sleeves are rated for a working pressure of 250 psi. Use Buna-N gaskets and flanges that meet the requirements of AWWA C207, with fusion-bonded epoxy coated carbon steel.

2.09 VALVE BOXES

A. Use 3-piece valve boxes with a 5-1/4 inch diameter, screw type, gray iron castings. The valve boxes must consist of a base section, bottom section, and top section with a lid, all conforming to ASTM A48/A48M, Class 20. Adjust the overall length to meet the grade.

2.10 CORPORATION STOPS

A. Use water service bronze for corporation stops, couplings, and plugs as detailed on the Plans, specifying the type and size.

2.11 SERVICE SADDLES

A. Use water service saddles compatible with the main and service lead. Ensure straps are made of ductile material to prevent crushing and deforming the main. Install a molded rubber or neoprene gasket to fully encircle the tapped opening, ensuring a watertight connection. Do not use lead gaskets.

B. Water service saddles must be bronze with AWWA tapped threads.

C. Use double strap, full circular service saddles for PVC water main, ensuring uniform bearing around the circumference. Do not use U-bolt type straps.

2.12 CURB STOPS

A. Water service bronze of types and sizes detailed on the Plans.

B. Include an extension type, 3-piece curb box with extension type base, foot piece, one-piece lid, and a 3-foot stationary rod for curb stops, unless specified otherwise.

2.13 THREADED FITTINGS

A. Conform threads for water main service fittings to the requirements of AWWA C800 and AWWA C800 "Appendix for Materials" where indicated on the Plans.

2.14 WATER SERVICE PIPE

A. Use Type "K" soft copper conforming to ASTM B88, with flared fittings.

B. Use polyvinyl chloride conforming to ASTM D2241 or ASTM D1785 Schedule 40.

C. HDPE, conforming to AWWA C901, PE 4710, DR 11, PC200,

2.15 RESTRAINTS, CLAMPS, RODS, AND TIES

A. Use high-strength low-alloy steel or stainless steel conforming to AWWA C111/A21.11. Use bronze alloy or corrosion-protected steel for balls and fittings.

2.16 STRUCTURES

A. Conform water main structure materials to the details on the plans and the requirements listed below:

1. Use concrete brick conforming to ASTM C55, Grade S-II, solid units of nominal 3 inch thickness.

2. Use concrete block conforming to ASTM C139 shape, scored as detailed and approved.

3. Ensure precast concrete structures conform to ASTM C478/C478M, circular with circular reinforcement as detailed. Include lifting holes in precast units where indicated.

2.17 MANHOLE STEPS

A. Use cast iron manhole steps conforming to ASTM A48/A48M, Class 30, with a minimum cross-section dimension of 1 inch (25 mm) in any direction.

B. Use steel-reinforced plastic manhole steps made of suitably approved co-polymer polypropylene, conforming to ASTM D4101, PP0344B33534Z02. Reinforcement must include a minimum diameter of 1/2 inch deformed reinforcing bar, conforming to ASTM A615/A615M, Grade 60.

C. Make manhole steps of the types and sizes indicated on the Plans. Ensure compliance with applicable state and federal occupational and safety standards.

2.18 COVERS AND FRAMES

A. Make structure frame and covers of the types and sizes detailed on the Plans. Use ASTM A48/A48M, Class 30, gray iron castings for the covers. Ensure castings are neatly made, free from cracks, cold sheets, holes, and other defects. Grind casting surfaces to assure proper fit and prevent rocking. Make units frost-proof and provide tapping screws and anchors where indicated on the Plans.

2.19 BOLTS, STUDS, AND NUTS

A. Use bolts, studs, and nuts as specified on the Plans. Conform to the requirements of AWWA C111/A21.11 and the ASTM standards listed below:

1. Bronze ASTM B98/B98M

2. Steel ASTM A307, Grade B

3. Cadmium Plating ASTM B766, Grade NS

4. Zinc Coating ASTM A153/A153M or ASTM B633, Type GS

B. Make tee head bolts and nuts of high strength, low alloy steel conforming to AWWA C111/A21.11. Apply a ceramic-filled, baked-on fluorocarbon resin coating.

2.20 CONCRETE

A. Conform concrete to MDOT Section 1004 . Use 3,000 psi strength; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without Engineer's approval.

2.21 FLOWABLE FILL

A. Flowable Fill for filling abandoned Water Mains.

1. Materials:

a. Cement: Conform cement to ASTM C150/C150M or ASTM C595/C595M.

b. Fly Ash: Ensure fly ash has a maximum loss on ignition of 12 percent and meets the other requirements of ASTM C618 (Class F).

c. Meet water requirements of ASTM C94/C94M.

2. Mixture Strength: (50 to 100 psi

a. Fly ASh: 2,000 lbs/cyd minimum

b. Cement: 100 lbs/cyd minimum

c. Sufficient water to produce the desired flowability (approximately 700 lbs/cyd)

B. Ensure the temperature of the flowable fill mixture as manufactured and delivered is at least 50 degrees Fahrenheit.

C. The flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.

D. Submit a history of the mix design for seven (7) day and 28 day strengths, along with any other technical information. Include the design mix as part of the submittals for the project.

2.22 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. Copper cladding to measure 3% minimum of the overall wire diameter. Wire to be 12 AWG, 0.0808 inch diameter, 0.0024 inch nominal copper thickness, 9.5270 ohms nominal resistance per 1,000 feet, 675 pounds breaking strength. Wire to be Copperweld ® or equal.

2.23 ACCEPTABLE MANUFACTURERS

A. Flexible Joint Pipe:

1. Acceptable manufacturers include: "F141," Clow, "Usiflex," U.S. Pipe, or equal.

B. Restrained Joints:

1. 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”; Ebaa Iron “Megalug” or Engineer approved equal.

2. Acceptable manufacturers for restrained joints for PVC pipe include: Ebaa Iron, “Megalug” or Engineer approved equal.

C. Valve Boxes:

1. Acceptable manufacturers include: "A-295 Three Piece Screw Type," Traverse City Iron Works; "F2450," Clow, "Series 6860, Tyler," or Engineer approved equal.

D. Corporation Stops:

1. Acceptable manufacturers include: Hays; Crane; Mueller; Ford; or Engineer approved equal.

E. Service Saddles:

1. Acceptable manufacturers include: "Twin Seal," Clow, "Hays Seal," Hays, "Service Saddles," Mueller, or Engineer approved equal.

F. Curb Stops

1. 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. Ascertain that all excavation bottoms, compacted subgrades and pipe bedding are adequate to receive water main materials to be installed. Correct all defects and deficiencies before proceeding with the work.

B. Expose the existing water main piping and structures to which the new work connects and notify the Engineer. The Engineer will verify the vertical and horizontal locations of the existing system and inform the Contractor of any necessary adjustments to align the new water main work with the existing system.

3.02 PREPARATION

A. Remove all lumps, blisters, and excess coatings from the socket and plain ends of the pipe. Wire brush and wipe clean the outside surfaces of all plain ends and the inside surfaces of all socket ends before installation. Scrub any pipe or fitting with heavily chlorinated water if it has acquired a coating of mud or other foreign material.

B. Examine pipe fittings, valves, hydrants, accessories, and appurtenances carefully for damage and other defects immediately before installation. Reject and remove defective or damaged materials from the Project.

3.03 INSTALLATION - GENERAL

A. Prevent foreign matter from entering the pipe while placing it in the trench. During and after laying operations, do not place debris, clothing, or other materials in the pipe.

B. Carry watertight plugs along during the progress of all water main Work and insert them in the end of each pipe as it is laid to prevent foreign matter or rodents from entering. Fasten the watertight plug securely in the end of the water main to prevent it from floating or being displaced whenever construction operations are temporarily halted, such as at noon or at the end of the day's Work.

C. Ensure each section of pipe, when placed to grade and line, has firm bearing on the trench bedding throughout its length between bell holes.

D. Cut pipe with approved tools and methods suitable for the pipe material. Employ pipe cutting methods that produce a smooth, square-cut end without damaging the pipe and minimize airborne particles. Follow the manufacturer's recommendations for the type of pipe material being cut and adhere to best trade practices.

E. Take care when cutting pipe or fittings to prevent damage to linings and coatings. Reject any section with damaged linings. Correct damage to exterior coatings to meet original Specifications.

F. Where pipe using a resilient gasket to effect the seal is cut, taper the cut pipe end at a 30-degree angle to the centerline of the pipe and grind the outside end smooth to remove any sharp edges or burrs that could damage the gasket.

G. Lay pipe with bell ends facing in the direction of laying, unless otherwise specified. After placing a length of pipe in the trench, center the spigot in the bell end of the adjacent pipe section, shove the pipe into position, align it, and secure it with sand tamped under and on both sides of the pipe, except at bell holes. Provide adequate support for all water main pipe.

H. Install the pipe bedding material after excavating the trench bottom, in accordance with Section 31 23 33. Install the pipe strictly following the manufacturer's recommendations. Continue the bedding above the pipe as specified in Section 31 23 33 after laying the pipe. Take particular care to fill and tamp all spaces under, around, and above the top of the pipe.

I. Provide a continuous and uniform bedding in the trench for all buried pipe, as specified in Section 31 23 33.

J. Backfill according to the Plans and as specified in Section 31 23 33.

K. Install bolts, studs, and nuts of the specified type following the manufacturer's installation and torquing requirements. Paint steel bolts, studs, and nuts with bituminous paint after installation.

3.04 INSTALLATION OF DUCTILE IRON PIPE

A. Install ductile iron water main in accordance with the most current version of AWWA C600.

B. Make push-on joints using a compression-type push-on resilient gasket. Prelubricate the gasket before installation with a lubricant recommended by the pipe manufacturer. Identify seated joints by the visible mark on the spigot of the installed pipe section.

C. Make mechanical joints with bolts, a molded resilient gasket, and a cast iron follower gland. Screw the nuts up finger tight before using a wrench. Bring the gland and rubber gasket up evenly at all points around the bell flange, then torque according to the manufacturer's recommendations.

D. Cover exposed portions of bolts with mastic.

E. Assemble, handle, and install flexible joint pipe in accordance with the printed recommendations provided by the manufacturer of the piping materials. Ensure handling and installation methods are acceptable to the Engineer.

3.05 INSTALLATION OF CONCRETE PIPE

A. Joint pipe and fittings using a resilient gasket and steel spigot ring. Lubricate the resilient gasket and install it to form a watertight joint between the bell and spigot of the pipe.

B. Lay pipe in accordance with the accepted tabulated laying schedule and the Plans. Install short lengths of pipe 10 feet as specified in part 1 of this Section and evenly distribute them along the line of the Work, if required.

C. Clean and properly lubricate the bell of the pipe in place, then install the pipe section. After the spigot is fully entered into the bell and the gasket is fully compressed and shaped, check each gasket for proper position around the full circumference of the joint before driving the pipe home and completing the installation.

D. Provide cloth bands wired around each joint's outside diameter and grout with Portland cement mortar grout. Completely fill the annular recess between the adjoining bell and spigot pipe ends. Fill annular spaces between pipe ends on the inside of joints for pipes 24 inches or more in diameter with Portland cement mortar grout.

