

**SECTION 00 01 00
CONTRACT DOCUMENTS**

FINAL CSO COMPLIANCE PROGRAM - EARLY ACTION PROJECT

City of St. Joseph
700 Broad Street, St. Joseph, Michigan 49085

April 19, 2024



**WADE
TRIM**

2851 Charlevoix Drive SE, Suite 108, Grand Rapids, MI 49546



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ST JOSEPH MICHIGAN INTERCEPTING SEWERS (1951)

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SECTION 00 11 13
ADVERTISEMENT FOR BIDS

Final CSO Compliance Program - Early Action Project

Sealed Bids will be received by City of St. Joseph at the Clerk's Office, at 700 Broad Street , St. Joseph, Michigan, 49085, until 3 pm, Local Time, 05-21-2024, at which time and place said Bids will be opened and publicly read aloud.

Bids will be received for the following Work:

The Project includes the construction of several sanitary sewer system components, including a new concrete diversion chamber, new sanitary sewer, replacement of on site storm sewer and associated items at the City of St. Joseph Department of Public Works property and across the street through the Pri Mar Petroleum property as part of the City's Final CSO Compliance program.

Contract Documents may be examined at the following locations:

1. City of St. Joseph, 700 Broad Street, St. Joseph, Michigan 49085
2. Construction Association of Michigan, 43636 Woodward, P.O. Box 3204, Bloomfield Hills, Michigan 48302
3. McGraw-Hill Dodge, 401 Hall Street SW, Suite 431, Grand Rapids, MI 49503
4. Builders Exchange of Grand Rapids, 678 Front Avenue NW, Suite 330, Grand Rapids, MI 49504
5. Wade Trim, Inc., 2851 Charlevoix Drive SE, Suite 108, Grand Rapids, MI 49546
6. Plans and spec are also available for viewing (not to be used for bidding purposes) at no cost online at: www.wadetrim.com/resources/bid-tab/
 - A. Documents downloaded from our website will bear a watermark on various signature pages and will be considered unofficial copies for bidding purposes; copies obtained from anywhere other than Wade Trim will be considered unofficial copies and will not be considered a responsible bid.
7. Copies of the Contract Documents for bidding purposes must be obtained at the office(s) of Wade Trim, Inc., 2851 Charlevoix Drive SE, Suite 108, Grand Rapids, MI 49546, starting on April 19, 2024, upon making a payment of Eighty Dollars (\$80.00) Dollars if picked up or One Hundred Dollars (\$100.00) Dollars if mailed (checks or money orders only – payable to Wade Trim, no cash), none of which will be refunded.

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

A non-mandatory pre-bid conference will be held at 3:00 PM, Local Time, on 05-08-2024 . Any prospective General Contractor bidding the project is encouraged to attend this non-mandatory meeting. Representatives of the Owner and the Engineer will be present to discuss the project. Attendance is not required for Bidders to be considered responsive.

City of St. Joseph reserves the right to reject any or all bids, and to waive any informality or irregularities in any bids, and further reserves the right to accept any bid or part of bids which it deems to best serve the interest of the City.

Bids may not be withdrawn for the period of 120 days after date of receiving bids.

Inquiries shall be directed to Shawn W. Keough Engineer at Phone: (313) 363-1434 or email: skeough@wadetrim.com.

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 St. Joseph, 700 Broad Street, St. Joseph, Michigan 49085, a Municipal Corporation and being a party of the first part of this Contract.
- E. The term "Engineer" means Wade Trim, Inc., 2851 Charlevoix Drive SE, Suite 108, Grand Rapids, MI 49546, 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. The Bidder may rely upon the general accuracy of the "technical data" contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the site, nor upon the completeness thereof for bidding or construction purposes.
 3. Before submitting 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 PRE-BID CONFERENCE

- A. An in-person, non-mandatory pre-bid conference will be held, and representatives of the Owner and the Engineer will be present to discuss the Project.
- B. Engineer will transmit to prospective Bidders a record of such Addenda as the Engineer considers necessary in response to questions arising at the meeting. Oral statements made during the meeting may not be relied upon and will not be binding or legally effective.

1.05 INTERPRETATIONS AND ADDENDA

- A. Should any prospective bidder find discrepancies in, or omissions from the Plans, Specifications or other parts of the Contract Documents, he may submit a written request to the Engineer for an interpretation thereof. The person submitting the request will be held responsible for its prompt delivery at least seven (7) days prior to the date for opening of Bids.

Questions received less than seven (7) days prior to the date for opening of bids will not be answered. Any interpretation of inquiry will be made by Addendum duly issued to all prospective bidders.

- B. Any change in or addition to the Contract Documents deemed necessary by the Owner 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.

1.06 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 and in a form 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. The 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. The 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.

1.07 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.

1.08 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.

1.09 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 in an opaque sealed envelope, marked with the Project title and name and address of the Bidder and accompanied by the Bid Security and other required documents.
 - 2. If the Bid is sent through the mail or other delivery system, the sealed envelope must be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face thereof.
- 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. The quantities as shown in Section 00 42 43 - Proposal are approximate only and will be used as a basis of comparison of Bids, and award of Contract(s).
 - 1. Payment will be made on basis of actual quantities of Work performed in accordance with the Contract Documents.
- F. Unit Prices must include such amounts as the Bidder deems proper for overhead, profit, taxes, General Conditions and such other incidentals as noted in the Contact Documents.
- G. Bidder must acknowledge of receipt of all Addenda as provided for in the electronic bidding platform. Failure to acknowledge Addenda will be cause for rejection of bid.
- H. 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.
- I. Other documents to be attached to the Proposal and made a condition thereof are identified in the Proposal.
- J. A tabulation of the amounts of the base bids and any alternates will be made available after the opening of Bids.
- K. 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.

1.10 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.

1.11 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 120 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.

1.12 SIGNING OF AGREEMENT

- A. Within fifteen (15) 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 00 21 13

**SECTION 00 42 43
PROPOSAL**

Owner: City of St. Joseph

Project: Final CSO Compliance Program - Early Action Project

Project Location: at 700 Broad Street

BIDDER INFORMATION

Bidder Name: _____

By (Printed Name): _____

Signature: _____

Address: _____

Phone No: _____

Email: _____

The Bidder proposes and agrees, if their Bid is accepted, to enter into an Agreement with the City of St. Joseph 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:

1. Bidder has examined copies of all Contract Documents, (consisting of Plans dated April 19, 2024 and Project Manual dated April 19, 2024) 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: _____
2. 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 Owner.
3. The Bidder agrees to complete the Work, in accordance with the Contract Documents, for the following Contract Price:

N.	D	E Q	U	B U P	B P
A. GENERAL					
1	Audio/Video Route Survey	1	LS	\$	\$
2	Inspector Days		DAY	\$880.00	\$
3	Mobilization, 5 Maximum of Contract Price	1	LS	\$	\$
GENERAL SUBTOTAL					
B. TEMPORARY FACILITIES AND CONTROL					
4	Maintenance Gravel, LM	200	CY	\$	\$
5	Barricade, Type III, High Intensity, Double Sided, Lighted, Furn	14	EA	\$	\$
6	Barricade, Type III, High Intensity, Double Sided, Lighted, Oper	14	EA	\$	\$
7	Pedestrian Type II Barricade, Temp	8	EA	\$	\$
8	Minor Traf Devices	1	LS	\$	\$
9	Plastic Drum, Fluorescent, Furn	30	EA	\$	\$
10	Plastic Drum, Fluorescent, Oper	30	EA	\$	\$
11	Sign, Type B, Temp, Prismatic, Furn	411	SF	\$	\$
12	Sign, Type B, Temp, Prismatic, Oper	411	SF	\$	\$
13	Traffic Regulator Control	1	LS	\$	\$
14	Fencing, Temporary	1	LS	\$	\$
15	Silt Fence	2,000	LF	\$	\$
16	Inlet Filter	15	EA	\$	\$
17	Temporary Gravel Construction Entrance/Exit	2	EA	\$	\$
TEMPORARY FACILITIES AND CONTROL SUBTOTAL					
C. REMOVALS					
18	Utility Pole, Relocate	1	EA	\$	\$

19	Sanitary Manhole, Remove	2	EA	\$	\$
20	Storm Manhole, Remove	6	EA	\$	\$
21	Sanitary Sewer, 36 inch, Remove	51	LF	\$	\$
22	Storm Sewer, 12 inch, Remove	120	LF	\$	\$
23	Pavement Excavation, Bituminous	500	CY	\$	\$
24	Concrete Curb and Gutter, Remove	200	LF	\$	\$
25	Concrete Sidewalks and Drives, Remove	5,500	SF	\$	\$
REMOVALS SUBTOTAL					
D. FACILITY CONSTRUCTION					
26	Allowance for Telemetry and Level Sensors	1	LS	\$100,000.00	\$100,000.00
27	Construct Supported Sanitary MH #5 Chamber Over Existing 36-inch Supported Sewer	1	LS	\$	\$
28	Diversion Chamber	1	LS	\$	\$
29	Connection to Diversion Chamber	6	EA	\$	\$
30	Existing CSO Diversion Chamber Expansion	1	LS	\$	\$
31	Concrete Bollard	4	EA	\$	\$
FACILITY CONSTRUCTION SUBTOTAL					
E. EARTHWORK					
32	Site Grading	1	LS	\$	\$
33	Adjust Structure, Pervious	1	EA	\$	\$
34	Adjust Structure, Impervious	5	EA	\$	\$
35	Earth Excavation	250	CY	\$	\$
36	Embankment	20	CY	\$	\$
37	Subbase Undercut (21AA)	50	CY	\$	\$
EARTHWORK SUBTOTAL					

F. PAVING AND EXTERIOR IMPROVEMENTS					
38	Aggregate Base Course, 21AA Limestone	1,800	TON	\$	\$
39	Bituminous Wearing Course, 36A, 1.5 inch	60	TON	\$	\$
40	Bituminous Wearing Course, 5EML, 1.5 inch	120	TON	\$	\$
41	Bituminous Leveling Course, 4EML, 2 inch	240	TON	\$	\$
42	Bituminous Base Course, 4EML, 3 inch	370	TON	\$	\$
43	Hand Patching with Bituminous Materials	100	TON	\$	\$
44	Concrete Curb and Gutter, Det C4	280	LF	\$	\$
45	Sidewalk, Concrete, 4 inch	990	SF	\$	\$
46	Sidewalk Ramp, ADA, Concrete, 6 inch	325	SF	\$	\$
46A	Concrete Pavement, 8-inch Plain	500	SY	\$	\$
47	Fence, 8 Ft Ht, Chain Link, Industrial Ga	200	LF	\$	\$
48	Gate, 8 Ft Ht, Wheeled, 40 Ft Wide	1	EA	\$	\$
49	Restoration w/ 3 inches Topsoil, Seed, Fertilizer, and Mulch	1,900	SY	\$	\$
50	Soil Disposal (at Type 2 Landfill)	6,100	CY	\$	\$
PAVING AND EXTERIOR IMPROVEMENTS SUBTOTAL					
G. SANITARY UTILITY SEWERAGE PIPING					
51	Sanitary Sewer, 18 inch, Ductile Iron, Trench B Sand	102	LF	\$	\$
52	Sanitary Sewer, 24 inch, Ductile Iron, Trench B Sand	347	LF	\$	\$
53	Sanitary Sewer, 30 inch, Ductile Iron, Trench B Sand	120	LF	\$	\$
54	Sanitary Sewer, 36 inch, Ductile Iron, Trench B Sand	13	LF	\$	\$
55	Sanitary Sewer, 24 inch, Ductile Iron, Trench B Sand, Supported with Helical Piles	93	LF	\$	\$
56	Sanitary Sewer, 36 inch, Ductile Iron, Trench B Sand, Supported with Helical Piles	59	LF	\$	\$
57	Sanitary Sewer, 24 inch, PVC SDR 26, Trench B Sand	159	LF	\$	\$