3.06 INSTALLATION OF POLYVINYL CHLORIDE PIPE

A. Lay polyvinyl chloride pipe with gasketed joints in complete accordance with AWWA C605 and the pipe manufacturer's published instructions. Lubricate the joints sufficiently using the pipe manufacturer's recommended lubricant.

B. Insert gaskets for pipe joints with the painted edge facing the end of the bell. Push each length of pipe home individually. Position the pipe so the reference mark on the spigot end aligns with the bell end.

C. Install tracer wire along with PVC water mains. Ensure the tracer wire is continuous from end to end and terminates at each structure with enough length for easy connection to utility tracing equipment. Test the wire for continuity after installation. Replace any wire that fails the continuity test.

3.07 INSTALLATION OF RESTRAINED JOINTS

A. Provide restrained joints where indicated on the plans. Assemble joints in strict accordance with the manufacturer’s directions. Fully extend joints after assembly.

3.08 FITTINGS, STRAPPING, AND LUGGED PIPE

A. Install all fittings to the lines, levels and locations indicated on the Plans.

1. Construct thrust blocks as indicated on the plans or as required by the Engineer.

2. Provide fittings with restraints as specified herein, as indicated on the Plans, or as required for a functional installation.

B. Secure bends in water main piping and piping runs subject to impact reaction by means of metal strapping where indicated on the Plans or as determined by the Engineer. Install all

necessary bands, tie rods, nuts, and washers. Avoid using metal strapping 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.

3.09 POLYETHYLENE ENCASEMENT

A. Encase ductile iron water main, fittings, and hydrants in a polyethylene film tube where called for on the plans.

B. Install the polyethylene film tube in accordance with 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.

2. Make service taps, bends, tees, and other connections to polyethylene encased pipe in accordance with Section 4.4.6 of AWWA C105/A21.5.

C. Make the cost of the polyethylene encasement incidental to the water main.

3.10 VALVES

A. Install valves to the grade, lines, levels, and locations indicated on the Plans.

B. Make valve connections as specified for the piping materials used. Set valves with the stem plumb on permanent, firm foundations as indicated on the Plans.

C. Support valves with special supports where required, as indicated on the Plans and approved by the Engineer. Install valves so they do not receive support from the connecting pipe.

D. Do not use valve installation to bring misaligned pipe into alignment.

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. Complete structures with concrete bases, reinforcing, frames, covers, adjustment rings, and any other components required for a complete installation.

B. Construct water main structures to the type of construction and dimensions indicated on the Plans and as described below.

1. Block Structures:

a. Construct concrete block structures in the locations and according to the details on the Plans. Place the first course of concrete blocks on the prepared base or footings in a full bed of mortar.

b. Make mortar joints full and close in all courses. Ensure joints are uniform in thickness throughout the structures. Strike all joints and properly point to provide true, smooth surfaces.

c. Ensure courses are level throughout. Stagger joints in adjoining courses by one-half the length of the block, as nearly as practicable.

2. Precast Concrete Structures

a. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth.

b. Provide two (2) to four (4) courses of 8 inch brick at top of structure for future adjustment.

C. Apply a cement mortar plaster coat to the exterior surfaces of all brick or block gate wells and other water main structures indicated on the Plans. The plaster coat must be 1/2 inch thick and applied to the outer surfaces of the structures.

D. Provide and install cast iron covers, frames, adjusting rings, anchors, and other components to the elevations shown on the Plans and as required. Set castings in a full bed of cement mortar, 1/2 inch thick minimum. Strike mortar joints smooth.

E. Install steps for structures of the types and in the locations indicated on the Plans. Install steps on 16 inch centers, unless shown otherwise on the Plans.

F. Place pipe in structures for inlet or outlet connections so it extends through the walls and beyond the outside wall surfaces a sufficient distance to allow complete connections. Seal openings between pipes and walls with a full bed of cement mortar. Support pipe with concrete supports.

3.12 VALVE BOXES

A. Install valve boxes to the grade, lines, levels, and locations indicated on the Plans. Ensure valve boxes do not transmit shock or stress to the valve, and set them plumb with covers centered over operating nuts and flush with the indicated surface elevations. Uncover and reset any valve boxes that shift or fill during backfilling.

3.13 HYDRANTS

A. Install all hydrants plumb to the lines, levels, grades, and locations indicated on the Plans. Set hydrants to the established grade, ensuring their nozzles are parallel to or at right angles to, and facing the grade or curb.

B. Plug hydrant drain/weep holes.

C. Install additional pipe between the water main and road box where necessary to adjust for proper hydrant location. Install hydrant and valve extensions to adjust the hydrant to the proper grade.

D. Plumb all hydrants at the time they are set using a plumb line or other means acceptable to the Engineer.

E. Recheck all hydrants for plumb and grade upon substantial completion of cleanup. Make all necessary adjustments at this time. Consider the work of constructing fire hydrants complete only after these final adjustments for plumb and grade have been made.

3.14 FIRE HYDRANT APPROACHES

A. Construct fire hydrant approaches using culvert pipe with end protection and a gravel approach.

B. Use culvert pipe of the size and type shown on the Plans. Install the culvert pipe to match the existing or proposed grade of the drain or ditch with pipe bedding and backfill from a point below the pipe to a point 12 inches above the top of the pipe.

1. Use bank run sand meeting the requirements of MDOT Class II granular materials for pipe bedding and compact it to 95% of maximum unit weight.

C. Protect each end of the culvert pipe against erosion, as shown on the Plans.

D. Extend the gravel approach from the edge of the traveled portion of the road to the fire hydrant for a minimum of 10 feet.

1. Construct the gravel approach with a minimum of 6 inches of compacted MDOT 22A or 23A aggregate aggregate.

3.15 AIR RELEASE ASSEMBLY

A. Provide all materials and construct air release assemblies as indicated on the Plans. Install all valves, fittings, caps, plugs, and piping as required. Use fittings and joint materials for air release assemblies as specified for the water main piping materials used.

3.16 BLOW-OFF ASSEMBLY

A. Provide all materials and construct blow-off assemblies as indicated on the Plans. Install blow-off assemblies and pipe to the lines, levels, and elevations shown.

B. Install all valves, fittings, reducers, piping, plugs, joints, etc., as detailed. Install blow-off assemblies on stable, undisturbed earth materials. Provide changes in directions and returns with bedding and restraints as indicated on the Plans, as specified herein, and as required for a complete installation.

C. Include valve boxes in blow-off assemblies as detailed.

3.17 TAPPING VALVE ASSEMBLY

A. Install all tapping valve assemblies of sizes and to the lines, elevations, locations and details indicated on the Plans.

B. Assemble the tapping sleeve around the main and perform the tapping in strict accordance with the manufacturer's recommendations.

C. Accomplish tapping without interrupting service.

3.18 ANCHORS, ENCASEMENTS, AND RESTRAINTS

A. Provide plugs, tees, sleeves, bends, caps, straps, and lug piping with suitable anchors, encasements, and restraints as indicated on the Plans. Follow detailed anchoring, encasement, and restraint methods. Use all bearings as shown.

B. Rest anchors, encasements, and restraints on firm, stable, compacted subgrade. Provide them for all standard and special fittings.

3.19 WATER SERVICE LINES

A. Provide water service lines in accordance with this Section when indicated in the Proposal or on the Plans. Otherwise, water service lines are not required.

B. Install water service lines after successfully testing and putting the water main into service, including installing fire hydrants. Use service lines of the type indicated on the Plans and with a minimum size of 3/4 inch or as otherwise indicated on the Plans or Proposal.

C. Provide water service lines for all lots or parcels at locations indicated on the Plans, within these Contract Documents, or as designated by the Engineer. Extend service lines from the water main to within 1 foot of the limits of a right-of-way or easement at a minimum 5 foot depth, terminating with a curb stop and curb box as specified herein.

D. Install water service lines under concrete or asphalt pavements by boring or tunneling, unless otherwise indicated on the Plans or approved by the Engineer.

E. Backfill open cut construction for water services in accordance with Section 31 23 33, after laying the service line, including curb stop, and obtaining approval from the Engineer. Request inspection and obtain approval of the service line from the Engineer prior to backfilling.

F. Alternative methods such as hydraulic jacking; air jetting; piston mole; etc, may be used to install water service lines if approved by the Engineer. The proposed method must be approved by the governmental agency having jurisdiction over the work area and the Contractor must demonstrate that, in the opinion of the Engineer, the method is suitable for local soil and ground conditions.

   1. 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.

   2. Do not permit water jetting.

   3. Complete final installation of the service pipe in accordance with the manufacturer's recommendations. Do not allow joints or fittings under roadway surfaces.

G. Keep existing water mains in service until connecting all water services to the new mains. Repair all water services damaged during the installation of the new water mains. Make service connections to the new mains only after testing, accepting, and putting the new mains into service.

H. Reconnection of Water Services

   1. Make the connection of existing service lines to the new mains within the street rights-of-way or within the easements, utilizing the existing curb stops.

   2. Abandon existing lead water service lines and install new water service lines from the new water main to the water meter.

I. Follow this Section's specifications for backfill, method of construction under pavements, and new water service lines.

3.20 CORPORATION STOPS

A. Locate corporation stops on water main piping where indicated on the Plans or as determined by the Engineer.

B. Make corporation stops on PVC water mains with full circle service saddles.

C. Install a minimum of two (2) corporation stops in each valve well.

D. Install one 1 inch tapping outlet at approximately 20 foot intervals along the entire length of the concrete water main.

1. Construct these tapping outlets as detailed on the Plans and position them 45 degrees off vertical.

2. Mark the location of tapping outlets with a No 4 reinforcing rod. Place the rod in a vertical position immediately adjacent to, but not touching, the water main, with the top 6 inches below finished grade.

3.21 SERVICE SADDLES

A. Remove all loose material from the entire circumference of the main where installing service saddles. Install the saddle and tap the main in accordance with the manufacturer's recommendations.

3.22 CURB STOPS

A. Install curb stops of the types and sizes indicated on the Plans. Furnish and install a curb box with each curb stop.

3.23 ABANDONING WATER MAIN

A. Install cap with a minimum 2 inch diameter threaded opening at one end of water main to be abandoned and solid cap at opposite end.

B. Install a minimum 2 inch diameter stand pipe no farther than 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 diameter drain pipe in the threaded opening at the opposite end of the water main from the stand pipe. Bend the drain pipe up to a 90-degree angle, with the end of the pipe a minimum of 6 inches above the top of the water main.

D. Use the stand pipe to fill the water main to be abandoned with flowable fill material. Place the material in the water main until free water flows from the drain pipe at the opposite end.

E. 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.

F. Remove the stand pipe and cap the filling hole.

3.24 RELOCATE WATER MAIN

A. Relocate water main by removing and relaying the existing water main to avoid an existing or proposed utility. Remove and dispose of existing pipe. Install bends and vertical anchors as shown on the Plans. Ensure vertical anchors and thrust blocks resist thrust forces sufficiently.