58	Standard 4-foot Sanitary Manhole, 0 to 8-foot-Deep (San MH #2 and #3)	2	EA	\$	\$
58A	Standard 4-foot Sanitary Manhole, 0 to 8-foot-Deep (San MH# 8, 10, 11 & 12)	4	EA	\$	\$
59	Standard 4-foot Sanitary Manhole, 0 to 8-foot-Deep, Supported with Helical Piles (San MH #4 & 6)	2	EA	\$	\$
60	Standard 5-foot Sanitary Manhole, (for 24 inch sewer), 0 to 8-foot-Deep (San MH #7)	1	EA	\$	\$
61	Additional Depth Sanitary Manhole, 48 inch Diameter, Over 8-foot-Deep	10	VFT	\$	\$
62	Additional Depth Sanitary Manhole, 60 inch Diameter, Over 8-foot-Deep	2	VFT	\$	\$
63	Additional Depth Sanitary Manhole, 72 inch Diameter, Over 8-foot-Deep	5	VFT	\$	\$
64	Construct 4-foot Sanitary Manhole Over Existing 15-inch Sewer, 0 to 8-foot Deep (San MH #9)	1	EA	\$	\$
65	Construct 6-foot Sanitary Manhole Over Existing 30-inch Sewer, 0 to 8-foot-Deep (San MH #1)	1	EA	\$	\$
SANITARY UTILITY SEWERAGE PIPING SUBTOTAL					
H. STORM UTILITY DRAINAGE PIPING					
66	Storm Sewer, 12 inch, RCP, Trench B Sand	50	LF	\$	\$
67	Storm Sewer, 18 inch, RCP, Trench B Sand	104	LF	\$	\$
68	Standard 4-foot Storm Manhole, 0 to 8-foot Deep	2	EA	\$	\$
69	Catch Basin	2	EA	\$	\$
70	Construct 4-foot Storm Structure Over Existing 15 inch Sewer, 0 to 8-foot Deep	1	EA	\$	\$
STORM UTILITY DRAINAGE PIPING SUBTOTAL					
TOTAL CONTRACT PRICE					

4. The 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 Owner 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.
5. The 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 Owner.
6. The 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 Owner to furnish all labor, material, tools, and equipment necessary to do all Work specified and prescribed for the completion of the Project.
7. The Bidder will provide a bid bond, in the amount of at least (5) percent of the amount Bid, drawn payable to City of St. Joseph as security for the proper execution of the Agreement.
8. The 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 Owner's Notice of Award.
9. The 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.
10. Liquidated damages, as specified in the General Conditions, Supplementary Conditions and Agreement, shall also apply to the Substantial Completion date.
11. Engineering and inspection costs incurred after the final completion date shall be paid by the Contractor to the Owner as specified in the Conditions of the Contract and Agreement.
12. Proposals may not be withdrawn for a period of 120 days after bid opening.
13. The following documents are made a condition of this Proposal:
 - A. Required Bid Security
 - B. Legal Status of Bidder
 - C. Non-Collusion Affidavit
 - D. Certification Regarding Debarment, Suspension, and Other Responsibility Matters

**SECTION 00 43 13
BID BOND FORM**

KNOW ALL MEN BY THESE PRESENTS, 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 Final CSO Compliance Program - Early Action Project.

NOW, THEREFORE, if the Owner shall accept the Bid of the Principal and the Principal shall 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 shall pay 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 shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this _____ day of _____, 20__.

(Witness)

(Principal)

(Title)

(Witness)

(Surety)

(Title)



MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Finance Division

NON-EQUIVALENCY PROJECTS CONTRACT BOILERPLATE LANGUAGE

I

The following is the required standard contract language that must appear in bidding documents of Clean Water State Revolving Fund and Drinking Water State Revolving Fund non-equivalency projects. Determination of equivalent vs. non-equivalent projects is made on a yearly basis as indicated in the Intended Use Plan (IUP) and will be communicated by your EGLE project manager. If you are unsure whether your project is equivalent, consult with your EGLE project manager.

- A S C L
- D-B R A/P F W
- L S P F A P
- C R D, S, O R M

Bidders should note this section contains instructions regarding forms/information that must be completed and included with any submitted bid.

If you need this information in an alternate format, contact EGLE-Accessibility@Michigan.gov or call 800-662-9278.

EGLE does not discriminate on the basis of race, sex, religion, age, national origin, color, marital status, disability, political beliefs, height, weight, genetic information, or sexual orientation in the administration of any of its programs or activities, and prohibits intimidation and retaliation, as required by applicable laws and regulations. Questions or concerns should be directed to the Nondiscrimination Compliance Coordinator at EGLE-NondiscriminationCC@Michigan.gov or 517-249-0906.

The Contractor acknowledges to and for the benefit of the City of City of St. Joseph (“Purchaser”) and the Michigan Department of Environment, Great Lakes, and Energy (the “State”) that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or the Drinking Water State Revolving Fund and such laws contain provisions commonly known as “American Iron and Steel (AIS);” that requires all iron and steel products used in the project be produced in the United States (“AIS Requirements”) including iron and steel provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the AIS Requirements, (b) all iron and steel used in the project will be and/or have been produced in the United States in a manner that complies with the AIS Requirements, unless a waiver of the requirements is approved or the State made the determination in writing that the AIS Requirements do not apply to the project, and (c) the Contractor will provide any further verified information, certification, or assurance of compliance with this paragraph, or information necessary to support a waiver of the AIS requirements, as may be requested by the Purchaser.

Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney’s fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

Davis-Bacon Act/Prevailing Wage

P.L. 111-88 requires compliance with the Davis Bacon Act and adherence to the current U.S. Department of Labor Wage Decision. Attention is called to the fact that not less than the minimum salaries and wages as set forth in the Contract Documents (see Wage Decision included herein) must be paid on this project. The Wage Decision, including modifications, must be posted by the Contractor on the job site. The “Contracting Agency” or “Contracting Officer” for Davis-Bacon Wage Decision posters on jobsites is the loan applicant/bond issuer. A copy of the Labor Standards Provisions for Federally Assisted Projects is included and is hereby a part of this contract.

"General Decision Number: MI20240052 01/05/2024

Superseded General Decision Number: MI20230052

State: Michigan

Construction Type: Heavy

County: Berrien County in Michigan.

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

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<ul style="list-style-type: none"> . Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number Publication Date
 0 01/05/2024

CARP0525-006 06/01/2023

	Rates	Fringes
CARPENTER, Includes Form Work....	\$ 28.29	21.42

ELEC0153-007 06/01/2023

	Rates	Fringes
ELECTRICIAN.....	\$ 39.50	27.09

ENGI0325-009 09/01/2023

POWER EQUIPMENT OPERATORS: Underground Construction (Including Sewer)

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
GROUP 1.....	\$ 39.27	25.25
GROUP 2.....	\$ 34.38	25.25
GROUP 3.....	\$ 33.88	25.25
GROUP 4.....	\$ 33.60	25.25

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

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

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

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

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

ENGI0326-025 06/01/2023

EXCLUDES UNDERGROUND CONSTRUCTION

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 45.48	25.25
GROUP 2.....	\$ 42.18	25.25
GROUP 3.....	\$ 39.53	25.25
GROUP 4.....	\$ 37.82	25.25
GROUP 5.....	\$ 37.82	25.25
GROUP 6.....	\$ 31.96	25.25
GROUP 7.....	\$ 29.48	25.25

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

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

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

GROUP 2: Crane operator with main boom and jib 140' or

longer, tower crane, gantry crane, whirley derrick

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

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

GROUP 5: Boom truck (non-swinging)

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

GROUP 7: Oiler

FOOTNOTES:

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

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

IRON0292-008 06/01/2020

	Rates	Fringes
IRONWORKER, STRUCTURAL AND REINFORCING.....	\$ 31.75	22.84

LAB00334-011 09/01/2022

SCOPE OF WORK:

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

	Rates	Fringes
LABORER		
(1) Common or General.....	\$ 22.42	12.95
(2) Mason Tender- Cement/Concrete.....	\$ 22.55	12.95
(4) Grade Checker.....	\$ 22.73	12.95
(5) Pipelayer.....	\$ 22.85	12.95

LAB00355-010 06/01/2022

EXCLUDES OPEN CUT CONSTRUCTION

	Rates	Fringes
LABORER		
Common or General; Grade Checker; Mason Tender - Cement/Concrete.....	\$ 26.70	12.95
Pipelayer.....	\$ 20.34	12.85

PAIN0312-014 06/12/2014

Rates	Fringes
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PAINTER

Brush & Roller.....	\$ 21.75	11.94
Spray.....	\$ 22.75	11.94

PLAS0016-019 04/01/2014

Rates Fringes

CEMENT MASON/CONCRETE FINISHER...	\$ 24.63	12.88
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PLUM0172-009 05/28/2018

City of Niles & vicinity

Rates Fringes

PLUMBER.....	\$ 33.60	19.36
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PLUM0357-011 07/01/2020

Rates Fringes

PLUMBER.....	\$ 35.20	22.35
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TEAM0007-011 06/01/2023

Rates Fringes

TRUCK DRIVER

Lowboy/Semi-Trailer Truck...	\$ 31.55	.75 + a+b
Tractor Haul Truck.....	\$ 31.30	.75 + a+b

FOOTNOTE:

- a. \$470.70 per week.
- b. \$68.70 daily.

SUMI2010-050 11/09/2010

Rates Fringes

LABORER: Landscape.....	\$ 12.25 **	0.00
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TRUCK DRIVER: Dump Truck.....	\$ 18.00	6.43
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TRUCK DRIVER: Off the Road Truck.....	\$ 20.82	3.69
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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.20) or 13658 (\$12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any

solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

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

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

Union Rate Identifiers

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

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

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates

the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

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

Union Average Rate Identifiers

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

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

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

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

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

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

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

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

Wage and Hour Administrator
U.S. Department of Labor

200 Constitution Avenue, N.W.
Washington, DC 20210

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

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

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

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

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END OF GENERAL DECISION"

5.5 Contract Requirements

(a) The Agency head shall cause or require the contracting officer to insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a public building or public work, or building or work financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in Sec. 5.1, the following clauses (or any modifications thereof to meet the particular needs of the agency, *Provided*, That such modifications are first approved by the Department of Labor):

(1) *Minimum wages.* (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in Sec. 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination, and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and

- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
- (B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- (C) In the event the contractor, the laborers, or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- (D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii) (B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.
- (iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
- (iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside, in a separate account, assets for the meeting of obligations under the plan or program.

(2) *Withholding.* The **City of St. Joseph** shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action

as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) *Payrolls and basic records.* (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency). The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead, the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at [dol.gov/agencies/whd/government-contracts/construction/forms](https://www.dol.gov/agencies/whd/government-contracts/construction/forms) or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency), the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance", signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

- (1) That the payroll for the payroll period contains the information required to be provided under Sec. 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under Sec. 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;
 - (2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;
 - (3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.
- (C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.
- (D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.
- (iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the Michigan Department of Environment, Great Lakes, and Energy or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as maybe necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.
- (4) *Apprentices and trainees-* (i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the jobsite in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates

(expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

- (ii) **Trainees.** Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.
- (iii) **Equal employment opportunity.** The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.
- (5) **Compliance with Copeland Act requirements.** The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.
- (6) **Subcontracts.** The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the (write in the name of the Federal agency) may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

- (7) *Contract termination: debarment.* A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.
- (8) *Compliance with Davis-Bacon and Related Act requirements.* All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.
- (9) *Disputes concerning labor standards.* Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.
- (10) *Certification of eligibility.* (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C.1001.
- (b) *Contract Work Hours and Safety Standards Act.* The Agency Head shall cause or require the contracting officer to insert the following clauses set forth in paragraphs (b)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Sec. 5.5(a) or 4.6 of part 4 of this title. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.
- (1) *Overtime requirements.* No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.
- (c) *Violation; liability for unpaid wages; liquidated damages.* In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible there for shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

- (3) Withholding for unpaid wages and liquidated damages. The City of St. Joseph shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.
- (4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.
- (5) In addition to the clauses contained in paragraph (b), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in Sec.5.1, the Agency Head shall cause or require the contracting officer to insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Agency Head shall cause or require the contracting officer to insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Michigan Department of Environment, Great Lakes, and Energy and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS FORM

The prime contractor must provide a completed *Certification Regarding Debarment, Suspension, and Other Responsibility Matters Form* with its bid or proposal package to the owner.

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

- (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in transactions under federal nonprocurement programs by any federal department or agency;
- (2) Have not, within the three-year period preceding the proposal, had one or more public transactions (federal, state, or local) terminated for cause or default; and
- (3) Are not presently indicted or otherwise criminally or civilly charged by a government entity (federal, state, or local) and have not, within the three-year period preceding the proposal, been convicted of or had a civil judgment rendered against it:
 - (a) For the commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public transaction (federal, state, or local) or a procurement contract under such a public transaction;
 - (b) For the violation of federal or state antitrust statutes, including those proscribing price fixing between competitors, the allocation of customers between competitors, or bid rigging; or
 - (c) For the commission of embezzlement, theft, forgery, bribery, falsification, or destruction of records, making false statements, or receiving stolen property.