3.25 ABANDON EXISTING GATE VALVE AND WELL

A. Abandon gate valve wells and other water main structures on the existing water main in accordance with the following:

1. Remove and salvage the existing frame and cover during the abandonment of existing structures. Open the valve. Break down masonry to an elevation at least 3 feet below the subgrade.

2. Backfill the abandoned structure with flowable fill to 1 foot above the pipes and fill the remainder of the structure with a sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1 foot below finished grade.

3.26 REMOVE GATE VALVE AND WELL

A. Remove gate valve wells and other water main structures on the existing water main in accordance with the following:

1. Remove and salvage the existing frame, cover, and valve during the removal of existing structures.

2. Plug and brace the ends of the existing water main. Remove and dispose of the complete structure entirely.

3. Backfill the excavation with sand and compact it to 95 percent of its maximum unit weight.

3.27 REMOVE EXISTING FIRE HYDRANTS

A. Excavate and remove existing fire hydrants, gate valves, and valve boxes on the existing water main.

1. Cap and block the existing hydrant lead.

2. Salvage the fire hydrant, valve, and box, and deliver them to the location designated by the Owner.

3. Backfill the excavation with sand and compact it to 95 percent of its maximum unit weight.

3.28 RELOCATION OF FIRE HYDRANTS

A. Include new hydrant shoes, frost jackets, and restraints in the relocation of hydrants. Provide all new materials required for hydrant relocation.

1. Reinstall hydrants at the new locations to the lines and levels shown.

2. Make all joint connections to new or existing water mains, joints, couplings, etc., as shown and as required.

3. Provide all anchorage and restraint for a complete installation.

3.29 HYDROSTATIC TESTING

A. General:

1. Hydrostatically test the pipe for leakage after laying and backfilling.

2. Hold a meeting with the Engineer, Contractor, affected subcontractors, and Owner prior to testing mains, valves, hydrants, and appurtenances.

3. Notify the Engineer in writing at least 48 hours prior to hydrostatic testing of mains, valves, hydrants, and appurtenances.

4. Furnish the pump, pipe connection, hydrants, valves, any other necessary apparatus including gauges and meters, and all personnel necessary for conducting the test.
5. Expel all air from the pipe before applying the test pressure. Make taps at points of higher elevation if necessary, then plug them afterward.
6. Have the Engineer witness and accept the hydrostatic testing.
7. Test sections will normally not exceed 1 mile and in the event more than one 1 mile 1) mile (1.6 km) of water main is tested, the permissible leakage will remain at the amount determined for one (1) mile (1.6 km) of pipe.
8. Conform hydrostatic testing to AWWA C600.

B. Testing Ductile Iron Water Main

1. Make the test at a minimum pressure of 150 psi gauge. Hold the full pressure for at least two (2) hours.
2. Replace any faulty pipe fittings, gate valves, or other accessories that permit leaks during testing with sound material. Repeat the test until meeting specified requirements.
3. Limit maximum permissible leakage measured by water meter from the tested main section to 10.49 U.S. gallons per inch diameter of main per mile of pipe in 24 hours (1.079 liters per millimeter diameter of main per kilometer of pipe per 24 hours).

C. Testing PVC Water Main

1. Make the test at a minimum pressure of 150 psi gauge. Hold the full pressure for at least two (2) hours.
2. Replace any faulty pipe fittings, gate valves, or other accessories permitting leaks during testing with sound material. Repeat the test until meeting specified requirements.
3. Limit maximum permissible leakage measured by water meter from the tested main section to 10.5 U.S. gallons per inch diameter of main per mile of pipe in 24 hours (0.971 liters per millimeter diameter of main per kilometer of pipe per 24 hours).

3.30 FLUSHING

A. After completion of water main installation , flush the new mains, valves, hydrants and appurtenances completely.

1. Complete flushing prior to hydrostatic pressure testing and chlorination.
2. Notify the Engineer in writing at least 24 hours prior to flushing mains, valves, hydrants, and appurtenances.
3. Have the Engineer witness and accept the flushing.

B. Control heavily chlorinated water discharged from a disinfected system adequately to protect any surface water resource or adjacent property from potential environmental damage or 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 system approval, pump down all fire hydrants and verify that the hydrant valve seats properly to prevent the hydrant standpipe from filling with water.

3.31 DISINFECTION

A. Disinfect the water main before making any connections to existing water mains. After satisfactory hydrostatic testing and flushing of the new water main, disinfect the complete system in accordance with AWWA C651 by introducing a chlorine-water solution throughout the water main piping.

B. Apply the liquid mixture using a solution-feed chlorinating device. Install a corporation stop and feed the chlorine solution through the corporation stop at the beginning of the main or valved section.

C. Let a slow flow of water into the main at the point of chlorine solution injection, maintaining a rate to achieve at least 25 parts per million (ppm) chlorine dosage in the entering water. Maintain an open discharge at the far end of the section being chlorinated, and continue introducing chlorine solution and water until the water discharging at the far end carries the required chlorine dosage.

D. Open each outlet from the main as it fills with chlorinated water and draw off sufficient water to ensure the full dosage of chlorine reaches each outlet.

E. Prevent back pressure that could cause a reversal of flow in the main being chlorinated. Maintain pressure in the main at a level that prevents chlorinated water from entering other sections of the main or water system.

F. Keep the chlorine-treated water in the main for at least 24 hours. At the end of that time, ensure the chlorine residual at pipe extremities and other representative points is at least 10 ppm. If the chlorine residual is less than 10 ppm, apply additional chlorine and repeat the retention period until the required 10 ppm residual is obtained.

G. Repeat the chlorination procedure for all or any section of the mains if, in the opinion of the Engineer, the initial treatment proves ineffective. Continue until confirmed tests show that water sampled from the new mains meets the specified requirements.

H. Collect water samples and perform analyses at Contractor’s own expense.

I. Ensure the testing laboratory and sample collection meet the approval of the public health authorities having jurisdiction.

3.32 WATER FOR CLEANING, TESTING AND DISINFECTION

A. Obtain water for cleaning, testing, and disinfection from a potable water supply.

B. Provide all required water at Contractor’s own expense and make necessary arrangements with the authority controlling the water source. Follow all rules and regulations imposed by that authority regarding water use.

C. Provide and remove temporary connections between the source water system and mains constructed under this contract. Ensure temporary connections meet approval of the Engineer, the authority controlling the source water system, and public health authorities having jurisdiction.

3.33 BACTERIOLOGICAL ANALYSIS

A. Collect not less than two (2) consecutive water samples, taken 24 hours apart, for bacteriological analysis prior to placing a water main in service. Ensure each analysis shows results meeting state and local drinking water standards.

B. Collect water samples and perform analyses at Contractor's own expense.

C. Collect samples in accordance with AWWA C651.

D. Ensure testing laboratory and sample collection meet approval of the public agency having jurisdiction.

3.34 CLEANING (PIGGING)

A. Mechanically clean all water mains when required in the plans or specifications. Use a metal-bodied, mandrel-type solid plug (pig) with scrapers. Pull or otherwise propel the pig through the entire line prior to testing or connecting to any existing water main.

END OF SECTION

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SECTION 33 31 10
HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish labor, materials, equipment, and incidentals required to install High Density Polyethylene (HDPE) pressure pipe, fittings, and appurtenances as shown on the Drawings and specified in the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 01 89 33 - Temporary Bypass Pumping

C. Section 33 05 07 - Utility Horizontal Directional Boring

D. Section 33 14 00 - Water Utility Distribution Piping

E. Section 33 31 00 - Sanitary Sewerage Piping

F. Section 33 31 10.15 - Leakage Testing for HDPE Pipe

1.03 REFERENCE STANDARDS

A. Ensure Work conforms to applicable provisions of the Contract Documents and to the latest edition of the following standards, except as modified in this Section.

1. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 63 inch, for Water Distribution
2. AWWA M17 - Fire Hydrants: Installation, Field Testing, and Maintenance
3. AWWA M55 - PE Pipe Design and Installation
4. AWWA C651 - Disinfecting Water Mains
5. ASTM D2321 - ASTM D1248 - Standard Specifications for Polyethylene Plastics Molding and Extrusion Materials
6. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping
7. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
8. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
9. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
10. ASTM D3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Materials

11. ASTM E3261 - Standard Specification for Butt Heat Fusion Polyethylene Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings Materials
12. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
13. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
14. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
15. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
16. NSF/ANSI 14 - Certification of Plastic Piping Products
17. NSF 61 - Drinking Water System Components - Health Effects

1.04 SUBMITTALS

A. Detailed Plans and Shop Drawings:

1. Make submittals in accordance with Section 01 33 00 and include:
    a. A list of materials to be furnished, the names of the suppliers, and the appropriate shop drawings for HDPE pipe and fittings;
    b. Pipe manufacturer's certification of compliance with the applicable sections of the Specifications; and
    c. Shop drawings showing installation method and the proposed method and specialized equipment to be used.
2. Permits and Inspection Records:
    a. Prior to beginning any horizontal directional drilling operations, submit copies of all permits and inspection records obtained from state and local authorities having jurisdiction.
3. Record Drawings:
    a. Submit as-built records, in duplicate, within five (5) days of Substantial Completion.
    b. Include plan, profile, and information recorded during the progress of the Work, including subsurface anomalies, in as-built records.

1.05 QUALITY ASSURANCE

A. Qualification of Manufacturer:

1. Furnish HDPE pipe, fittings, and appurtenances from a single manufacturer fully experienced, reputable, and qualified in manufacturing the specified items.
2. Use a manufacturer with manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications.

B. Requirements of Regulatory Agencies:

1. Federal, State, and Local Regulations: Conform to the requirements of federal, state, and local regulatory agencies having jurisdiction.

1.06 DELIVERY, STORAGE AND HANDLING

A. The manufacturer must package product to deliver the pipe and fittings to the project neatly, intact, and without physical damage. During transportation, rest each pipe on suitable pads, strips, skids, or blocks securely wedged or tied in place.

B. Take every precaution during loading, transportation, and unloading to prevent damage to the pipe. Handle the pipeline to avoid dragging it over sharp or cutting objects. Cut out and discard any sections with cuts or gouges that reduce wall thickness by more than 10%.

C. Handle the pipe in accordance with AWWA M55. Load and unload pipe and accessories by lifting with hoists or by skidding to avoid shock or damage. Do not drop materials under any circumstances. Avoid rolling or skidding pipe against other pipe on the ground when using skidways. Pad slings, hooks, or pipe tongs and use them to prevent damage to the pipe's exterior surface or interior. Visually inspect all pipe and fittings at delivery and before lowering into the trench for installation.

D. Store materials safely to prevent damage and do not stack higher than manufacturer-recommended limits. Keep bottom tiers off the ground on timbers, rails, or concrete. Avoid storing pipe close to heat sources. Contractor will be responsible for security, damage and loss of pipe.

E. Keep the interior of the pipe and all sealing surfaces of mating components (e.g., flange faces) free from dirt or foreign matter at all times. Plug the open ends of all sections of joined or installed pipe (not in service) to prevent insects, animals, or foreign material from entering the pipeline or pipe section. Do not stuff cloth or paper into the open ends of the pipe. Use waterproof nightcaps to prevent natural precipitation from entering the carrier or containment pipe and secure them so the wind cannot blow them loose. Where possible, raise and support the pipe at a suitable distance from the open end so the open end remains below the level of the pipe at the support point.

1.07 PERMITS AND INSPECTIONS

1. Where applicable, obtain and pay for permits and inspections for horizontal directional drilling operations as required by PA 451, State of Michigan, 1994, and government and private agencies having jurisdiction.

2. Allow no additional compensation due to failure to obtain and pay for such permits and inspections.

3. Be aware of and conform to Owner-obtained permits.

1.08 WARRANTY AND ACCEPTANCE

A. Warrant Work to be free from defects in workmanship and materials for one year from the date of construction completion. If Work meets these specifications, issue a letter of acceptance, subject to the one-year warranty period, at completion.

B. Issue a final acceptance letter upon final inspection at the end of the one-year warranty period, provided the work still complies with these specifications.

C. Correct any deficiencies discovered during the warranty period without additional charge to the Owner before final acceptance.

D. Have the Engineer determine whether warranty repairs or replacement work must be performed by the Contractor during the warranty period.

PART 2 PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

A. Fabrication:

1. Use PE4710 high density polyethylene pipe and fittings meeting cell classification 345434E/C per ASTM D3350.

2. Manufacture pipe and fittings in accordance with ASTM F714 or ASTM D3035. Mark piping to indicate either SDR-PR or DR-PR.

3. Use pipes and fittings suitable for pressure conduits and listed as NSF 14 and NSF 61.

4. Pipe and fittings will have a nominal burst strength of three times the Working Pressure Rating or Pressure Class of the pipe per AWWA C906.

B. Pipe Identification:

1. Indent print the following continuously on the pipe or space it at intervals not exceeding 5 feet:

a. Name and/or trademark of the pipe manufacturer

b. Nominal pipe size

c. Dimension ratio

d. The letters “PE” followed by the polyethylene grade in accordance with ASTM D1248 followed by the hydrostatic design basis in pounds per square inch (psi).

e. Identify service by co-extruding multiple equally spaced color stripes into the pipe’s outside surface or by using a solid-colored pipe shell. Use striping material of the same material as the pipe except for color. Use the following colors to identify piping service:

1) Blue: Potable Water

2) Green: Wastewater or Force Main

3) Black: Raw Water

C. Fittings:

1. General:

a. Fully pressure rate molded and fabricated fittings to match the pipe SDR pressure rating to which they are made. Mold or fabricate fittings by the manufacturer. Do not permit Contractor-fabricated fittings unless approved by the Engineer.

b. Manufacturer of the HDPE pipe must supply HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

c. Install fittings using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters approved by the Engineer.

d. Make transitions from HDPE pipe to ductile iron or PVC per Engineer approval and HDPE pipe manufacturer's recommendations and specifications.

e. Use a molded flange connector adapter within a carbon steel back-up ring assembly for pipe type transitions. Mate ductile iron back-up rings with cast iron flanges per ASME B16.1. Mate a 316 stainless steel back-up ring with a 316 stainless steel flange per ASME B16.1.

1) Obtain Engineer approval before installing transitions from HDPE to ductile iron fittings and valves.

2) Do not allow solid sleeves between such material transitions.

2. Polyethylene Fittings and Custom Fabrications:

a. Mold or fabricate polyethylene fittings and custom fabrications by the pipe manufacturer.

b. Make butt fusion outlets to match the outside diameter, wall thickness, and tolerances of the mating pipe.

c. Fully rate fittings and custom fabrications for the same internal pressure as the mating pipe. Prohibit pressure de-rated fabricated fittings.

3. Molded Fittings:

a. Manufacture molded fittings in accordance with ASTM D3261 and mark them accordingly.

b. Subject each production lot of molded fittings to the tests required under ASTM D3261.

4. Fabricated Fittings:

a. Make fabricated fittings by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings.

b. Rate fabricated fittings for internal pressure service equivalent to the full service pressure rating of the mating pipe.

c. Provide directional fittings 16 inches IPS and larger, such as elbows, tees, crosses, etc., with a plain end inlet for butt fusion and flanged directional outlets.

d. Submit part drawings for Engineer approval.

5. Polyethylene Flange Adapters:

a. Make flange adapters with sufficient through-bore length to clamp in a butt fusion joining machine without using a stub-end holder.

b. Machine the sealing surface of the flange adapter with a series of small v-shaped grooves to provide gasketless sealing or to restrain the gasket against blow-out.

6. Back-up Rings and Flange Bolts:

a. Fit flange adapters with lap joint flanges pressure rated equal to or greater than the mating pipe.

b. Chamfer or radius the lap joint flange bore to provide clearance to the flange adapter radius.

c. Use Grade 2 or higher flange bolts and nuts.

2.02 TRACER WIRE

A. Install two strands of copper clad steel wire with 30 mil high density polyethylene insulation.

B. Metallurgically bond concentric copper cladding to a steel core through a continuous solid cladding process.

C. Copper cladding to measure 3% minimum of the overall wire diameter.

D. Wire to be 12 AWG, 0.0808 inches in diameter, 0.00242 inches nominal copper thickness, 9.5270 ohms nominal resistance per 1,000 feet, 675 pounds breaking strength.

PART 3 EXECUTION

3.01 GENERAL

A. Cut, join, and install HDPE pipe and fittings in accordance with the manufacturer's recommendations. Perform joining, laying, and pulling of polyethylene pipe using personnel experienced in polyethylene pipe systems.

3.02 PREPARATION

A. Layout of the Work:

1. Stake, mark, and layout the Work using suitable stakes and markers to facilitate verification of grades, lines, levels, and locations of the Work to be performed in a manner acceptable to the Engineer.

2. From reference points established by the Engineer on the surface of the ground, carry line and grade down to the bottom of any shafts or boring pits. Perform the Work to the line and grades established; protect such reference points throughout the progress of the Work.

B. Examination of Materials:

1. Prior to performing any installation Work, examine pipe for damage including but not limited to cracks, breaks, bends, dents, broken ends, or other damage which might affect the structural integrity, performance requirements, or jointing as shown on the Plans, specified herein, or as directed by the Engineer.

2. Defective pipe removed from the site and replaced with pipe at the expense of the Contractor.

3.03 HEAT FUSION JOINING

A. General:

1. Make joints between plain end pipes and fittings by butt fusion, and joints between the main and saddle branch fittings using saddle fusion, following only procedures recommended by the pipe and fitting manufacturer. Do not remove external and internal beads.

B. Butt Fusion:

1. Join pipe using the butt fusion procedure outlined in ASTM F2620. Provide a record or certificate of training for the fusion operator documenting training in the fundamentals of ASTM F2620.

2. Considerations should be given to and provisions made for adverse weather conditions, such as temperatures below freezing, precipitation, or wind, which is accepted by the Owner/Engineer.

3. Fusion Operators:

a. The employer of the fusion machine operator is responsible for the fusion joint quality of the fusion weld made by that individual. The employer is responsible for documenting all training and qualification records for that individual, including compliance to any code requirements for fusion/bonder operators.

b. Qualify HDPE fusion equipment operators to the procedure used for pipe joining. Ensure operators have current, formal training on all fusion equipment employed on the project. Do not consider training received more than two years prior, without evidence of activity within the past 6 months, as current.

c. For Projects with at least 5,000 feet or with pipe larger than 24 inches, operators or their supervisor must have a current McElroy Fusion Training Certificate for the equipment to be used on the project

4. Butt Fusion Equipment:

a. Use a hydraulic fusion machine capable of butt fusing HDPE pipe for pipe 6 inches and larger. Ensure the carriage is removable from the chassis for in-ditch use. Use a machine compatible with an electronic data recording device such as the McElroy DataLogger or equal.

b. Accessories will include all butt fusion inserts for the specified range of pipe sizes, a pyrometer kit for checking the surface temperature of the heater, extension cord of appropriate gauge (25' minimum), and hydraulic extension hoses (minimum of four).

c. The butt fusion machine will be McElroy, or approved equivalent.

3.04 MECHANICAL JOINING

A. General:

1. Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections (flange adapters and back-up rings) or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material.

2. Use fully pressure-rated, fully thrust-restrained mechanical couplings such that, when installed per the manufacturer's recommendations, a longitudinal load causes the pipe to yield before the mechanical coupling disjoins.

3. Do not use external joint restraints in place of fully restrained mechanical couplings.

B. Installation:

1. Install mechanical joints and flange connections in accordance with the manufacturer's recommended procedure.

2. Center and align flange faces to each other before assembling and tightening bolts. Do not use flange bolts to draw the flanges into alignment.

3. Lubricate bolt threads and fit flat washers under the flange nuts. Evenly tighten bolts according to the Manufacturer's tightening pattern and torque step recommendations.

4. Retighten flange connections at least one hour after initial assembly, following the Manufacturer's tightening pattern and torque step recommendations. Apply final tightening torque of 100 ft-lbs or less, as recommended by the Manufacturer.

3.05 BRANCH CONNECTIONS

A. Make branch connections to the main using saddle fittings or tees. Saddle fuse polyethylene saddle fittings to the main pipe.

3.06 INSTALLATION

A. General:

1. Install HDPE pipe by direct bury, directional bore, or a method approved by the Owner/Engineer prior to construction.

2. Install in accordance with the Manufacturer's recommendations and this specification. Take necessary precautions to ensure a safe working environment following applicable codes and standards.

B. Direct Bury:

1. Foundation and Bedding:

a. Lay pipe on grade and on a stable foundation in accordance with Section 33 14 00, and/or Section 33 31 00.

2. Install buried HDPE pipe and fittings in accordance with ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Water Supply Practices M55 Chapter 8. Consider the Design Window identified in AWWA M55 Chapter 5 (page 65 of the 2006 version) as acceptable design and installation conditions.

3. Do not place thrust blocks in the HDPE pipe system unless required by the owner’s engineer, since the fused system is fully restrained.

C. Trenchless Installation:

1. See Section 33 05 07 - Utility Horizontal Directional Boring.

D. Appurtenances:

1. Independently support appurtenances (tees, elbows, services, valves, air relief valves, fire hydrants, etc.) and do not rely on the pipeline and its connections for support. Avoid excessive stresses caused by inadequate support of appurtenances.

2. Install and field test Hydrant Assemblies according to the requirements of AWWA M17.

3. Installation of Tracer Wire:

a. When tracer wire is required, Contractor will install along the entire section of pipeline per local and manufacturer's requirements.

b. Install tracer wire once backfill has been placed and compacted to at least 12 inches above the top of the pipe and not more than 18 inches above the top of the pipe.

c. Properly splice tracer wire at each end connection and each service connection. Adequately wrap and protect wire at all splice locations. Do not accept bare tracer wire.

3.07 CLEANING, FLUSHING AND DISINFECTING

A. Cleaning and Flushing: Mains will be cleaned and flushed to remove dirt, sand, debris and foreign matter.

B. Disinfection:

1. Disinfect potable water systems in accordance with AWWA C651 and AWWA AWWA M55.

2. Disinfection chemicals should be limited to less than 12% active chlorine. Chlorine tablets and powders are not permitted.