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

Name and Title of Authorized Representative

Name of Participant Agency or Firm

Signature of Authorized Representative Date

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

SECTION 00 43 45
LEGAL STATUS OF BIDDER

(The Bidder shall 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: _____

SECTION 00 45 19
NON-COLLUSION AFFIDAVIT OF PRIME BIDDER

State of _____)

) ss:

County of _____)

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

1. He/She is the of _____ (Position) of _____ (Firm) the Bidder that has submitted the attached Bid;
2. He/She is fully informed with respect to the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham bid;
4. 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 St. Joseph, or any person or other entity interested in the proposed Contract Documents; and
5. 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: _____

My Commission Expires: _____

Notary Seal

**SECTION 00 51 00
NOTICE OF AWARD**

Attention: _____

Date: _____

Project: Final CSO Compliance Program - Early Action Project

Pursuant to the provisions of Article 1.11 of the Instructions to Bidders, 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: The Project includes the construction of sanitary sewer system improvements, including a new concrete diversion chamber, new sanitary sewer and supporting infrastructure. as delineated in your Bid submitted to City of St. Joseph on 05-21-2024.

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

1. Deliver to Engineer _____ (_____) fully executed counterparts of the Agreement including all the Contract Documents.
2. Deliver with the executed Agreement the Contract Security (Bonds), on the form included in the Contract Documents, as specified in the General Conditions (Article 5).
3. Deliver with the executed Agreement the Insurance Certificates (and other evidence of insurance) as specified in the General Conditions (Article 5).
4. Please do not date Agreement and Contract Security (Bonds), as these will be dated by 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.

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

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

Owner: _____

Authorized Signature: _____

Copy to Wade Trim, Inc.

**SECTION 00 52 00
AGREEMENT**

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

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

The Project includes the construction of sanitary sewer system improvements, including a new concrete diversion chamber, new sanitary sewer and supporting infrastructure.

The Work will be substantially completed within **200 calendar days** after the date when the Contract Time commences to run as provided in paragraph 2.03 of Section 00 72 00, and completed and ready for final payment in accordance with paragraph 14.11 of Section 00 72 00 within **230 calendar days** after the date when the Contract Time commences to run.

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

1. Charges shall be made at such times and in such amounts as the Engineer shall invoice the Owner, provided however said charges shall be in accordance with the Engineer's current rate schedule at the time the costs are incurred.
2. The costs of the Engineer incurred after the specified final completion date shall 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 shall pay the Owner Five Hundred Dollars (\$500.00) for each day that expires after the time specified in paragraph 1.03.A above for Substantial Completion until the Work is Substantially Complete.

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

Owner shall 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 shall apply:

1. The person representing the Contractor who will submit written requests for progress payments shall be: _____
2. The person representing the Owner to whom requests for progress payments are to be submitted shall be: Designated Representative.
3. Contractor's representative, listed above, shall submit Applications for Payment on the form provided in the Contract Documents in accordance with Article 14 of 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:

1. Contractor has considered the nature and extent of the Contract Documents, Work, locality, and all local conditions and federal, state and local laws, and regulations that may affect cost, progress, performance, or furnishing of the Work.
2. Contractor has studied carefully all reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which were relied upon in the preparation of the Plans and Specifications and which have been identified in the Supplementary Conditions.

3. Contractor has made or caused to be made examinations, investigations and tests and studies of such reports and related data in addition to those referred to 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.
4. Contractor has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.
5. Contractor has given Engineer written notice of all conflicts, errors or discrepancies that he has discovered in the Contract documents and the written resolution thereof by Engineer is acceptable to 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:

1. 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).
2. This Agreement
3. Performance and other Bonds
4. Notice of Award
5. Notice to Proceed (if issued)
6. Conditions of the Contract (including Section 00 72 00 - General Conditions and Section 00 73 00 - Supplementary Conditions, if any)
7. Specifications contained within Division 01 through 49 of the Project Manual dated April 19, 2024
8. Plans bearing the following general title: Final CSO Compliance Program - Early Action Project
9. Addenda numbers _____ to _____, inclusive
10. Documentation submitted by the Contractor prior to Notice of Award
11. 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 shall 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 shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon the Owner and the Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

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

This Agreement will be effective on _____, 20____.

Owner: City of St. Joseph

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

Contractor: _____

By: _____

Authorized Signature: _____

Attest: _____

Address for giving notices:

License No. _____

Agent for service of process: _____

**SECTION 00 55 00
NOTICE TO PROCEED**

To: _____

Date: _____, 20____

Attention: _____

Project: Final CSO Compliance Program - Early Action Project

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.

In accordance with paragraph 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.

Also, in accordance with paragraph 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. A minimum of three (3) full working days' notice is required to set up the Pre-Construction Meeting. Also, please notify the Engineer three (3) full working days in advance of any staking requirements or other activity on the Project.

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

Owner: _____

Authorized Signature: _____

COPY TO: Wade Trim, Inc.

**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. Change Proposal
 3. Construction Change Requisition / Work Change Directive
 4. Field Order
 5. Non-Compliance Notice / Order to Remove Defective Work
 6. Open Items List
 7. Punch List Items
 8. Request for Final Inspection
 9. Request for Information
 10. Substitution Request Form
 11. Warranty Data Sheet

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 00 60 00

**SECTION 00 61 12
PERFORMANCE BOND**

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 shall in anywise affect its obligations on this bond, and it does hereby waive notice of any such change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the Work or to the Contract Documents.

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

Signed and sealed this day of _____, 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
LABOR AND MATERIAL PAYMENT BOND

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 Owner State, 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 _____

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

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

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

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

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

Signed and sealed this day of _____, 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 19
MAINTENANCE AND GUARANTEE BOND**

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

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

If Contractor or Surety shall fail to do as hereinbefore specified, they shall jointly and severally indemnify, 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 Total Balance Due This Certificate.

Certified By: _____ Date: _____

**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 shall ask, demand, sue for, or claim compensation from the Owner or its agents, and the Engineer or its agents, in addition to the regular items set forth in the Contract as dated above executed between myself and the Owner and in the Change Orders for Work issued by the Owner in writing as provided thereunder, except as I hereby make claim for additional compensation and/or extension of time, as set forth on the itemized statement attached hereto.

By: _____ Title: _____

**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:

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

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

Submitted By: _____

Signature: _____ Date: _____

Position: _____ Company: _____

Address: _____

Telephone: _____ Email: _____

**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. 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: _____ Final Completion: _____
Increase or Decrease from previously approved Change Order(s): \$ _____	Increase or Decrease from previously approved Change Order(s): Substantial Completion: _____ Final Completion: _____
Contract Price prior to this Change Proposal: \$ _____	Contract Time prior to this Change Proposal: Substantial Completion: _____ Final Completion: _____
Increase of this Change Proposal: \$ _____	Increase of this Change Proposal: Substantial Completion: _____ Final Completion (days): _____
Contract Price incorporating this Change Proposal: \$ _____	Contract Time incorporating this Change Proposal: Substantial Completion: _____ Final Completion: _____
Engineer's Decision on Change Proposal	

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

SECTION 00 65 16
CERTIFICATE OF SUBSTANTIAL COMPLETION

Project: Final CSO Compliance Program - Early Action Project

Owner: City of St. Joseph

Contractor: _____

Contract Date: _____ Project No.: _____

Date of Issuance: _____

Project or Designated Portion Shall Include: _____

The Work performed under this Contract has been reviewed and found to be Substantially Complete. The _____ 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 shall be as follows:

Owner shall have 45 days after receipt of this certificate during which he may make written objection to Engineer and Contractor as to any provisions of the certificate or attached list. Such objection may be cause for this Certificate of Substantial Completion to be null and void.

Engineer: _____

By: _____

Date: _____

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

Warning to Owner: Owner or Lessee of the property described herein may not rely 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 Compiled 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 he or she shall 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 his agreement therewith, including that the Change Order constitutes a final adjustment in the Contract Price or Contract Time for all issues addressed or described in the Change Order.
 8. Change Proposal -- A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 9. Claims --
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.
 - b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, arising after Engineer has issued a

recommendation of final payment.

- d. A demand for money or services by a third party is not a Claim.
10. Constituents of Concern -- Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
11. Contract -- The entire and integrated written contract between Owner and Contractor concerning the Work.
12. Contract Documents -- Those items so designated in the Agreement, and which together comprise the Contract.
13. Contract Price -- The monies or other considerations payable by Owner to Contractor for completion of acceptable Work in accordance with the Contract Documents as stated in the Agreement.
14. Contract Time -- The number of days or the date stated in the Agreement:
 - a. to achieve Substantial Completion of all or any specified portions of the Work, and;
 - b. to complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with paragraph 14.11.
15. Contractor -- The person, firm or corporation with whom Owner has entered into the Agreement.
16. Cost of the Work -- The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined in paragraph 12.01.
17. Day -- A calendar day of 24 hours measured from midnight to the next midnight.
18. Defective -- An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to Engineer's recommendation of final payment.
19. Drawings -- See Plans.
20. Effective Date of Agreement -- The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
21. Electronic Document -- Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
22. Electronic Means -- Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow:
 - a. the transmission or communication of Electronic Documents;
 - b. the documentation of transmissions, including sending and receipt;
 - c. printing of the transmitted Electronic Document by the recipient;
 - d. the storage and archiving of the Electronic Document by sender and recipient; and
 - e. the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

23. Engineer -- The person, firm, or corporation identified in the Supplementary Instructions to Bidders hired by Owner to prepare Plans and Specifications for the Project and to assist Owner in interpreting Plans and Specifications during the performance of the Work. Engineer's authority and responsibility are set forth in the Contract between Owner and Engineer. Contractor acknowledges and agrees that Engineer's obligations and duties under Engineer's contract with Owner are obligations and duties to Owner only, and Engineer has no independent obligation to Contractor of any kind, including but not limited to providing services, or to take any action or to refrain from taking action on behalf of Contractor or any Subcontractor, Sub-Subcontractor or Supplier.
24. Field Order -- A written order issued by Engineer which clarifies or interprets the Contract Documents or orders minor changes in the Work in accordance with 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 shall start to perform his obligation under the Contract Documents.
31. Owner -- The public body or authority, corporation, limited liability company, association, partnership, or individual with whom Contractor has entered into the Agreement and for whom the Work is to be provided and as identified in the Supplementary Instructions to Bidders.
32. Partial Utilization -- Use by Owner of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.
33. Plans -- The part of the Contract Documents which graphically show the extent, character and Scope of the Work to be furnished and performed by Contractor and which have been prepared or approved by Engineer or Owner; sometimes also referred to as Drawings.

34. Progress Schedule -- A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
35. Project -- The total construction of which the Work to be provided under the Contract Documents may be the whole or a part as indicated elsewhere in the Contract Documents.
36. Project Manual -- The volume assembled for the Project which may include, among other parts, Procurement Requirements, Contracting Requirements and Specifications.
37. Proposal -- The offer or bid of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
38. Radioactive Material -- Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 as amended.
39. Resident Project Representative -- The authorized representative of Engineer who may be assigned to the Site or any part thereof.
40. Samples -- Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
41. Schedule of Submittals -- A schedule, prepared and maintained by Contractor, of required Submittals and the time requirements for Engineer's review of the Submittals.
42. Schedule of Values -- A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
43. Shop Drawings -- All drawings, diagrams, illustrations, schedules and other data or information required by the Contract Documents which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate material or equipment for some portion of the Work.
44. Site -- Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
45. Specifications -- That part of the Contract Documents which consist of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.
 - a. Project Specifications are those portions of the Contract Documents which have been prepared specifically for this Project and which are identified by the job number in the lower right-hand corner of each page.
 - b. Standard Specifications are Specification sections that are the same from Project to Project as of the revision date shown in the lower left-hand corner of the page.
 - c. Standard Specification Section Revisions -- Section 00 9120 of the Specifications which amends or supplements the Standard Specification Sections.
46. Subcontractor -- An individual, firm or corporation having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
47. Submittal -- A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance

data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

48. Substantial Completion -- The Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer as evidenced by the Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by Engineer's written recommendation of final payment in accordance with paragraph 14.11. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.
49. Supplementary Conditions -- The part of the Contract Documents which amends or supplements these General Conditions.
50. Supplementary Instructions to Bidders -- The part of the Contract Documents which amends or supplements the Instructions to Bidders.
51. Supplier -- A manufacturer, fabricator, supplier, distributor, material man, or vendor having a direct contract with Contractor, or with any Subcontractor, or with Owner, to furnish materials or equipment to be incorporated in the Work by Contractor or any Subcontractor.
52. Unit Price -- Construction Work where Owner pays a fixed sum (Unit Price) per each completed unit of Work. Units are listed on the Proposal Form.
53. Utilities -- Underground or above ground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any structures or encasements containing such facilities, which have been installed to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems, water or other liquids or chemicals.
54. Work -- The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction, and performing or furnishing services and furnishing documents, all as required by the Contract Documents.
55. Work Change Directive -- A written directive to Contractor, issued on or after the Effective Date of the Agreement and signed by Owner and reviewed by Engineer, ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed as provided in paragraph 4.03 or to emergencies under paragraph 6.18. A Work Change Directive will not change the Contract Price or Contract Time but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Time as provided in paragraph 10.01.