3. The duration of the disinfection should not exceed 24 hours.

4. Upon completion, the system should be thoroughly flushed with fresh water, and sampled to verify the disinfectant chlorine level has been reduced to potable drinking water concentrations in service water tubing and branch lateral pipes.

3.08 TESTING

A. Butt Fusion Testing:

1. Make the first fusion of the day a trial fusion on days when butt fusions are to be made.

a. Allow the trial fusion to cool completely before cutting out test straps.

2. Make test straps 12 inches minimum or 30 times the wall thickness in length with the fusion in the center, and 1 inch minimum or 1.5 times the wall thickness in width.

3. Bend test straps until the ends of the strap touch. If the fusion fails at the joint, make a new trial fusion, allow it to cool completely, and test again.

a. Do not commence butt fusion of pipe to be installed until a trial fusion has passed the bent strap test.

4. Perform butt fusion joints in the presence of the Engineer or Engineer's representative. Record the temperature and corresponding time for each fusion joint.

B. Hydrostatic Pressure Testing:

1. Pressure test HDPE pipes in accordance with Section 33 31 10.15 - Leakage Testing for HDPE Pipe.

END OF SECTION

SECTION 33 31 10.15
LEAKAGE TESTING FOR HDPE PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Perform testing for signs of leakage in pipelines and structures to ensure watertightness. Furnish labor, equipment, air, water, and other materials, including meters, gauges, smoke producers, blowers, pumps, compressors, fuel, bulkheads, and accessory equipment for complete and proper testing of specified utilities.

1. Test gravity sewers and drain lines by low pressure air testing.

2. Test all other pipelines with water under the specified pressures.

B. The section of the piping to be tested is isolated from other parts of the system and properly restrained in order to prevent failure of both the test section and the existing system connected to the test section. Isolated sections of the test section are vented to the atmosphere in order to ensure compressible gases do not remain within the hydraulic test section. The test section is filled with liquid, raised to the test pressure, and allowed to stabilize. The system is then inspected for leakage and the pressure is relieved. Any required repairs or replacements are then performed while the pipe is depressurized.

C. Allow no leakage, as properly made heat-fusion joints of HDPE do not leak. Correct any defects or leaks revealed, and retest the pipeline after a minimum 24-hour recuperation period between tests. Limit total testing on a section of pipeline to eight hours within a 24-hour period.

D. An expansion allowance is allowed as HDPE will expand slightly due to elasticity and Poisson effects. The amount of make-up water (expansion allowance) will vary because expansion is not linear. This procedure compensates for expansion with an initial expansion phase followed by a testing phase as to which the test pressure is reduced suspending expansion. Expansion or contraction due to Poisson effects may disjoin other non-restrained joints, such as bell and spigot joints, so measures must be taken to fully restrain the test section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 33 14 00 - Water Utility Distribution Piping

C. Section 33 30 00 - Sanitary Utility Sewerage Piping

D. Section 33 31 00 - Sanitary Sewerage Piping

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00:

1. Submit a detailed bound Pre-Testing Report to the Engineer prior to placing the sewer system in service. Include a summary of leakage test data, a description of the test procedure, and the calculations supporting the leakage test data.

2. Post Resting Report: Submit a detailed bound Post Testing Report to the Engineer following leakage testing. Include a summary of leakage test data, including:

a. Length and diameter of section to tested (manhole to manhole);

b. Location of all service laterals and their status (active or inactive);

c. Type of plugs used and where;

d. Depth of pipe, and ground water pressure over pipe;

e. Stabilization time period and air pressure;

f. Actual air test pressures used if ground water is present;

g. The allowed time by specifications versus the actual test time;

3. The air pressure at beginning and end of test;

a. The name of the person performing the testing;

b. Date(s) and time(s) of testing, including any retesting; and,

c. Description of any repairs made following testing.

1.04 REFERENCE STANDARDS

A. ASTM F1417-11A - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

B. ASTM F2164-21 - Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Test new HDPE pipelines for leakage. Ensure the Engineer witnesses the tests.

3.02 FLUSHING

A. Flush mains to remove sand and other foreign matter.

B. Maintain a flushing water velocity of at least 4 feet per second (fps).

C. Terminate flushing at the direction of the Engineer.

D. Dispose of the flushing water without causing a nuisance or property damage.

E. Install temporary flush out connections on all dead-end water mains at the locations shown on the Contract Drawings.

3.03 RESTRAIN AGAINST MOVEMENT

A. Before applying pressure, all piping and all components in the test section must be restrained. This means that if piping or parts move or separate during the test, it will not result in damage or injury. Never conduct leak tests on unrestrained piping.

1. Heat fusion joints must be properly cooled before testing.

2. Mechanical connections must be completely installed and tightened per manufacturer's instructions.

3. If backfill provides restraint, it must be properly placed and compacted. Joints and connections may be exposed for inspection.

4. End closures must be suitable for pressure service and pressure-rated for the test pressure.

5. Ensure that connections to test equipment are secure. Disconnect or isolate all low pressure filling lines and other parts that are not to be subjected to test pressure. Restrain, isolate or remove expansion joints before leak testing.

3.04 TEST SECTION

A. Testing may be conducted on the full system or in sections. Test section length is determined by the capacity of the testing equipment. Lower capacity pressurizing or filling equipment may not be capable of completing the test within permissible time limits. If so, use higher capacity test equipment or select a shorter test section.

B. Before applying test pressure, allow time for the test fluid and the test section to equalize to a common temperature.

3.05 TEST PRESSURE

A. For pressure piping systems that include polyethylene pipe or fittings:

1. The maximum permissible test pressure is measured at the lowest elevation in the test section.

2. The maximum permissible test pressure is the lower of (a) 150% of the system design operating pressure provided that all components in the test section are rated for the test pressure, or (b) the pressure rating of the lowest pressure rated component in the test section.

B. For leak testing purposes, the maximum allowable test pressure in polyethylene pipe is 150% of the pipe's design pressure rating for the application and the application service temperature.

C. Do not subject lower pressure rated, non-polyethylene parts or devices to pressures above their pressure rating. Lower pressure rated parts may be removed or isolated from the test section to avoid damage or failure. Vent isolated parts or equipment to atmosphere.

D. Thermoplastic pipes have reduced strength at elevated temperature. Test pressure must be reduced when the test section is at elevated temperature either from service conditions or from environmental conditions such as being warmed by the sun. Multiply the test pressure by the multiplier shown in the table below to determine the allowable elevated temperature test pressure.

3.06 TEST DURATION

A. When testing at pressures above system design pressure up to 150% of the system design pressure, the maximum test duration is eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section.

1. If the test is not completed due to leakage, equipment failure, or for any other reason, depressurize the test section completely, and allow it to relax for at least eight (8) hours before pressurizing the test section again.

B. Testing at excessive pressure or for excessive time may damage the piping system.

C. When testing at system design pressure or less, test duration including time to pressurize, time for initial expansion, time at test pressure and time to depressurize should be limited to a practical time period given that the test section is not to be left unsupervised at any time during leak testing.

3.07 HYDROSTATIC LEAK TESTING

A. This hydrostatic leak test procedure consists of filling, an initial expansion phase, a test phase, and depressurizing. There are two alternatives for the test phase.

1. Filling:

a. Fill the restrained test section completely with test liquid; ensure that there is no air trapped in the test section. Failure with entrapped air can result in explosive release and result in death or serious bodily injury. Use equipment vents at high points to remove air.

2. Initial Expansion Phase:

a. Gradually pressurize the test section to test pressure, and maintain test pressure for three (3) hours. During the initial expansion phase, polyethylene pipe will expand slightly. Additional test liquid will be required to maintain pressure. It is not necessary to monitor the amount of water added during the initial expansion phase.

3. Test Phase:

a. Immediately following the initial expansion phase, reduce test pressure by 10 psi, and stop adding test liquid.

b. If test pressure remains steady (within 5% of the target value) for one (1) hour, no leakage is indicated.

3.08 LOW PRESSURE AIR TESTING OF GRAVITY FLOW SYSTEMS

A. For gravity flow and low or intermittent pressure applications such as sewer and odor control, leak testing in accordance with ASTM F1417 is recommended.

3.09 OTHER LEAK TESTS

A. Low Pressure Air Testing of Gravity Flow Systems:

1. For gravity flow and low or intermittent pressure applications such as sewer and odor control, leak testing in accordance with ASTM F1417-11A is recommended.

B. Initial Service Leak Testing:

1. An initial service leak test may be acceptable when other types of tests are not practical, or when leak tightness can be demonstrated by normal service, or when an opportunity is afforded by performing initial service tests of other equipment. An initial service leak test may apply to systems where isolation or temporary closures are impractical, or where

checking out pumps and other equipment allows the system to be examined for leakage prior to full-scale operations.

2. The piping system should be gradually brought up to normal operating pressure, and held at normal operating pressure for at least ten (10) minutes. During this time, joints and connections may be examined for leakage.

C. At the conclusion of the test, depressurize the test section by the controlled release of fluid from the test section. Controlled release avoids the potential for pressure surge.

END OF SECTION

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SECTION 33 41 00
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes storm sewer Work indicated on the Plans complete with pipes, joints, structures, pipe bedding, final inspection and appurtenances.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 33 00 - Submittal Procedures

B. Section 31 23 19 - Dewatering

C. Section 31 23 16 - Structural Excavation and Backfill

D. Section 31 23 33 - Trenching and Backfilling

1.03 REFERENCE STANDARDS

A. Conform the Work for this Section, unless otherwise specified, to the applicable portions of the following Standard Specifications:

1. AASHTO M 36: Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
2. AASHTO M 167M/M 167: Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
3. AASHTO M 196: Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
4. AASHTO M 245: Standard Specification for Corrugated Steel Pipe, Polymer- Precoated, for Sewers and Drains
5. AASHTO M 252: Standard Specification for Corrugated Polyethylene Drainage Pipe
6. AASHTO M 274: Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
7. AASHTO M 278: Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
8. AASHTO M 330: Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
9. ASTM A48/A48M: Standard Specification for Gray Iron Castings
10. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
11. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
12. ASTM C12: Standard Practice for Installing Vitrified Clay Pipe Lines

13. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
14. ASTM C55: Standard Specification for Concrete Building Brick
15. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
16. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
17. ASTM C150/C150M: Standard Specification for Portland Cement
18. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
19. ASTM C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
20. ASTM C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
21. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
22. ASTM C507: Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
23. ASTM C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
24. ASTM C877: Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
25. ASTM C990: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
26. ASTM C1433: Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
27. ASTM C1577: Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
28. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
29. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
30. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
31. ASTM F949: Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings

32. ASTM F2881/F2881M: Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
33. American Concrete Pipe Association (ACPA)
34. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.04 SOURCE QUALITY CONTROL

A. Laboratory test not less than one (1) percent, with a minimum of three (3) pieces each size, material and class of gravity pipe required in the Work.

1.05 SUBMITTALS

A. Submit a complete field report of the location of all wye openings and sump pump discharge leads to the Engineer at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.

B. Submit two (2) copies of the laboratory test reports required per Part 1, Source Quality Control, of this Section to the Engineer.

C. Submit complete Shop Drawings for all manhole tees to the Engineer.

D. Submit shop drawings and design information for all precast concrete box sections.

1.06 STORAGE OF MATERIALS

A. Do not stack piping material higher than 4 feet or the manufacturer’s recommended height, whichever is lower. Provide suitable racks, chairs, and other supports to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers, and chock tier ends.

B. Protect jointing and sealing materials used in the storm sewer system from sunlight and store them in as cool and clean a place as practicable until ready for application.

1.07 HANDLING OF MATERIAL

A. Load and unload materials using suitable approved equipment. Prevent materials from being dropped, bumped, or allowed to impact against themselves. Reject damaged material as determined by the Engineer.

B. Use lifting devices suited to the Work and designed to protect surfaces from damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. It is the intent of the Articles in Part 2 of this specification section is to specify in detail the various types of sewer pipe, joints, manholes, etc. which have been indicated throughout the Plans and Specifications. Do not construe these Articles as permitting any alternate type of material other than what is indicated on the Plans or elsewhere in the Specifications.

2.02 CLAY PIPE

A. Use clay pipe conforming to ASTM C700, extra strength vitrified clay pipe.

B. Use premium compression type joints conforming to ASTM C425.

C. When not specified, make joints with cold applied pipe joint sealer. Refer to Part 2 of this Section for requirements for cold applied pipe joint sealer.

2.03 NONREINFORCED CONCRETE PIPE SYSTEMS

A. Use pipe conforming to ASTM C14, Class III nonreinforced concrete sewer pipe.

B. When not specified, make pipe joints with cold applied pipe joint sealer. Refer to Part 2 of this Section for requirements for joints.

2.04 REINFORCED CONCRETE PIPE

A. Use reinforced concrete pipe conforming to ASTM C76. Use pipe sizes 12 to 30 inch diameter as Class II thru V, Wall B or Wall C, circular reinforced. Use pipe sizes 36 to 108 inch diameter as Class I through V, Wall B or Wall C, circular reinforced or elliptical reinforced.

B. Use the following method of indexing the steel and pipe barrel when elliptical reinforcement is used.

1. Set a dummy lift pin form in the outer pipe wall form, projecting into the pipe wall a minimum of 1-3/4 inch and a maximum of . Weld an additional spacer chair to the elliptical steel cage at the proper location to engage the dummy lift pin form during the pipe casting operation.

2. It is the intent of the spacer chair and dummy lift pin arrangement to provide a means of assuring the final position of the elliptical steel cage within the barrel of the pipe and, further, for providing a means of indexing the pipe in the field to assume proper placement of the pipe.

3. Stripe elliptically reinforced pipe along the inside top with a minimum 1 inch wide indelible marker prior to shipment to allow final inspection of pipe orientation after installation.

C. Submit design information for circular pipe 114 inch or larger in diameter to the Engineer for approval prior to fabrication, in accordance with Section 6 of ASTM C76.

D. Design all pipes to meet the d-load requirements for the class of pipe indicated on the Plans.

E. Make pipe joints with cold applied pipe joint sealer when not specified otherwise.

2.05 REINFORCED CONCRETE ELLIPTICAL PIPE

A. Conform reinforced concrete elliptical pipe to ASTM C507.

B. Make pipe joints with cold applied pipe joint sealer when not specified otherwise.

2.06 PRECAST CONCRETE BOX SECTION

A. Ensure precast concrete box sections meet ASTM C1433, ASTM C1577, or ACPA "Boxcar" requirements. Use the same design conditions existing at construction time or planned for future development unless specified otherwise.

2.07 JOINTS FOR CONCRETE OR CLAY PIPE, BOX SECTIONS AND MANHOLES

A. Sealed Joints (Cold Applied Pipe Joint Sealer):

1. Make pipe joints with cold applied pipe joint sealer when not specified otherwise.

2. Conform cold-applied pipe joint sealer to MDOT Section 909.09. Use bituminous material with a consistency that allows spreading on joints with a trowel when the air temperature ranges between 20 and 100 degrees Fahrenheit.

3. Ensure the bituminous material adheres to the pipe to create a watertight seal and does not flow, crack, or become brittle when exposed to the atmosphere.

B. Premium Joints:

1. Conform premium joints for circular pipe to ASTM C443 with the following limitations: Replace Section 5.1 of ASTM C443, "Physical Requirements for Gaskets," with Section 6.9 of ASTM C361, "Rubber Gaskets." Limit Section 5 of ASTM C443 to a modified grooved tongue designed to receive a rubber gasket.

2. Conform premium joints for elliptical pipe to ASTM C877, external sealing bands for non-circular concrete pipe.

a. Ensure the width of the sealing bands is at least equal to twice the depth of the groove. For modified bell tongue and groove pipe, use the next larger gasket.

b. Set the length of the sealing bands equal to the outside circumference of the pipe at its largest diameter plus an amount equal to the width of the gasket to be used.

3. Use only lubricant supplied by the pipe manufacturer on the groove and tongue when making joints. Couple the joints in accordance with the pipe manufacturer's requirements.

C. Preformed Flexible Joint Sealant:

1. Butyl Rubber Sealant complying with ASTM C990.

D. Fill the inside annular space of all concrete pipe 36 inch diameter (or equivalent) and larger with cement mortar and trowel flush. Mix the mortar using 1 part Portland cement and 2 parts plaster sand. Use only enough water for "dry packing" when mixing mortar for inside joints.

2.08 CORRUGATED METAL PIPE

A. Galvanized Corrugated Metal Pipe:

1. Conform corrugated galvanized steel pipe with circular cross section and pipe-arch shape to the requirements of AASHTO M 36 and MDOT Section 909.05.

2. Reroll a minimum of two (2) circumferential corrugations on each end of each section of helical corrugated pipe.

B. Polymeric Coated Corrugated Galvanized Steel Pipe:

1. Conform polymeric coated corrugated galvanized steel pipe with circular cross section and pipe-arch shape to the requirements of AASHTO M245 and MDOT Section 909.05.

2. Ensure the helical corrugated pipe has a minimum of two (2) circumferential corrugations re-rolled on each end of each pipe section.

C. Aluminized Type 2 Corrugated Metal Pipe:

1. Conform Type 2 aluminized corrugated steel pipe with circular cross section and corrugated steel pipe with pipe-arch shape to the requirements of AASHTO M 36, AASHTO M 274, Type 2, and MDOT Section 909.05 specifications.

2. Provide a minimum of two (2) circumferential corrugations re-rolled on each end of each helical corrugated pipe section.

D. Corrugated Aluminum Alloy Pipe:

1. Conform corrugated aluminum alloy pipe with circular cross section and corrugated aluminum alloy pipe with arch-pipe shape to the requirements of AASHTO M196 and MDOT Section 909.05.

E. Joints for Corrugated Metal Pipe:

1. Make joints for corrugated metal pipe using coupling bands. Use coupling bands made of the same material specified for the pipe and prevent infiltration of the side fill material.

a. Corrugate coupling bands to match the pipe's corrugations and include two (2) "O" ring neoprene gaskets for each joint. Do not use dimple bands.

b. Wrap all joints with a 3 foot wide geotextile filter fabric centered on the joint.

2. Use bell and spigot coupling system with rubber gasketed joints when called for in the Contract Documents.

2.09 DUAL WALL CORRUGATED PVC PIPE – SMOOTH INTERIOR

A. Provide pipe as a single extrusion of PVC with smooth interior and corrugated outer walls. Ensure the corrugated outer profile is annular and seamless.

B. Provide pipe and fittings in accordance with ASTM F949. Use bell and spigot type joints with elastomeric gasket meeting ASTM F477 requirements and suitable for storm sewer service.

C. Provide molded wye or tee fittings per ASTM F949, with gasketed joints on each end suitable for direct insertion into the mainline pipe. Use branch connection fittings with gasketed joints suitable for the specified house lead pipe. Do not allow saddle connections.

D. Acceptable manufacturers of Dual wall corrugated pipe include Contech A2000, Uponor ETI Ultra-Corr or Engineer approved equal.

2.10 CORRUGATED POLYETHYLENE PIPE

A. Smooth-Lined Corrugated Polyethylene Pipe:

1. Meet the requirements of MDOT section 909.06 and AASHTO M 252, Type S for smooth lined corrugated polyethylene pipe sized 4 to 10 inch diameter, and AASHTO M 294, Type S for 12 to 48 inch diameter.

2. Conform fittings to the corresponding pipe specification and construct them from the same material classification as the pipe. Weld fittings on the interior and exterior at all junctions.

3. Use bell & spigot type joints with rubber gaskets on both sides conforming to MDOT section 909.03 and ASTM F477. Do not allow split collar couplers. Ensure joints are watertight and meet ASTM D3212 performance requirements.

B. Corrugated Plastic Edge Drain / Underdrains.

1. Corrugated plastic tubing for edge drains or underdrains must meet the requirements of AASHTO M 252 for polyethylene tubing. Wrap pipe in a Geotextile Pipe Wrap per MDOT Section 910.03.A.

2.11 SMOOTH PLASTIC PIPE

A. Use polyvinyl chloride (PVC) smooth plastic pipe for underdrains meeting AASHTO M 278 requirements. Wrap pipe in a Geotextile Pipe Wrap per MDOT Section 910.03.A.

2.12 DUAL WALL CORRUGATE POLYPROPYLENE PIPING

A. Provide Dual Wall Corrugate Polypropylene Pipe with smooth interior and annular exterior corrugations. Ensure pipe sized 12 through 60 inch diameter meets ASTM F2881/F2881M or AASHTO M 330 requirements.

B. Use impact modified copolymer polypropylene compound for pipe and fitting production that meets material requirements of ASTM F2881, Section 5, and AASHTO M 330, Section 6.1.

C. Join pipe using a bell & spigot joint meeting ASTM F2881/F2881M or AASHTO M 330 requirements. Ensure the joint is watertight according to ASTM D3212 requirements.

D. Meet gasket requirements of ASTM F477. Install gasket by the pipe manufacturer and cover it with a removable, protective wrap to keep the gasket free from debris. Use a manufacturer-approved joint lubricant on the gasket and bell during assembly.

E. Fittings

1. Conform fittings to ASTM F2881/F2881M or AASHTO M 330. Use bell and spigot connections with welded or integral bell and valley or inline gaskets meeting ASTM D3212 watertight joint performance requirements.

2.13 STRUCTURAL PLATES FOR FIELD ASSEMBLY OF PIPE, PIPE-ARCHES, AND ARCHES

A. Use plates, bolts, and nuts for field assembled circular pipe, pipe-arches, and arches that meet all applicable requirements of AASHTO M 167M/M 167 and MDOT Section 909 specifications.

2.14 END SECTIONS

A. Conform precast concrete end section to ASTM C76, Class II, and MDOT Section 909.04 specifications. Use a standard tongue and groove joint with cold-applied pipe joint sealer for connection to pipe. Refer to Part 2 of this Section for cold-applied pipe joint sealer requirements.

B. Conform metal end sections to MDOT 909.05. Refer to Part 2 "Corrugated Metal Pipe" for joint requirements for end sections.