1.02 TERMINOLOGY

- A. The following words, terms, or phrases are not defined but, when used in the Contract Documents, have the following meaning:
 1. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," "as allowed," "as approved" or terms of like effect or import are used; or the adjectives "reasonable," "suitable," "acceptable," "proper" or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review or judgment of Engineer as to the Work, it is intended that such requirement, direction, review or judgment will be solely to evaluate, in general, the completed Work for compliance with the technical requirements of and information in the Contract Documents and conformance with the

design concept of the completed Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective shall not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of paragraph 9.10 or any other provision of the Contract Documents.

2. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 3. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 4. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 5. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
- B. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS AND INSURANCE

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

2.02 COPIES OF DOCUMENTS

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

2.05 PRECONSTRUCTION MEETING

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

- B. Prior to the scheduling of the Preconstruction Meeting, Contractor shall submit to Engineer for review:
 - 1. A preliminary Progress Schedule indicating the starting and completion dates of the various stages of the Work, including any Milestones specified in the Contract Documents;
 - 2. A preliminary Schedule of Submittals which will list each required Submittal and the times for submitting, reviewing and processing such Submittal;
 - 3. An estimated monthly payment schedule, and a preliminary Schedule of Values for all of the Work.
- C. The Preconstruction Meeting will be held for review and acceptance of the schedules, to establish procedures for handling Shop Drawings and other Submittals, for processing Applications for Payment, and to establish a working understanding among the parties as to the Work.

2.06 ELECTRONIC TRANSMITTALS

- A. Except as otherwise stated elsewhere in the Contract, Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3 CONTRACT DOCUMENTS INTENT AND REUSE

3.01 INTENT

- A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations; or

3. any obligation on the part of Engineer to Contractor.

3.02 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard, specification, manual, or Laws or Regulations in effect at the time of opening of Bids or, on the effective date of the Agreement if there were no Bids, except as may be otherwise specifically stated in the Contract Documents.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any Work, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result shall be furnished and performed whether or not it is specifically called for.
- C. No provision of any standard, specification, manual, code or instruction shall be effective to change the duties and responsibilities of Owner, Contractor or Engineer, or any of their Subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Owner, Engineer or any of Engineer's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of paragraph 9.10 or any other provision of the Contract Documents.

3.03 REPORTING AND RESOLVING DISCREPANCIES

- A. Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor has a duty to and shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor should reasonably have discovered and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
- B. If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity or discrepancy within the Contract Documents or between the Contract Documents and any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, Contractor shall report it to Engineer in writing at once, and, Contractor shall not proceed with the Work affected thereby (except in an emergency as authorized by paragraph 6.18) until receiving written instruction or clarification from Engineer or Owner. However, Contractor shall not be liable to Owner or Engineer for failure to report any such conflict, error, ambiguity or discrepancy unless Contractor knew or reasonably should have known thereof.
- C. Except as otherwise specifically stated in the Contract Documents or as may be provided by amendment or supplement issued by one of the methods indicated in paragraph 3.05, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity or discrepancy between the provisions of the Contract Documents and;
 1. the provisions of any standard, specification, manual, code or instruction (whether or not specifically incorporated by reference in the Contract Documents); or
 2. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 REQUIREMENTS OF CONTRACT DOCUMENTS

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

Contract Documents, and judge of the acceptability of the Work.

- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve
 - 1. the performance or acceptability of the Work under the Contract Documents,
 - 2. the design (as set forth in the Drawings, Specifications, or otherwise), or
 - 3. other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in paragraph 11.01.

3.05 ORDER OF PRECEDENCE

- A. In resolving conflicts, errors or discrepancies between Plans and Specifications,
 - 1. figured dimensions shall govern over scaled dimensions;
 - 2. Plans shall govern over Standard Specifications;
 - 3. and Project Specifications shall govern over Standard Specifications and Plans.

3.06 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

- A. The Contract Documents may be amended to provide for additions, deletions and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:
 - 1. a Field Order (pursuant to paragraph 9.05), or,
 - 2. a Change Order (pursuant to paragraph 10.01.A.1), or
 - 3. a Work Change Directive Order (pursuant to paragraph 10.01.A.2)
- B. In addition, the requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, in one or more of the following ways:
 - 1. a Field Order (pursuant to paragraph 9.05),
 - 2. Engineer's review of a Shop Drawing or Sample (pursuant to paragraph 6.21), or
 - 3. Engineer's written interpretation or clarification (pursuant to paragraph 9.04).

3.07 REUSE OF DOCUMENTS

- A. Neither Contractor nor any Subcontractor, manufacturer, fabricator, Supplier, distributor, or other person or organization performing or furnishing any of the Work under a direct or indirect contract with Owner:
 - 1. shall have or acquire any title to or ownership rights in any of the Plans, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or Engineer's Consultant, and
 - 2. they shall not reuse any of such Plans, Specification, other documents or copies on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

3.08 ELECTRONIC DATA

- A. Except as otherwise stated elsewhere in the Contract Documents, Owner, Engineer and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information and graphics, including but not limited to Shop Drawings and

other Submittals, in electronic media or digital format, either directly or through access to a secure Project website.

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

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

4.01 AVAILABILITY OF LANDS

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

4.02 SUBSURFACE AND PHYSICAL CONDITIONS; INVESTIGATIONS AND REPORTS

- A. Reference is made to the Supplementary Conditions for identification of those reports of investigations and tests of subsurface and physical conditions at the Site or otherwise affecting cost, progress or performance of the Work which have been reviewed in preparation of the Contract Documents. Such reports are not guaranteed as to accuracy or completeness and are not part of the Contract Documents.
- B. The locations of utilities or other physical conditions relating to existing surface or subsurface structures at or contiguous to the Site as shown on the Plans are taken from drawings from sources believed to be reliable. Neither Owner nor Engineer will be responsible for any omissions of, or variations from, the indicated location of existing utilities which may be encountered in the Work.
- C. Contractor shall draw its own conclusions as to the general accuracy of the "technical data" contained in such reports and drawings, and confirms such reports and drawings are not Contract Documents. Contractor may not rely upon or make any Claim against Owner, Engineer or any of Engineer's Consultants with respect to:
 - 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 shall 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 shall immediately notify Owner and Engineer of the physical condition; and follow up within 48 hours in writing:
1. A subsurface or a physical condition at the Site differing materially from those indicated in the Contract Documents, or
 2. An unknown physical condition at the Site of a nature differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for the improvement project.
- B. **Engineer's Review.** After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in paragraph 4.03.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. **Owner's Statement to Contractor Regarding Site Condition.** After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. **Possible Price and Times Adjustments:**
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in paragraph 4.03.A;
 - b. with respect to Work that is paid for on a Unit Price basis, any adjustment in Contract Price will be subject to the provisions of paragraph 12.03; and
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times pursuant to paragraph 10.05.
 2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by paragraph 4.03.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order or Work Change Directive.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of Owner's written statement to Contractor regarding the subsurface or physical condition in question.

4.04 UTILITIES

- A. Contractor's Responsibilities. The information and data shown or indicated in the Contract Documents with respect to existing Utilities at or adjacent to the Site, if any, is based on information and data furnished to Owner or Engineer by the owners of such Utilities, including Owner, or by others.
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Utilities at the Site;
 - b. locating all Utilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Utilities, during construction; and
 - d. the safety and protection of all existing Utilities at the Site, and repairing any damage thereto resulting from the Work.
- B. Notice by Contractor. If Contractor believes that an Utilities that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by paragraph 6.18), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.
- C. Engineer's Review. Engineer will:
 1. promptly review the Utilities and conclude whether such Utilities was not shown or indicated in the Contract Documents,
 2. or was not shown or indicated with reasonable accuracy;
 3. obtain any pertinent cost or schedule information from Contractor;
 4. prepare recommendations to Owner regarding 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 shall 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 shall issue a written statement to Contractor (with a copy to Engineer) regarding the Utilities in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's

written findings, conclusions, and recommendations in whole or in part.

F. Possible Price and Times Adjustments:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Utilities at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Utilities in question;
 - b. With respect to Work that is paid for on a Unit Price basis, any adjustment in Contract Price will be subject to the provisions of paragraph 12.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in paragraph 4.04.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of Owner's written statement to Contractor regarding the Underground Facility in question.

4.05 REFERENCE POINTS

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

4.06 CONSTITUENTS OF CONCERN

- A. Owner shall be responsible for any Constituents of Concern uncovered or revealed at the Site which was not shown or indicated in Plans or Specifications or identified in the Contract Documents to be within the scope of the Work and which may present a substantial danger to persons or property exposed thereto in connection with the Work at the Site. Owner shall not be responsible for any such materials brought to the Site by Contractor, Subcontractor, Suppliers or anyone else for whom Contractor is responsible.
- B. Upon discovering any such material, Contractor shall immediately:
 1. stop all Work in connection with such Hazardous Environmental Condition and in any area affected thereby (except in emergency as required by paragraph 6.18), and
 2. notify Owner and Engineer (and thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such Hazardous Environmental Condition or take corrective action, if any.
- C. Contractor shall not be required to resume Work in connection with such Hazardous Environmental Condition or in any such affected areas until after Owner has obtained any

required permits related thereto and delivered to Contractor special written notice:

1. specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or
 2. specifying any special conditions under which such Work may be resumed safely.
- D. If Owner and Contractor cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Terms as a result of such Work stoppage or such special conditions under which Work is agreed by Contractor to be resumed, either party may make a Claim therefor as provided in paragraph 11.01.
- E. If after receipt of such special written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order such portion of the Work that is in connection with such condition, or in such affected area, to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to, or the amount, or extent of an adjustment, if any, in Contract Price or Contract Time as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in paragraph 11.01. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with paragraph 7.01.
- F. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, Engineer, Engineer's Consultants and the officers, directors, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from such condition per this paragraph 4.06, provided that:
1. any such claim, cost, loss or damage is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, and
 2. nothing in this paragraph 4.06 shall obligate Owner to indemnify any person or entity from and against the consequences of that person's or entity's own negligence.
- G. The provisions of paragraph 4.03 are not intended to apply to the presence of Constituents of Concern or Hazardous Environmental Conditions uncovered or revealed at the Site.

ARTICLE 5 BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

- A. Contractor shall furnish performance and payment Bonds, on the form included in the Contract Documents, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These Bonds shall remain in effect at least until 1 year after the date when final payment becomes due, except as otherwise provided by Laws and Regulations or as specified in the Contract Documents or Bond. Contractor shall also furnish such other Bonds as are required by the Supplementary Conditions.
- B. All Bonds shall be in the forms prescribed by the Contract Documents and be executed by such Sureties as
1. are licensed to conduct business in the state where the Project is located, and
 2. are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch.
- C. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.
- D. If Surety on any Bond furnished by Contractor is declared as bankrupt or becomes insolvent, or its right to do business is terminated in any state where any part of the Project is located, or it ceases to meet the requirements of clauses (1) and (2) of paragraph 5.01, Contractor shall

within 5 days thereafter substitute another Bond and Surety, both of which shall be acceptable to Owner.

5.02 LICENSED INSURERS AND SURETIES

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

5.03 INSURANCE

- A. Contractor shall purchase and maintain during the term of the Project such insurance as will protect him, Owner(s) and Engineer(s) from Claims arising out of the Work described in this Contract and performed by Contractor, Subcontractor(s) or Sub subcontractor(s) consisting of:
 - 1. Workers' Compensation Insurance including Employer's Liability to cover employee injuries or disease compensable under the Workers' Compensation Statutes of the states in which Work is conducted under this Contract; disability benefit laws, if any; or Federal compensation acts such as U.S. Longshoremen or Harbor Workers', Maritime Employment, or Railroad Compensation Act(s), if applicable. Self-insurance plans approved by the regulatory authorities in the state in which Work on this Project is performed are acceptable.
 - 2. An occurrence form Commercial General Liability policy to cover bodily injury to persons other than employees and for damage to tangible property, including loss of use thereof, plus appropriate endorsements to protect Owner and Engineer against Claims, demands, and lawsuits from employees of Contractor and Subcontractors, including the following exposures:
 - a. All premises and operations.
 - b. Explosion, collapse and underground damage.
 - c. Contractor's Protective coverage for independent contractors or Subcontractors employed by him.
 - d. Broad form blanket, contractual liability for the obligation assumed in the Indemnification or Hold Harmless agreement found in the General Conditions or Supplementary Conditions of this Contract.
 - e. Personal Injury Liability endorsement with no exclusions pertaining to employment.
 - f. Products and Completed Operations coverage. Coverage shall extend through the Contract guarantee period.
 - g. Broad form property damage.
 - h. Cross liability endorsement.
 - i. For design professional additional insureds, ISO Endorsement CG 20 32 04 13, "Additional Insured-Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
 - 3. Comprehensive Automobile Liability policy to cover bodily injury and property damage arising out of the ownership, maintenance or use of any motor vehicle, including owned, non-owned and hired vehicles. Comprehensive General Liability and the Comprehensive Auto Liability shall be written by the same insurance carrier, though not necessarily in one policy.
 - 4. Contractor shall purchase for Owner an Owner's Protective Liability policy to protect Owner, Engineer, their consultants, agents, employees and such public corporations in whose jurisdiction the Work is located for their liability for Work performed by Contractor, the Subcontractor(s) or the Sub subcontractor(s) under this Contract.

5. When a limit of liability is identified in the Supplementary Conditions, Contractor shall purchase a Builder's Risk Installation Floater in a form acceptable to Owner covering property of the Project for the full cost of replacement as of the time of any loss which shall include, as named insureds,
 - a. Contractor,
 - b. all Subcontractors,
 - c. all Sub subcontractors,
 - d. Owner, and Engineer(s) or Architect(s), as their respective interests may prove to be at the time of loss, covering insurable property which is the subject of this Contract, whether in place, stored at the Site, stored elsewhere, or in transit at the risk of the insured(s).
 - e. Coverage shall be effected on an "All Risk" form including, but not limited to, the perils of fire, wind, vandalism, collapse, theft, flood and earthquake, with removal of passive design error exclusion. Except as may otherwise be required by Owner, Contractor may arrange for such deductibles as Contractor deems to be within Contractor's ability to self-assume, but Contractor will be held solely responsible for the amount of such deductible and for any co-insurance penalties. Any insured loss shall be adjusted with Owner and Contractor and paid to Owner and Contractor as Trustee for the other insureds.
 6. Umbrella or Excess Liability:
 - a. Contractor is granted the option of arranging coverage under a single policy for the full limit required or by a combination of underlying policies with the balance provided by an Excess or Umbrella Liability policy equal to the total limit(s) requested. Umbrella or Excess policy wording shall be at least as broad as the primary or underlying policy(ies) and shall apply both to Contractor's General Liability and Automobile Liability Insurance and shall be written on an occurrence basis.
 7. Railroad Protective Liability:
 - a. Where any of the Work is within a railroad right-of-way or where a limit of liability is identified in the Supplementary Conditions, Contractor will provide coverage in the name of each railroad company having jurisdiction over rights of way across which Work under the Contract is to be performed. The form of policy and the limits of liability shall be determined by the railroad company(ies) involved. See 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 shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against Claims arising out of performance of professional design or related services caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- B. Owner's responsibilities in respect of purchasing and maintaining insurance are set forth below:
1. Owner shall assume responsibility for such boiler and machinery insurance as may be required or considered to be necessary by Owner in the course of construction, testing or after completion.
 - a. Owner shall assume responsibility for such insurance as will protect Owner against any loss of use of Owner's property due to those perils insured pursuant to paragraph

1 above.

5.04 LIMITS OF LIABILITY

- A. The required limits of liability for insurance coverages required in paragraphs 5.03 shall be not less than those specified in 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 shall be given to Owner and to Engineer of cancellation, intent not to renew, or material modification of the coverage.

5.06 EVIDENCE OF COVERAGE

- A. Prior to commencement of the Work, Contractor shall furnish to Owner and Engineer, Certificates of Insurance in force on current Accord® Certificate of Insurance form. Other forms of Certificate are acceptable only if;
 - 1. they include all of the items prescribed in the current Accord® Certificate of Insurance form, including agreement to cancellation provisions outlined in paragraph 5.05 above; and
 - 2. they have approval of Owner and Engineer.
- B. Prior to the commencement of the Work, Contractor shall furnish to Owner complete "originally signed" copies of the Owner's Protective Liability Policy. The number of copies shall be the same as the number of counterparts of the Agreement. Owner reserves the right to request complete copies of other policies if deemed necessary to ascertain details of coverage not provided by the certificates. Such policy copies shall be "Originally Signed Copies," and so designated.

5.07 QUALIFICATION OF INSURERS

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

5.08 DAMAGE CLAIMS - ACKNOWLEDGMENT AND REPORTS

- A. Contractor shall furnish to Owner an acknowledgment receipt from the insurance carrier for each damage claim against the Project. The receipt shall include the insurance carrier's assigned claim number.
- B. Upon request, Contractor or his insurance carrier shall also furnish to Owner a status report on all damage claims. This report shall include inspections made, the disposition of claims, and what action has been taken towards settlement of each claim.
- C. Failure of Contractor to comply with this paragraph 5.08 may result in the amount of such damage claims being withheld from Contractor's monthly pay estimate. Such withholding shall be reimbursed in the monthly pay estimate following compliance with this paragraph.

5.09 COST OF INSURANCE

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

5.10 WAIVER OF RIGHTS

- A. Owner and Contractor intend that all policies purchased in accordance with paragraph 5.03 will protect Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants (and all other persons or entities identified in the Supplementary General Conditions to be listed as insureds or additional insureds in such policies) and will provide primary coverage for all losses and damages caused by the perils covered thereby. Such policies shall contain provisions to

- 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 shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

5.11 RECEIPT AND APPLICATION OF INSURANCE PROCEEDS

- A. Any insured loss under the policies of insurance required by paragraph 5.03.A.5 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause. If no other special agreement is reached the damaged Work shall be repaired or replaced, the monies so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order, Field Order or Work Change Directive.
- B. Owner as fiduciary shall have power to adjust and settle any loss under the policies required by paragraph 5.03.A.5 with the insurers unless one of the parties in interest shall object in writing within fifteen days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers.

ARTICLE 6 CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

- A. Contractor shall supervise and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction. Contractor shall be responsible to see that the finished Work complies with the Contract Documents. However, if specific means, methods, techniques, sequences and procedures of construction are prescribed in the Plans or Specifications, Contractor shall be responsible to comply therewith, but may implement such prescribed Work in a manner of Contractor's choosing so long as the Work complies with the requirements of the Plans and Specifications.
- B. At all times during the progress of the Work, Contractor shall assign and maintain a competent superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances. Any superintendent or foreman who neglects to have Work done in accordance with the Plans and Specifications shall be removed from the Project. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to the superintendent shall be as binding as if given to Contractor.

6.02 LABOR AND WORKING HOURS

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

6.03 SERVICES, MATERIALS AND EQUIPMENT

- A. Unless otherwise specified in the Contract Documents, Contractor shall furnish and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities and all other facilities and incidentals necessary for the furnishing, performance, testing, start up and completion of the Work.
- B. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Contract Documents shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence, (including reports of required tests) as to the kind and quality of materials and equipment to be incorporated in the Work. Contractor shall 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, shall be plainly marked and removed immediately from the Work.
- C. All materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with the instructions of the applicable manufacturer, fabricator, Supplier or distributor, except as otherwise provided in the Contract Documents.

6.04 SUBSTITUTES AND "OR-EQUALS"

- 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 shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment or means, methods, techniques, sequences and/or procedures proposed is essentially equivalent to that named and an acceptable substitute therefor. The procedure for review by Engineer will include the following, as supplemented in the Specifications, and as Engineer may decide is appropriate under the circumstances. Requests for review of substitute items of material and equipment will not be accepted by Engineer from anyone other than Contractor.
- C. If Contractor wishes to furnish or use a substitute, Contractor shall make written application to Engineer on the Substitution Request Form provided for acceptance thereof, certifying that the proposed substitute will:
 - 1. perform adequately the functions and achieve the results called for by the general design,

2. be similar in substance to that specified,
 3. and be suited to the same use and capable of performing the same function as that specified.
 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 shall be identified in the application and available maintenance, repair and replacement service shall be indicated. The application shall also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.
- E. All data to be provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's expense. Engineer will be the sole judge of acceptability, and Engineer's determination shall be final and binding, may not be reversed through an appeal under any provisions of the Contract Documents, and no "or-equal" or substitute shall be ordered, installed or utilized without Engineer's prior written acceptance. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute which has been approved by Engineer.
- F. Engineer will record time required by Engineer and Engineer's consultants in evaluating substitutions proposed by Contractor and in making changes in the Contract Documents occasioned thereby. Whether or not Engineer accepts a proposed substitute, Contractor shall reimburse Owner for the charges of Engineer and Engineer's consultants for evaluating any proposed substitute and in making any changes in the Contract Documents resulting therefrom.

6.05 CONCERNING SUBCONTRACTORS

- A. Contractor shall not employ any Subcontractor, Supplier or other person or organizations, including those who are to furnish the principal items of materials or equipment, whether initially or as a substitute, against whom Owner or Engineer may have reasonable objection. Contractor shall furnish Engineer a complete list of any Subcontractor, Supplier or other person or organization furnishing principal items of material or equipment within 4 days of request. Failure to object to any Subcontractor, Supplier, other person or organization by Owner or Engineer shall not constitute a waiver of any right of Owner or Engineer to reject defective Work.
- B. If Owner or Engineer, after due investigation, has reasonable objection to any Subcontractor, Supplier, other person or organization proposed by Contractor after the Notice of Award, Contractor shall submit an acceptable substitute and the Contract Price shall be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate Change Order shall be issued. Contractor shall not be required to employ any Subcontractor, Supplier, other person or organization against whom Contractor has reasonable objection.
- C. Contractor shall not award Work to Subcontractor(s), in excess of 50% of the Contract Price, without prior written approval of Owner.
- D. Contractor shall be fully responsible for all acts and omissions of his Subcontractors, Suppliers and of persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier of other person or organization any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other person or organization, nor

shall it create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any Subcontractor, Supplier or other person or organization. Owner or Engineer may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, evidence of amounts paid to Contractor on account of specific Work done.

- E. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with Contractor. Contractor shall require all Subcontractors, Suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with 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 his subcontract, and for the same purpose and under the same specifications as those of the general Contract. The Surety on the general Contract shall not be eligible to furnish such Subcontract Bonds.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as and additional insured on the property insurance provided in paragraph 5.03.A.5, the agreement between Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, Engineer's Consultants and all other additional insureds for all losses and damages caused by, arising out of or resulting from any of the perils covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same. Contractor shall file a true copy of such agreement with Owner.

6.06 PATENT FEES AND ROYALTIES

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product or device is specified in the Contract Documents for use in the performance of the Work and if to the actual knowledge of Owner or Engineer its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Contractor shall defend, indemnify and hold harmless Owner and Engineer and anyone directly or indirectly employed by either of them from and against all claims, costs, losses, damages and expenses arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not specified in the Contract Documents, and shall defend all such claims in connection with any alleged infringement of such rights.

6.07 PERMITS AND LICENSES

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

6.08 LAWS AND REGULATIONS

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

Regulations.

- B. If Contractor performs any Work that is contrary to such laws, ordinances, rules and regulations, Contractor shall bear all claims, costs, losses, damages and expenses caused by, arising out of, or resulting therefrom. However, it shall not be Contractor's primary responsibility to make certain that the Specifications and Plans are in accordance with such laws, ordinances, rules, and regulations, but this shall not relieve Contractor of Contractor's obligations under paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated Contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to, or on the amount, or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

6.09 TAXES

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

6.10 USE OF PREMISES

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

6.11 REMOVAL OF DEBRIS AND CLEANING

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

6.12 LOADING STRUCTURES

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

6.13 PROTECTION OF UTILITIES

- A. When it is possible for construction operations to endanger any public or private utility, conduit, or structure, Contractor shall notify the utility owner of this possibility, and safeguard and support such utilities, conduits, or structures. Where it is the policy of any utility owner to make

its own repairs to damaged conduit or other structures, Contractor shall cooperate to the fullest extent with the utility, and he shall see that his operations interfere as little as possible with these operations, and Contractor shall assume the cost of any charge against Owner therefor. In cases where existing Utilities or Utility service connections are encountered, Contractor shall perform his operations in such a manner that service will be uninterrupted, and the cost thereof shall be at Contractor's expense, unless otherwise provided.