2.15 STORM STRUCTURES

A. Conform materials for storm sewer structures to the requirements indicated on the Plans and specified below.

B. Concrete Brick:

1. Provide concrete brick as ASTM C55, Grade S-II, solid units with nominal 3 inch thickness.

C. Concrete Block:

1. Conform block to ASTM C139, manufactured of Portland cement meeting ASTM C150/C150M, Type II. Use solid curved blocks with inside and outside surfaces parallel and curved to required radii. Provide blocks with a groove or other approved joint type at the ends.

    a. Shape blocks intended for use in cones or tops of manholes as required to form the structure indicated on the Plans.

D. Precast Concrete:

1. Conform precast concrete manhole flat top slabs, risers, cones, bases, grade rings, transition sections, and bottom sections to ASTM C478/C478M. Ensure all are circular with circular reinforcement.

    a. Design manhole for earth loading at the design bury depth with a factor of safety of 1.5 for depths greater than 32 feet.

2. Provide base slab with minimum thickness of 8 inches thick for depths up to 25 feet and minimum thickness of 12 inches thick for depths greater than 25 feet.

3. Design transition sections, reducers, and flat top slabs for earth loading at the design bury depth with a factor of safety of 1.5.

4. Conform precast concrete manhole tee units to ASTM C76, Class IV. Ensure units are circular with circular reinforcement. Provide Shop Drawings for all manhole tees.

5. Use joints on the precast manhole tee identical to those on the storm sewer section.

E. Manhole Steps:

1. Conform cast iron manhole steps to ASTM A48/A48M, Class 30, gray iron. Provide steps with a minimum cross section dimension of 1 inch in any direction.

2. Use steel reinforced plastic steps made of suitably approved co-polymer polypropylene conforming to ASTM D4101, PP0344B33534Z02, with 1/2 inch minimum diameter deformed reinforcing bar conforming to ASTM A615/A615M, Grade 60.

3. Provide manhole steps of the type and size indicated on the Plans. Comply with applicable occupational safety and health standards. Install manhole steps at locations indicated on the Plans.

F. Frames and Covers:

1. Conform frames and covers for manholes, catch basins, and inlets to ASTM A48/A48M, Class 30, gray iron. Provide castings of the types and sizes indicated on the Plans. Ensure castings are neatly made and free from cracks, holes, and other defects.

2. Grind surfaces of casting to ensure proper fit and prevent rocking.

2.16 CONCRETE

A. Conform concrete to MDOT Section 1004. Use 3,500 psi strength concrete; Type IA cement; MDOT 6A coarse aggregate; MDOT 2NS fine aggregate; 3 inch maximum slump; no admixtures without the Engineer's approval.

2.17 CONCRETE REINFORCEMENT

A. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM ASTM A1064/A1064M for welded wire fabric.

EXECUTION

3.01 VERIFICATION OF EXCAVATION AND BEDDING

A. Prior to the installation of any storm sewer piping, structures, 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 the storm sewer materials to be installed.

C. Correct all defects and deficiencies before proceeding with the Work.

3.02 EXISTING STORM SEWERS AND DRAINS

A. Expose the existing storm sewer and structures designated for connection with the new Work and notify the Engineer. Allow the Engineer to verify the vertical and horizontal locations of the existing system and provide necessary adjustment instructions to align the new storm sewer Work with the existing system.

3.03 PREPARATION

A. Clean the outside surface of the spigot end and the inside surface of the bell end of the pipe, ensuring they are free of any foreign materials other than the manufacturer-recommended sealant, prior to installation.

B. Examine pipe, frames, covers, accessories, and appurtenances carefully for damage and other defects immediately before installation. Reject and remove defective or damaged material from the Project.

3.04 INSTALLATION - GENERAL

A. Ensure each section of pipe, when placed to grade and line, has firm bearing on the trench bedding throughout its length.

B. Use approved tools and methods suitable for the pipe material to cut pipe. Employ cutting methods that produce a smooth, square-cut end without damaging the pipe and that minimize airborne particles.

1. Perform pipe cutting using the manufacturer's recommendations for the specific pipe material and follow best trade practices.

2. Take care to prevent damage to the interior and exterior surfaces when cutting pipe. Reject a complete pipe section if either surface is damaged.

C. Keep the trench free of water during pipe bedding preparation and until satisfactory backfilling. Provide and maintain a dewatering system per Section 31 23 19. Keep the dewatering system operational until the trench is backfilled.

D. Use backfill as indicated on the Plans and specified in Section 31 23 33.

3.05 PIPE LAYING

A. Install pipe in conformance with ASTM C12 and manufacturer recommendations.

B. Protect the pipe during handling against impact shocks and free fall. Prevent hooks from contacting premolded joint surfaces.

C. Handle pipes with premolded joint rings or attached couplings so that no weight, including the pipe's own weight, bears on or is supported by the jointing material.

D. Avoid dragging any pipe on the ground or allowing damage from contact with gravel, crushed stone, or other hard objects.

E. Lay pipe to the line and grade specified on the Plans. Check each laid pipe with a line and grade pole or laser system to ensure accuracy. When using a laser system, provide an independent and alternate method for checking line and grade.

F. Begin construction at the outlet end and proceed upgrade with spigot ends pointing in the flow direction. Excavate bell holes to ensure the full barrel length bears uniformly on the bedding material.

G. Use lubricants, primers, or adhesives recommended by the pipe or joint manufacturer immediately before jointing.

H. Center the pipe in the bells or grooves and push tight together to form a smooth, continuous invert. After laying, avoid disturbing the pipe's line and grade. Re-lay any pipe found off grade or out of line properly.

I. Use mechanical means to pull home all pipe where manual methods cannot push and hold the pipe in place. Employ a cable placed inside the pipe with a suitable winch, jack, or come-along to pull the pipe home and hold it in position.

J. Install circular concrete pipe with elliptical reinforcement so that lift holes face the top of the pipe. Align the manufacturer's marks designating the top and bottom within five degrees of the vertical plane through the pipe's longitudinal axis. After installation, seal lift holes with suitable concrete plugs.

K. Install Type HE elliptical pipe with the longer axis placed horizontally within a ± five-degree tolerance.

L. Install Type VE elliptical pipe with the longer axis placed vertically within a ± five-degree tolerance.

M. Ensure the finished work is straight and sight it through between manholes.

3.06 PIPE BEDDING

A. After excavating the bottom of the trench, install pipe bedding material per Section 31 23 33. Then install the pipe strictly following the manufacturer's recommendations.

B. After laying the pipe, continue bedding above the pipe as specified in Section 31 23 33. Take particular care to fill and tamp all spaces under, around, and above the top of the pipe.

C. Provide continuous and uniform bedding in the trench for all buried pipe as specified in Section 31 23 33.

3.07 UNDERDRAINS

A. Lay the pipe in close conformity with the lines or grades shown on the Plans or established by the Engineer.

B. Close the upgrade ends of all underdrains with suitable plugs to prevent entry of soil or other foreign material.

C. Lay perforated pipe with the perforations down.

D. Bed underdrains in MDOT open graded drainage course material. Provide bedding with a minimum thickness of 6 inches beneath the pipe, a minimum width of 6 inches on each side, and extend to at least 12 inches above the top of the pipe.

E. Place bedding equally on both sides of the underdrain simultaneously. Use staking or other restraint methods during backfilling to maintain the underdrain's line and grade.

F. Rodent screens and outlet endings are required for all underdrains which terminate in a ditch or swale.

3.08 STORM STRUCTURES

A. Construct storm sewer manholes, catch basins, inlets, and other structures to the grades, lines, and levels indicated on the Plans and as specified. Complete structures with concrete bases, reinforcing, frames, covers, adjustment bricks, and other components shown or required for a complete installation.

B. Use storm sewer structures conforming to the type of material and dimensions indicated on the Plans.

C. Block Structures:

1. Construct concrete block structures at the locations and according to the details shown on the Plans. Place the first course of concrete blocks on the prepared base or footings in a full bed of mortar.

2. Provide full and close mortar joints in all courses. Keep courses level throughout. Stagger joints in adjoining courses by approximately one-half the block length. Maintain uniform joint thickness throughout the structures.

3. Strike all joints and properly point to provide true, smooth surfaces.

4. Apply a 1/2 inch thick cement mortar plaster coat to the exterior surfaces of the brick and block sections of all storm structures as indicated on the Plans.

D. Precast Concrete Structures:

1. Construct precast concrete structures as detailed on the Plans. Provide mortar joints struck smooth. Provide three (3) to five (5) courses of 8 inch brick or concrete grade rings at top of structure for future adjustment of castings.

E. Provide and install all frames and covers to the elevations indicated on the Plans. Set castings in a full bed of cement mortar at least 1/2 inch thick. Strike mortar joints smooth.

F. Install steps at the plant by the manufacturer for precast units. Field install steps for brick, block, or cast-in-place structures according to the types and locations indicated on the Plans.

G. Connect pipe up to 42 inches in diameter to storm structures using a grouted joint as indicated on the Plans. Support the pipe properly to prevent settlement from disturbing the connection.

H. Install pipe of in diameter or larger as an integral part of the manhole (manhole tees), constructed of 3,500 psi concrete and reinforcing as indicated on the Plans.

I. Use manhole tees for pipe 42 inches in diameter or larger as indicated on the Plans. Connect manhole tees using tees and pipe with the same type of joint. Support the pipe and tee properly with concrete as indicated on the Plans.

J. Provide sump in all catch basins and storm manholes with outlets of 18 inches in diameter or less, as indicated on the Plans.

K. Construct flow channels in all structures not requiring a sump, as indicated on the Plans.

3.09 FIELD QUALITY CONTROL

A. After laying, constructing, and backfilling all pipe and structures, perform the final inspection. Prepare the sewer system for final inspection within two (2) weeks after completing each 2,000 feet section of sewer installed.

B. Conduct the final inspection with a visible and audible check of the sewers and structures to confirm that steps are placed, all lift holes are filled, manhole bottom channeling is complete, all visible or audible leaks are stopped, pipe is laid straight and true to proper slopes and elevations, required brick courses for adjustment are placed, frame and cover are properly installed, required end section is installed, trenches and structures are backfilled in a workmanlike manner, and the system is thoroughly cleaned.

C. Consider the final inspection complete when all repairs have been made.

3.10 DEFLECTION TEST FOR PLASTIC PIPE

A. Test plastic pipe for deflection no sooner than 30 days after backfilling the pipe.

B. Limit maximum allowable deflection (reduction in vertical inside diameter) to five (5) percent.

C. Excavate and repair locations with excessive deflection by re-bedding and/or replacing the pipe.

D. Use optional devices for testing, including a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. Provide a mandrel with a minimum of nine (9) legs.

3.11 REMOVE STORM SEWER

A. Excavate and remove the existing storm sewer where indicated on the plans. Bulkhead the opening in storm sewers or structures where the existing storm sewer has been removed.

B. Where removal of existing storm sewer is occurring in essentially the same location as a new sewer or structure, the removal of the existing sewer is incidental to the project, unless otherwise indicated in the Proposal.

3.12 REMOVE CULVERTS

A. Excavate and remove culverts where indicated on the plans. Backfill the completed work as specified under “Backfilling Trenches” in Section 31 23 33.