6.14 RECORD DOCUMENTS

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

6.15 SAFETY AND PROTECTION

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
 - 1. all persons on the Work Site or who may be affected by the Work,
 - 2. all the Work and materials or equipment to be incorporated therein, whether in storage on or off the Site, and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and Utilities and not designated for removal, relocation or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property, Utilities, and utility owners when prosecution of the Work may affect them.
- C. Contractor shall restore, at his own expense, any public or private property damaged or injured in consequence of any act or omission on his part, or on the part of his employees or agents, to a condition equal or better than that existing before such injury or damage was done. If Contractor neglects to restore or make good such damages or injury, Owner may, upon 48 hours' notice, proceed to restore or make good such damage or injury and to order the cost thereof deducted from any monies that are due, or may become due, to Contractor for this Work.
- D. Contractor's duties and responsibilities for the safety and protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with paragraph 14.11 that the Work is Acceptable.
- E. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- F. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- G. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with paragraph 14.11 that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- H. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction

obligations, or to conduct other tasks arising from the Contract Documents.

6.16 SAFETY REPRESENTATIVE

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

6.17 HAZARD COMMUNICATION PROGRAM

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

6.18 EMERGENCIES

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

6.19 SHOP DRAWINGS AND SAMPLES

- A. Contractor shall submit Shop Drawings required by the Contract Documents to Engineer for review, in accordance with an accepted schedule. All Submittals will be identified as Engineer may require and in the number of copies specified in the Specifications. The data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials and similar data to show Engineer the materials and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by paragraph 6.21.
- B. Contractor shall also submit all samples required by the Contract Documents to Engineer for review in accordance with an accepted schedule. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalog numbers, the use for which intended, and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by paragraph 6.21. The number of each sample to be submitted will be as specified in the Specifications.

6.20 SUBMITTAL PROCEDURES

- A. Before submitting each Shop Drawing or Sample, Contractor shall have determined and verified:
 - 1. all field measurements, quantities, dimension, specified performance criteria, installation requirements, manufacturer's recommendations, material, catalog numbers and similar information with respect thereto,
 - 2. all materials with respect to intended use, fabrication, shipping, handling, storage, assembly and installation pertaining to the performance of the Work, and
 - 3. all information relative to Contractor's responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programs incident thereto.
- B. Contractor shall have reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.
- C. Each Submittal will bear a stamp or specific written indication that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to review and approval of that Submittal.

- D. At the time of each submission, Contractor shall in writing call Engineer's attention to any deviations that the Shop Drawings or Samples may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawing's or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review of each such variation.
- E. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
- F. Contractor shall furnish required Submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
- G. If Contractor requests a change of a previously approved Submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

6.21 ENGINEER'S REVIEW

- A. Engineer will review Shop Drawings and Samples in accordance with the Schedule of Submittals accepted by Engineer as required by paragraph 2.05. Engineer's review shall be only for conformance with the design concept of the Project and for compliance with the information given in the Contract Documents and shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto. The review of a separate item as such will not indicate review of the assembly in which the item functions.
- B. Engineer's review of Shop Drawings or samples shall not relieve Contractor from responsibility for any variations from the Contract Documents unless Contractor has in writing called Engineer's attention to such variation at the time of submission and Engineer has given written concurrence to the specific variation, nor shall any concurrence by Engineer relieve Contractor from responsibility for errors or omissions in the Shop Drawings. Engineer's review shall not relieve Contractor from responsibility for complying with the requirements of paragraph 6.20.
- C. Where a Shop Drawing or sample is required by the Contract Documents or the Schedule of Submittals accepted by Engineer per paragraph 2.05, no related Work shall be commenced until the Submittal has been reviewed by Engineer.

6.22 CONTINUING THE WORK

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

6.23 CONTRACTOR'S GENERAL WARRANTY AND GUARANTEE

- A. Contractor warrants and guarantees to Owner, Engineer, and Engineer's Consultants that all work will be in accordance with the Contract Documents and will not be defective. Contractor's warranty and guarantee excludes defects or damage caused by:
 - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or their employees, agents, or representatives, or any person or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- B. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that

is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;
 2. recommendation of any progress or final payment by Engineer;
 3. the issuance of a certificate of Substantial Completion or any payment by Owner to Contractor under the Contract Documents;
 4. use or occupancy of any part of the Work by Owner;
 5. any acceptance by Owner or failure to do so;
 6. any review or approval of a Shop Drawing or Sample Submittal or the issuance of a notice of acceptability by Engineer per paragraph 14.11;
 7. any inspection, test or approval by others; or
 8. any correction of defective Work by Owner.
- C. If Contract requires Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned Contract.
- D. Contractor shall assign to Owner all warranties extended to Contractor by material Suppliers and Subcontractors. If an assignment of warranty requires the material Supplier or Subcontractor to consent to same, then Contractor shall secure the material Supplier's or Subcontractor's consent to assign said warranties to Owner.
- E. The warranties provided in this section shall be in addition to, and not in limitation of, any other warranty or remedy required by law.

6.24 INDEMNIFICATION

- A. To the fullest extent permitted by law, Contractor shall indemnify, defend (with counsel acceptable to Owner) and hold harmless Owner, Engineer and any additional indemnitees identified in the Supplementary Conditions and their respective directors, officers, members, partners, affiliates, employees, agents and successors, from and against any and all liabilities, claims, causes of action, lawsuits, liens, injuries, damages, losses and expenses (collectively "Demands") to the extent caused by, arising out of, resulting from or occurring in connection with:
1. Contractor's breach of, or failure to comply with, the Agreement, the Contract Documents, or any other contract that it enters into regarding the Work, including any default in performance; or
 2. Personal injury or death to any person (including, but not limited to, Contractor, Contractor's employees, Subcontractors, Subcontractors' employees, and material Suppliers) or injury to or destruction of property (including claims for loss of use) caused by, arising out of, resulting from, or in any way connected with
 - a. the Work,
 - b. any activity associated with the Work, or
 - c. the operations or acts of commission or omission of Contractor, Contractor's employees, Subcontractors, Subcontractors' employees, material suppliers, or anyone for whom Contractor is legally liable in the performance of Work, whether arising before or after completion of the Work.
- B. To the extent caused by, arising out of, resulting from, or occurring in connection with the provisions of the above paragraph 6.24.A, Contractor's indemnity obligations under this Agreement shall include, but are not limited to:

1. Indemnity for all damages and judgment interest, all costs and fees, including, but not limited to, all defense costs, expenses and actual attorneys' fees, and all settlement payments relating to, arising out of, resulting from or in any way connected with any demand requiring indemnity by this Agreement;
 2. All expenses, including but not limited to, costs, expenses and actual attorneys' fees, incurred in securing and enforcing indemnity from Contractor if Contractor fails or refuses promptly to fulfill any of the indemnity obligations under this Agreement;
 3. All indemnification obligations imposed upon Owner or Engineer, or both, arising out of or in connection with the Work; and
 4. Indemnification for any penalties and/or fines arising or resulting from Contractor's or any Subcontractor's failure to comply with laws and/or regulations applicable to its/their Work.
- C. Contractor's duty to indemnify under subpart A.2. of 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 shall not be construed to negate, abridge, or otherwise reduce any other right or obligations of indemnity which would otherwise exist.
- E. Owner, at its option, may select counsel to defend any demand brought against it without impairing any obligation of Contractor to provide indemnification.
- F. The indemnification provisions under this Agreement shall survive the completion or termination of this Agreement.
- G. In the case of claims by any employee of Contractor, anyone directly or indirectly employed by Contractor, or anyone for whose acts Contractor may be liable, the indemnification obligations under this Agreement shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for Contractor under workers' compensation acts. Such obligations shall not be construed to negate, abridge or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Agreement.
- H. Indemnification, additional insured and hold harmless obligations of Contractor and Subcontractor under the Contract Documents shall survive the termination of this Agreement.
- I. Contractor and Subcontractors will compel their insurance company to waive subrogation against Owner, 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 shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, equipment, structures, means, methods, techniques or sequences of construction are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a professional properly licensed in the state in which the project is located, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other Submittals prepared by such professional. Shop Drawings and other Submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals.
- D. Pursuant to this paragraph 6.25, Engineer's review or approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review or approval of Shop Drawings and other Submittals (except design calculations and design drawings) will be only for the purpose stated in paragraph 6.21.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 7 WORK BY OTHERS

7.01 RELATED WORK AT SITE

- A. In addition to and apart from the Work under the Contract Documents, 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 shall inspect and promptly report to Engineer in writing any delays, defects or deficiencies in such other work that render it unavailable, or unsuitable for such proper execution and results of Contractor's Work. Contractor's failure to so report shall constitute an acceptance of the other work as fit and proper for integration with Contractor's Work except for latent or non-apparent defects and deficiencies in the other work.
- C. Contractor shall afford each contractor who is party to such a direct contract, and each utility owner, (and Owner, if Owner is performing the additional work with Owner's employees), proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, Contractor shall do all cutting, fitting and patching of Contractor's Work that may be required to make its several parts come together properly and integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating or otherwise altering their work and will only cut or alter their work with the written consent of Engineer and the others whose work will be affected.
- D. If the performance of additional work by other contractors, utility owner, or Owner was not noted in the Contract Documents, written notice thereof shall be given to Contractor prior to starting any such additional work. If Contractor believes that the performance of such additional work by Owner or others involves additional expense to Contractor, or requires an extension of the Contract Time, Contractor may make a Claim therefor as provided in paragraph 11.01. Claims for delay or inconveniences due to operations of such other parties for work noted in the Contract Documents will not be allowed.

ARTICLE 8 OWNER'S RESPONSIBILITIES

8.01 COMMUNICATION TO CONTRACTOR

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

8.02 REPLACEMENT OF ENGINEER

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

8.03 FURNISHING DATA

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

8.04 PAY WHEN DUE

- A. Owner shall make payments to Contractor promptly after they are due as provided in paragraphs 14.05 and 14.11.

8.05 LANDS AND EASEMENTS; REPORTS AND TESTS

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

8.06 CHANGE ORDERS

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

8.07 INSPECTIONS, TESTS, AND APPROVALS

- A. Owner's responsibility in respect to certain inspections, tests and approvals is set forth in paragraph 13.02.

8.08 LIMITATION ON OWNER'S RESPONSIBILITY

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

8.09 UNDISCLOSED HAZARDOUS MATERIALS

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

8.10 OWNER'S DESIGNATED REPRESENTATIVE

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

ARTICLE 9 ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

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

9.02 VISITS TO SITE

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

9.03 RESIDENT PROJECT REPRESENTATIVE

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

Resident Project Representative's duties and responsibilities include:

1. Schedules:
 - a. Review the Progress Schedule, Schedule of Submittals and Schedule of Values prepared by Contractor.
2. Conferences:
 - a. Arrange a schedule of progress meetings and other job conferences as required in consultation with Engineer and Owner, and notify those expected to attend in advance.
3. Liaison:
 - a. Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist him in understanding the intent of the technical aspects of the Contract Documents. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on Site operations.
4. Shop Drawings and Samples:
 - a. Advise Engineer and Contractor, or Contractor's superintendent, immediately of the commencement of any Work requiring a Shop Drawing or Sample submission if the submission was identified on the schedule and has not been reviewed by Engineer.
5. Review of Work, Rejection of Defective Work, Inspections, and Tests:
 - a. Conduct on Site observations of the Work and report to Engineer whenever Resident Project Representative believes that technical aspects of any executed Work is unsatisfactory, faulty or defective or does not meet the requirements of any inspections, tests or approval required to be made or has been damaged prior to final payment; and advise Engineer when Resident Project Representative believes that any partially completed portion of the Work should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
 - b. Observe, record and report to Engineer appropriate details relative to test procedures and startups.
 - c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the outcome of these inspections and report to Engineer.
6. Modifications:
 - a. Consider Contractor's suggestions for modifications in Plans or Specifications and report them to Engineer.
7. Reports:
 - a. Prepare periodic reports as required of progress of the Work and Contractor's compliance with the approved Progress Schedule and Schedule of Submittals.
8. Completion:
 - a. Verify that all items on final list of items requiring completion or correction have been completed or corrected and make recommendations to Engineer concerning acceptance.
9. Exceptions:
 - a. Resident Project Representative:
 - 1) Shall not authorize any deviation from the Contract Documents or approve any substitute materials or equipment.
 - 2) Shall not approve or accept any portion of the completed Work.

- 3) Shall not undertake any of the responsibilities of Contractor, Subcontractors or Contractor's superintendent, or expedite the Work.
- 4) Shall not advise on or issue directions relative to any aspect of the means, methods, techniques, sequences or procedures of construction unless such is specifically called for in the Contract Documents.
- 5) Shall not advise on or issue directions as to safety precautions and programs in connection with the Work.
- 6) Shall not advise on or issue directions regarding Contractor's failure to comply with Laws and Regulations applicable to the furnishing or performance of the Work.

9.04 CLARIFICATIONS AND INTERPRETATIONS

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

9.05 AUTHORIZED VARIATIONS IN WORK - FIELD ORDER

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

9.06 REJECTING DEFECTIVE WORK

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

9.07 SHOP DRAWINGS, CHANGE ORDERS, AND PAYMENTS

- A. Engineer's responsibility for Shop Drawings and samples are set forth in paragraphs 6.19 through 6.21 inclusive.
- B. Engineer's responsibilities as to Change Orders are set forth in Articles 10, 11, and 12.
- C. Engineer's responsibilities in respect of Applications for Payment are set forth in Article 14.

9.08 DETERMINATIONS FOR UNIT PRICE WORK

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review 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, shall be referred initially to Engineer in writing with a request for a formal decision in accordance with this paragraph 9.09.

- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believe that any such decision entitles them to an adjustment in the Contract Price, or Contract Times, or both, a Claim may be made under paragraph 11.01.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of paragraph 11.01.
- D. In this capacity Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.10 LIMITATIONS ON 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, shall give rise to any duty or responsibility of Engineer to Owner or Contractor, any Subcontractor, any manufacturer, fabricator, Supplier, distributor, surety, or any other person, employee, or agent of any of them.
- B. Engineer will not supervise, direct, control or have authority over, or be responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the furnishing or performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents. These limitations on authority and responsibility shall also apply to Engineer's Consultant's, Resident Project Representative and assistants.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer will not be responsible to Contractor or any Subcontractor, or Supplier, or to their agents or employees for injuries, damages, claims, losses, or expenses (including attorney's fees) of whatsoever kind resulting from or caused by any act or omission of Engineer in preparation for, arising from, relating to, or concerning the Project. Such acts or omissions include, but are not limited to, Engineer's negligence, tortuous conduct, errors, omissions, strict liability, breach of contract, or breach of warranty. Engineer makes no representations to Contractor, Subcontractors, Suppliers or their agents or employees regarding or respecting any work performed by Engineer in preparation for, arising from, relating to, or concerning the Project.
- E. Neither Contractor, its agents or employees, nor any Subcontractors or Suppliers or their agents or employees, are intended beneficiaries of Engineer's agreement with Owner, nor are such parties intended beneficiaries of Engineer's duties or responsibilities arising therefrom. Engineer disclaims all duties to Contractor, Subcontractors, Suppliers or their agents or employees arising from, relating to, or concerning Engineer's involvement in the Project. Owner and Contractor further agree to notify all Contractor's, Subcontractors or Suppliers of this disclaimer of Engineer's liability and require them to abide by this disclaimer.

ARTICLE 10 AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

10.01 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. Change Orders:
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve;

- 1) the performance or acceptability of the Work,
 - 2) the design (as set forth in the Drawings, Specifications, or otherwise), or
 - 3) other engineering or technical matters, without the recommendation of Engineer. Such an amendment shall be set forth in a Change Order.
2. Work Change Directives:
- a. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including paragraph 10.04 regarding change of Contract Price.
 - b. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the issuance of the Work Change Directive.
 - c. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.
3. Field Orders:
- a. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and Contractor, which shall perform the Work involved promptly.
 - b. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

10.02 OWNER-AUTHORIZED CHANGES IN THE WORK

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive.
- B. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph 10.02 shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

10.03 UNAUTHORIZED CHANGES IN THE WORK

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

10.04 CHANGE OF CONTRACT PRICE

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of paragraph 11.01.
- B. An adjustment in the Contract Price will be determined as follows:
 - 1. where the Work involved is covered by Unit Prices contained in the Contract Documents, then by application of such Unit Prices to the quantities of the items involved (subject to the provisions of paragraph 12.03); or
 - 2. where the Work involved is not covered by Unit Prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 10.04.C.2); or
 - 3. where the Work involved is not covered by Unit Prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in paragraph 12.01) plus a Contractor's fee for overhead and profit (determined as provided in paragraph 10.04.C).
- C. Contractor's Fee: When applicable, Contractor's fee for overhead and profit shall be determined as follows:
 - 1. a mutually acceptable fixed fee; or
 - 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under paragraph 12.01.B.1 and 12.01.B.2, Contractor's fee shall be 15 percent;
 - b. for costs incurred under paragraph 12.01.B.3, Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 10.04.C.2.a and 10.04.C.2.b is that Contractor's fee shall be based on:
 - 1) a fee of 15 percent of the costs incurred under paragraphs 12.01.B.1 and 12.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and
 - 2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor;
 - 3) provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. no fee shall be payable on the basis of costs itemized under paragraphs 12.01.B.4, 12.01.B.5, and 12.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to 5 percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with paragraphs 10.04.C.2.a through 10.04.C.2.e, inclusive.

10.05 CHANGE OF CONTRACT TIMES

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of paragraph 10.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of paragraph 11.01.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in paragraph 12.04, concerning delays in Contractor's progress.

10.06 CHANGE PROPOSALS

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seeking other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.
 - 1. Procedures: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 5 days) after the start of the event giving rise thereto, or after such initial decision. Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any) to Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal and consider any comments or response from Owner regarding the Change Proposal.
 - 2. Engineer's Action: Engineer will review each Change Proposal and, within 30 days after receipt of Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of 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 shall be deemed a denial, and Contractor may choose to seek resolution under the terms of paragraph 11.01.

10.07 EXECUTION OF CHANGE ORDERS

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. changes in the Contract Price or Contract Times which are agreed to by the Parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 - 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 - 3. changes in the Work which are:

- a. ordered by Owner pursuant to paragraph 10.02,
 - b. required because of Owner's acceptance of defective Work under paragraph 13.08 or Owner's correction of defective Work under paragraph 13.09, or
 - c. agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under paragraph 10.06, or Article 16.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this paragraph 10.07, it shall be deemed to be of full force and effect, as if fully executed.

10.08 NOTIFICATION TO SURETY

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

ARTICLE 11 CLAIMS

11.01 CLAIMS

- A. Claims Process: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
- 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 10 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. Mediation:
- 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the

Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 16 for final resolution of disputes.
- F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 16 for final resolution of disputes.
- G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 12 COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

12.01 COST OF WORK

- A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this paragraph 12.01 are used to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. Costs Included: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in paragraph 12.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 2. Costs of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from Subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this paragraph 12.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - b. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - 1) The rental rate established for each piece of Contractor owned equipment, including appurtenances and attachments to the equipment, used will be determined by use of the Rental Rate Blue Book for Construction Equipment, Volume 1, 2 or 3, as applicable; the edition which is current at the time the Work was started will apply. The established rental rate will be equal to the "Monthly" rate divided by 176; modified by the rate adjustment factor and the applicable map adjustment factor, plus the "Estimated Operating Costs per Hour."
 - 2) For equipment not listed in the Rental Rate Blue Book, Volume 1, 2 or 3, the rental rate will be determined by using the rate listed for a similar piece of equipment or by proportioning a rate listed so that the capacity, size, horsepower, and age are properly considered.
 - 3) For equipment for which there are no comparables in the Rental Rate Blue Book, Volume 1, 2 or 3, the monthly rate shall be reasonable, but not more than 5 percent of the current list price, or invoice, of the equipment. The base hourly rate shall then be determined by dividing the monthly rate by 176 to which 20 percent will be added to the sum which will account for adjustments and operating costs.
 - c. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by laws and regulations.
 - d. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - e. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with paragraph 5.03), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses

shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining

- f. The cost of utilities, fuel, and sanitary facilities at the Site.
 - g. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. Costs Excluded: The term Cost of the Work shall not include any of the following items:
- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 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 shall be determined as set forth in paragraph 10.04.C.
- E. Documentation: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 12, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer on a daily basis, an itemized cost breakdown together with supporting data.

12.02 ALLOWANCES

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. Cash Allowances: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling of the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. Contingency Allowance: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

12.03 UNIT PRICE WORK

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Proposal.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each Unit Price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review 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 shall be entitled to request an equitable adjustment in the Contract Times and Contract Price. However, Contractor's entitlement to an adjustment of the Contract Times or Contract Price is expressly conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include only the following:
 - 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. acts or failures to act of utility owners (other than those performing other works at or adjacent to the Site by arrangement with Owner, as specified in paragraph 7.01); and
 3. acts of war or terrorism.
- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 10.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of paragraph 10.04.
- F. Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised Progress Schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- 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 shall not be entitled to any adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- 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 shall be Contractor's sole and exclusive remedy for such delay. In no event shall Owner or Engineer be liable to Contractor, any Subcontractor, any Supplier, or any other person or organization, or to any surety or employee or any agent of them, for damages, including but not limited to all

fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs, arising out of or resulting from:

1. delays caused by or within the control of Contractor (or Subcontractor or Supplier);
 2. delays beyond the control of both Owner and Contractor, including but not limited to fires, floods, epidemics, abnormal weather conditions, acts of God, or acts of neglect by utility owners or other contractors performing other work;
- L. Nor shall Owner or Engineer or each of them be liable to Contractor for any claims, costs, losses or damages sustained by Contractor on or in connection with any other project or anticipated project.
- 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 shall not be entitled to and hereby waives any and all damages that it may suffer by reason of such delay or for any Act of God, including but not limited to lost profits, overhead, and other consequential damages.

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

13.01 ACCESS TO WORK

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

13.02 TESTS AND INSPECTIONS

- A. Contractor shall give Engineer and testing agency at least 24-hour notice, unless otherwise specified, of readiness of the Work for all required inspections, tests or approvals, and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. If any Law and Regulation, code, or order of any public body having jurisdiction requires any Work or part thereof to specifically be inspected, tested or approved, Contractor shall assume full responsibility therefor, pay all costs in connection therewith and furnish Engineer the required certificates of inspection, testing or approval.
- C. Contractor shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with Owner's or Engineer's acceptance of a manufacturer, fabricator, Supplier or distributor of materials or equipment proposed to be incorporated in the Work, or of materials or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.
- D. The cost of all other inspections, tests and approvals required by the Contract Documents shall be paid by Owner unless otherwise specified.
- E. All inspections, tests or approvals other than those required by law, ordinance, rule, regulation, code or order of any public body having jurisdiction shall be performed by organizations acceptable to Owner and Contractor or by Engineer if so specified.
- F. Cost of materials to be used in inspection and transportation costs shall be paid for by Contractor.
- G. Neither observations by Engineer nor inspections, tests or approvals by others shall relieve Contractor from his obligations to perform the Work in accordance with the Contract Documents.

13.03 UNCOVERING WORK

- A. If any Work that is to be tested, inspected or approved is covered without written concurrence of Engineer, or contrary to the written request of Engineer, it shall, if requested by Engineer, be uncovered by Contractor for Engineer's observation. Such uncovering shall be at Contractor's expense unless Contractor has given Engineer timely written notice of his intention to cover such Work and Engineer has not acted with reasonable promptness in response to such notice.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose or otherwise make available for observation, inspection or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment. Except as otherwise specified in paragraph 13.04, the cost of Work shall be paid for as follows:
 - 1. If it is found that such Work is defective, Contractor shall bear all the expenses of such uncovering, exposure, observation, inspection and testing, and of satisfactory reconstruction, (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals) and an appropriate deductive Change Order shall be issued. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, Owner may make a Claim as provided in paragraph 11.01.
 - 2. If, however, such Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction. If the parties are unable to agree as to the amount or extent of any change in Contract Price or Contract Time, Contractor may make a Claim as provided in paragraph 11.01.

13.04 DEFECTIVE WORK

- A. Contractor's Obligation: It is Contractor's obligation to assure that the Work is not defective.
- B. Engineer's Authority: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

13.05 OWNER MAY STOP THE WORK

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

13.06 CORRECTION OR REMOVAL OF DEFECTIVE WORK

- A. If required by Engineer or Owner, Contractor shall promptly either correct all defective Work, whether or not fabricated, installed or completed, or if the Work has been rejected by Engineer, remove it from the Site and replace it with non-defective Work. Contractor shall pay all claims, costs, losses, damages and expenses caused by or resulting from such correction or removal (including, but not limited to all costs of repair or replacement of work of others) and shall take no action that would void or otherwise impair Owner's special warranty or guarantee, if any, on such Work.