3.13 REMOVE STRUCTURE

A. Excavate and remove structures where indicated on the plans. Bulkhead the ends of any sewers remaining in place. Backfill the completed work as specified under “Backfilling Trenches” in Section 31 23 33.

B. Removal of existing storm structures is incidental to the project if a new structure or sewer is being constructed in essentially the same location; unless otherwise indicated in the Proposal.

3.14 REMOVE AND REPLACE STORM SEWER

A. Remove and dispose of the existing storm sewer completely and replace it with the size and type specified on the plans or in the specifications.

B. Follow the materials and installation requirements of this section and Section 31 23 33, as applicable.

3.15 REMOVE AND REPLACE STORM STRUCTURE

A. Remove and dispose of the existing storm structure completely and replace it with the size and type specified on the plans or in the specifications.

B. Follow the materials and installation requirements of this section and Section 31 23 33, as applicable.

END OF SECTION

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SECTION 33 44 00
STORM UTILITY WATER DRAINS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes open drain construction complete with excavation and disposal of excavated material, backfilling and grading of abandoned open drains, maintaining overland drainage and cleanout of existing open and enclosed drains.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01 22 00 - Unit Prices

B. Section 01 57 13 - Temporary Erosion and Sediment Control

C. Section 01 89 00 - Site Construction Performance Requirements

D. Section 31 11 00 - Clearing and Grubbing

E. Section 31 23 16 - Structural Excavation and Backfill

F. Section 31 23 19 - Dewatering

G. Section 32 92 19 - Seeding

H. Section 33 41 00 - Storm Utility Drainage Piping

1.03 ALLOWABLE TOLERANCES

A. Trim and dress all excavation areas to conform to the lines, grades, and cross sections shown on the Plans within the following tolerances:

1. Maintain the finished surface elevation of all channel bottoms within ±1 inch of the Plan elevation.

2. Maintain the finished surface elevation of all channel areas, other than channel bottoms, within ±2 inches of the Plan elevation.

1.04 JOB CONDITIONS

A. Carefully protect trees, shrubs, and other vegetation outside the Work limits designated on the Plans or by the Engineer from damage or injury throughout the entire drain construction operation.

B. Replace trees, shrubs, or other vegetation damaged by the Contractor's operation but not designated for removal. Include all costs incurred as incidental to the open drain construction operation.

C. Carefully protect existing buildings, fences, culverts, drain tile, utility poles, overhead lines, underground conduits, underground cables, sewers, structures, and other improvements within the drain right-of-way limits not designated for removal on the Plans from damage during the drain construction operation.

D. Repair or replace any existing structure or improvement not designated for removal that sustains damage from the Contractor's operation. Include all costs incurred as incidental to the drain construction operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PERFORMANCE – GENERAL

A. Begin construction at the outlet end of the open drain and proceed upstream, unless the Engineer authorizes otherwise.

B. Keep the drain free of water prior to excavation or cleanout and until satisfactory completion of the open drain construction. Provide and maintain a dewatering system as specified in Section 31 23 19 - Dewatering.

3.02 DISPOSAL AREAS

A. Furnish and maintain a disposal area at personal expense if disposal areas for unsuitable materials are not specified on the Plans. Do not use spoil disposal areas designated on the Plans for unsuitable materials unless otherwise specified or determined by the Engineer.

3.03 CLEARING AND GRUBBING

A. Clear and grub the drain right-of-way and spoil deposit areas, designated on the Plans or determined by the Engineer, prior to the actual excavation of the open drain as provided in Section 31 11 00 - Clearing and Grubbing.

B. Perform the clearing and grubbing work along the open drain at least 1/2 mile before the excavation operation.

C. Prepare the area for excavation or fill by removing unsuitable materials and vegetation that interfere with the proposed work. Preserve all material ground cover, trees, other vegetation, and improvements designated to remain from injury or defacement.

D. Consider the clearing and grubbing operations, including removal and disposal of unsuitable materials, incidental to the Project and part of the excavation pay item.

3.04 REMOVING AND SALVAGING TOPSOIL

A. Salvage topsoil in an amount equivalent to the quantity required for the Work specified on the Plans or as designated by the Engineer.

B. Topsoil in excess of the required amount, will be disposed of at the Contractor's expense.

C. When additional topsoil is required to complete the drain construction operation, furnish, place, and spread the additional topsoil at the Contractor’s expense.

D. Cut all vegetation to a height of approximately 2 inches, and ensure the topsoil is free of foreign materials prior to removal. Remove topsoil in a manner that avoids lifting subsoils.

E. Remove topsoil within the grading limits for cuts, to the width and depth specified on the Plans or as directed by the Engineer.

F. Stockpile topsoil within the drain right-of-way, outside of the construction area. Keep topsoil separate from other excavated materials to be used for embankments or disposal. Place the topsoil as near the original location as possible, as no payment will be made for overhauls. Select stockpile locations that avoid placing material around tree trunks or over root systems of trees to be preserved.

G. Consider the cost of topsoil removal, stockpiling, hauling, spreading, and grading as incidental to the Project.

3.05 EXCAVATION

A. Excavate the open drain to the lines, grades, dimensions, and cross sections specified on the Plans.

B. Remove and dispose of all materials necessary to construct the open drain. Place the removed material in suitably prepared spoil disposal areas. If the Plans do not specify spoil disposal areas, provide and maintain a disposal area at the Contractor’s expense.

C. Perform construction, excavation, and disposal operations in a manner and sequence that maintains adequate drainage at all times.

D. Immediately cease operations and notify the Engineer when wet or unstable soil conditions are encountered during excavation. With the Engineer’s approval, make changes in the Work, in addition to dewatering, to facilitate soil dewatering and stabilization. Cover costs incurred for dewatering and stabilizing soils at the Contractor's expense.

E. Excavate a pilot channel at least 30 days before completing final drain side slopes when indicated on the Plans or when encountering wet or unstable soils. Let the Engineer determine when drain slopes have stabilized sufficiently to allow final slope shaping.

1. Excavate the pilot channel with a bottom width approximately one-half the proposed final width and 1:1 side slopes, to the elevations indicated on the Plans. Do not excavate the pilot channel upstream from any bridge requiring protection work or replacement until the scheduled bridge work is completed, unless approved otherwise by the Engineer.

F. Remove and dispose of stones, boulders, or rocks encountered during excavation as unsuitable material. Backfill and compact any holes or voids created below plan grade after removal with approved materials, to the Engineer’s satisfaction.

G. Cover costs incurred for removal and disposal of stones, boulders, and rocks, as well as backfilling and compaction, at the Contractor's expense.

H. Immediately cease operations and notify the Engineer upon encountering ledge rock.

I. Blasting will not be permitted unless otherwise specified on the Plans or approved by the Engineer.

3.06 GRADING REQUIREMENTS

A. Excavate channel areas receiving slope protection to a depth sufficient for installing protective materials and meeting finished surface grade tolerances.

B. Consider the additional excavation necessary for slope protection incidental to the Project cost.

C. Backfill and compact areas of over excavation with approved materials at the Contractor's expense.

D. Finish grades in a condition satisfactory to the Engineer immediately before placing slope protective materials.

E. Trimming and finishing the earth grade will be considered incidental to the excavation.

3.07 SOIL EROSION AND SEDIMENTATION CONTROL

A. Provide, maintain, and remove temporary and/or permanent soil erosion and sedimentation control measures specified on the Plans or determined by the Engineer, at the Contractor’s expense.

B. Prevent surface runoff from carrying excavated materials into the drain, reduce erosion of slopes, and prevent silting in of the drain downstream of the Work using the measures.

C. The 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 57 13 - Temporary Erosion and Sediment Control.

3.08 SLOPE STABILIZATION

A. After completing the grading operation and before placing any protective covering, have the Engineer inspect the slopes for signs of internal water movement, such as seepage and soil slippage, and for unstable slope conditions.

B. Take necessary measures to stabilize slopes, including removing and disposing of unsuitable or unstable materials, backfilling with approved material, and compacting. Consider costs incurred for slope stabilization incidental to excavation.

3.09 SPOIL DISPOSAL AREAS

A. Deposit excavation free from unsuitable materials in approved spoil disposal areas, as specified in Section 01 89 00 - Site Construction Performance Requirements.

B. Prohibit depositing spoil materials in existing watercourses or drains unless otherwise specified on the Plans. Deposit, compact, and grade spoil material to provide drainage. Construct swales when necessary to ensure positive drainage to the drain.

3.10 CULVERTS

A. Install new culverts or culverts to be relayed as indicated on the Plans, following Section 33 41 00 - Storm Utility Drainage Piping. Take special care when removing, salvaging, storing, handling, or placing culverts to prevent damage.

B. Only culverts meeting the approval of the Engineer may be relayed.

C. Repair any culverts with scraped or otherwise damaged protective coating to the Engineer’s satisfaction at the Contractor’s expense.

D. Corrugated steel pipe, when specified, will be laid with the outside laps of circumferential joints pointing upstream and with longitudinal laps at the sides at about the vertical mid-height of the culvert.

E. Rotate the inverts 180 degrees when relaying existing culverts.

F. Make arrangements with the landowner and/or land user for the removal of culverts. Provide the Engineer with a copy of the arrangements made, bearing the signature of the landowner and/or land user.

G. Dispose of any culvert removed and not relayed at the Contractor's expense.

H. Relay culverts specified for removal and relaying at the culvert crossing from which they were removed. Do not use salvaged culverts at any other location unless authorized by the Engineer.

3.11 TILE OUTLETS

A. Contact existing landowners and land users to locate and flag all field tile outlets to be protected during excavation. Do not proceed with the Work until marking of tile outlet locations is complete.

B. The Contractor will be responsible for leaving the tile outlets in good repair and in working order.

C. Shorten the length of existing field tile outlets and recess them into the newly shaped slope when necessary. Consider this Work incidental to the Project.

D. Install new outlets as called for on the Plans, using specified materials. Furnish and place a suitable rodent guard on the end of each new outlet at the Contractor's expense. Relocate existing rodent guards as incidental to the Project.

E. When it is apparent a field tile outlet is carrying human or animal waste material from a home or barnyard area, the Contractor will request the County Health Department approval before reconnecting the outlet to the drain.

3.12 BRIDGES

A. Remove and dispose of existing bridges or remove, salvage, and reinstall them as specified on the Plans. Take care when removing, salvaging, storing, handling, and reinstalling the existing bridge.

B. Make arrangements with the landowner and/or land user for the removal of the bridge. Provide the Engineer with a copy of the arrangements made, bearing the signature of the landowner and/or land user.

3.13 CLEANOUT OF DRAIN

A. Include clearing and grubbing of all trees, brush, stumps, and other vegetation in the cleanout of the existing drain, following Section 31 11 00 - Clearing and Grubbing. Perform excavation according to Part 3 of this Section.

B. Completely remove and dispose of all sediment, silt, dirt, debris, and other miscellaneous items to the bottom of the culvert, the elevation shown on the Plans, or as determined by the Engineer during enclosed drain cleanout.

C. Restore all disturbed areas with topsoil, seed, fertilizer, and mulch or with topsoil and sod upon completion of the cleanout.

END OF SECTION