13.07 GUARANTEE PERIOD

- A. If within 1 year after the date of Substantial Completion (or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents), or by any specific provision of the Contract Documents, any Work is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair defective land or areas;
 2. correct such defective Work;
 3. if the defective Work has been rejected by Owner, remove it from the Site and replace it with Work that is not defective, and
 4. satisfactorily correct or repair or remove and replace any damage to other Work or the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or the rejected Work removed and replaced, and all claims, costs, losses, damages and expenses caused by or resulting from such removal and replacement (including but not limited to all costs of repair or replacement or work of others) shall be paid by Contractor.
- C. Repair or replacements made under the guarantee shall bear an additional 1 year guarantee dated from the acceptance of repair or replacement.

13.08 ACCEPTANCE OF DEFECTIVE WORK

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, also Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, damages and expenses attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness). In such case, if acceptance occurs prior to Engineer's recommendation of final payment, a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate reduction in the Contract Price. If the acceptance occurs after such recommendation, an appropriate amount shall be paid by Contractor to Owner.

13.09 OWNER MAY CORRECT DEFECTIVE WORK

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with paragraph 13.06, or if Contractor fails to perform the Work in accordance with the Contract Documents (including any requirements of the Progress Schedule), Owner may, after 48 hours' written notice to Contractor and his Surety without prejudice to any other remedy he may have, correct and remedy any such deficiency.
- B. In exercising his rights and remedies under this paragraph 13.09, Owner shall proceed expeditiously. To the extent necessary to complete corrective and remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work, and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer's consultants such access to the Site as may be necessary to enable Owner to exercise his rights and remedies under this paragraph 13.09.
- C. All claims, costs, losses, damages and expenses incurred or sustained by Owner in exercising such rights and remedies shall be charged against Contractor and a Change Order shall be issued incorporating the necessary revisions in the Contract Documents with respect to the Work. Owner shall be entitled to an appropriate reduction in the Contract Price equivalent to such claims, costs, losses, damages and expenses including but not be limited to all costs of repair or replacement of work of others destroyed or damaged by correction, removal or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Time because of any delay in performance of the Work attributable to the exercise by Owner of Owner's rights under this Article 13.

ARTICLE 14 PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 SCHEDULES

- A. At least 10 days prior to submitting the first Application for Payment, Contractor shall submit to Engineer a final Schedule of Submittals, and, where applicable, a Schedule of Values for the Work. These schedules shall be satisfactory in form and substance to Engineer as provided in Article 2.
- B. The Schedule of Values shall include quantities and unit prices aggregating the Contract Price and shall subdivide the Work into component parts. Each unit cost so established shall include its proportionate share of Contractor's general operating charges such as profit, overhead, supervision, insurance, bond premiums, interest, equipment cost, depreciation and rental, contingencies, expendable tools, equipment and supplies. The total cost of the items and quantities Contractor lists in the Schedule of Values shall equal the total Contract Price established in the Proposal.
- C. The Schedule of Values shall include a complete set of detailed work sheets on bid take off and bid summary covering estimated general conditions expense (field overhead), general overhead, profit mark ups and revisions leading to the final bid amount.
- D. When the Schedule of Values is approved by Engineer, it shall become part of the Agreement and shall be used as the basis for Contractor progress payments.
- E. Progress payments based upon Unit Price Work will be based upon the number of units completed.

14.02 APPLICATION FOR PROGRESS PAYMENT

- A. At least 20 days before each Application for Payment falls due (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment, Contractor's Declaration, Payment Schedule, and updated Progress Schedules indicating the anticipated completion dates of the various stages of the Work and estimated payments during the next 3 months. Contractor's Application for Payment shall be filled out on the form provided in the Contract Documents and signed by Contractor covering the Work completed as of the date of the Application for Payment and accompanied by such supporting documentation as is required by the Contract Documents and as Engineer or Owner may reasonably require. The Payment Schedule shall be on the form provided in the Contract Documents or in a format acceptable to Engineer or Owner. On the second and all subsequent payments, partial Waivers of Lien and Sworn Statement shall be required for all Work completed and paid for on previous certificates.
- B. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by such data, satisfactory to Owner, as will establish Owner's title to the material and equipment and protect Owner's interest therein, including applicable insurance. A receipted vendor's invoice showing the quantities of materials and the amounts paid will be required and shall accompany the Application for Payment.
- C. Retainage with respect to progress payments will be in accordance with paragraph 14.03, and it will be retained until after completion of the entire Work and its final acceptance. When the amount to be retained is reduced to less than 10 percent, Contractor shall file with Owner the written consent of the Surety to such reduction and shall furnish an affidavit that all Contractor's indebtedness by reason of the Contract has been paid.

14.03 RETAINAGE

- A. On Contracts with a dollar value of \$30,000 and greater or on Contracts that provide for more than 3 progress payments, progress payments and retainage shall be governed by the provisions of any statutes, rules or regulations regarding retention and these are incorporated herein by reference and made a part of this Contract.
- B. If there are no statutes, rules, or regulations applicable to retention, retainage shall be 10%, or such an amount as Owner deems necessary.

14.04 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

- A. Engineer will, within 10 days after receipt of each Contractor's Application for Payment and Payment Schedule, including each resubmittal, either indicate in writing a recommendation of payment and present an Engineer's Certificate for Payment to Owner, or may return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
- B. Engineer's recommendation of any payment requested in Contractor's Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's review of the Contractor's Application for Payment and Certificate for Payment and the accompanying data and schedules, as an experienced and qualified design professional that to the best of Engineer's knowledge, information and belief;
 - 1. the Work has progressed to the point indicated;
 - 2. the quality of the Work is in accordance with the technical aspects of the Contract Documents subject to an evaluation of the Work as a functioning Project upon Substantial Completion, to the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for any Unit Price Work under paragraph 12.03, and any qualifications stated in the recommendation; and
 - 3. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
- C. However, by recommending any such payment Engineer will not thereby be deemed to have represented that:
 - 1. exhaustive or continuous on-Site inspections have been made to check the quality or the quantity of the Work; or
 - 2. involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - 3. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
- D. Neither Engineer's review of Contractor's Work for the purpose of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - 1. to supervise, direct or control the Work;
 - 2. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - 3. for the failure of Contractor to comply with Laws and Regulations applicable to the furnishing or performance of Work;
 - 4. for any failure of Contractor to perform or furnish Work in accordance with the Contract Documents;
 - 5. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price;
 - 6. to determine that title to any Work, materials, or equipment has passed to Owner free and clear of Liens.
- E. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make such representations as stated above to Owner. Engineer may also refuse to recommend any such payment, or, because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any such payment previously recommended to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

1. the Work is defective, or completed Work has been damaged requiring correction or replacement;
2. the Contract Price has been reduced because of Change Orders;
3. Owner has been required to correct defective Work in accordance with paragraph 1309, or has accepted defective Work in accordance with paragraph 13.08;
4. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
5. Engineer has actual knowledge of the occurrence of any of the events enumerated in paragraph 15.02.

14.05 PAYMENT BECOMES DUE

- A. Thirty (30) days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of paragraph 14.05.B) become due, (or only if Owner is a public agency, within 15 days after Owner receives the funds which are to be provided by a department or agency of the federal or state government, whichever is later, or in accordance with any time periods required by any applicable statute, rule or regulation) and when due will be paid by Owner to Contractor.
- B. Owner may refuse to make payment of the full amount recommended by Engineer because:
 1. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries,
 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 shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor corrects, to Owner's satisfaction, the reasons for such action. The reduction imposed shall be binding on Contractor unless Contractor duly submits a Change Proposal contesting the reduction.
- D. If it is subsequently determined that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by paragraph 14.05.

14.06 CONTRACTOR'S WARRANTY OF TITLE

- A. Contractor warrants and guarantees that title to all Work, materials and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner at the time of payment free and clear of all Liens, claims, security interests and encumbrances (hereafter in these General Conditions referred to as "Liens").

14.07 SUBSTANTIAL COMPLETION

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a Certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. Once Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary Certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefore. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final Certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary Certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and

complete or correct items on the punch list.

14.08 PARTIAL UTILIZATION

- A. Use by Owner of completed portions of the Work may be accomplished prior to Substantial Completion of all the Work subject to the following:
1. Owner at any time may request Contractor in writing to permit Owner to use any part of the Work which Owner believes to be substantially complete and which may be so used without significant interference with construction of the other parts of the Work. If Contractor agrees, Contractor will certify to Owner and Engineer that said part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time thereafter Owner, Contractor and Engineer shall make an inspection of that part of the Work to determine its status of completion.
 - a. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving his reasons therefor.
 - b. If Engineer considers that part of the Work to be substantially complete, Engineer will execute and deliver to Owner and Contractor a certificate to that effect, fixing the date of Substantial Completion for that part of the Work, attaching thereto a punch list of items to be completed or corrected before final payment.
 2. Prior to issuing a certificate of Substantial Completion for that part of the Work, Engineer will deliver to Owner and Contractor a written recommendation as to the division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, maintenance, utilities and insurance for that part of the Work, which shall become binding upon Owner and Contractor at the time of issuing the definitive certificate of Substantial Completion for that part of the Work unless Owner and Contractor shall have otherwise agreed in writing and so informed Engineer.
 3. Owner shall have the right to exclude Contractor from any part of the Work which Engineer has so certified to be substantially complete, but Owner shall allow Contractor reasonable access to complete or correct items on the punch list.
 4. In lieu of the issuance of a certificate of Substantial Completion as to part of the Work, Owner may take over operation of a facility constituting part of the Work whether or not it is Substantially Complete if such facility is functionally and separately usable; provided that prior to any such takeover, Owner and Contractor have agreed as to the division of responsibilities between Owner and Contractor for security, operation, safety, maintenance, correction period, heat, utilities and insurance with respect to such facility.

14.09 FINAL INSPECTION

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

14.10 FINAL APPLICATION FOR PAYMENT

- A. After Contractor has completed all corrections to the satisfaction of Engineer and delivered all maintenance and operating instructions, schedules, guarantees, Bonds, certificates of inspection, marked up record documents and other documents (all as required by the Contract Documents), and after Engineer has indicated that the Work is acceptable, subject to the provisions of paragraph 14.13, Contractor may make application for final payment following the procedure for progress payments.
- B. The final Application for Payment shall be accompanied by all documentation called for in the Contract Documents and such other data and schedules as Engineer may reasonably require, consent of Surety, if any, to final payment, together with complete and legally effective releases or waivers, satisfactory to Owner, of all Liens arising out of or filed in connection with the Work.

- C. In lieu of the releases or waivers of Lien, if approved by Owner, Contractor may furnish receipts or releases in full; an affidavit of Contractor that the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and that all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner or his property might in any way be responsible, have been paid or otherwise satisfied.
- D. If any Subcontractor, manufacturer, fabricator, Supplier or distributor fails to furnish a release or receipt in full, Contractor may furnish a Bond or other collateral satisfactory to Owner to indemnify Owner against any Claim or Lien.

14.11 FINAL PAYMENT AND ACCEPTANCE

- A. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation (all as required by the Contract Documents), Engineer is satisfied that to the best of Engineer's knowledge, information and belief as a design professional that the Work has been completed and Contractor has fulfilled all of his obligations under the Contract Documents, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's Certificate for Payment and present the application to Owner for payment. At that time Engineer will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of paragraph 14.13.
- B. Otherwise, Engineer will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application.
- C. If the Application and accompanying documentation are appropriate as to form and substance, Owner shall, within 45 days (or within the time period required by any applicable statute, rule or regulation) after receipt thereof pay Contractor the amount recommended by Engineer less any amounts of Owner claimed set-offs allowed under the Contract Documents, including but not limited to any applicable liquidated damages as determined by Owner. If Owner rejects the Application, Owner shall do so in writing stating the appropriate sections of the Contract Documents upon which the rejection is based. Contractor may take the necessary remedial actions and resubmit the Application.

14.12 FINAL COMPLETION DELAYED

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

14.13 WAIVER OF CLAIMS

- A. The making and acceptance of final payment shall constitute:
 - 1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to paragraph 14.09, or from failure to comply with the Contract Documents or the terms of any special guarantees specified therein; and shall not constitute a waiver by Owner of any rights in respect of Contractor's existing or continuing obligations under the Contract Documents; and,
 - 2. a waiver of all Claims by Contractor against Owner other than those previously made in writing and still pending in accordance with Article 16.

14.14 LATE PAYMENTS

- A. All monies not paid when due hereunder, except monies involving Federal and/or State Loans, Grants, or other sources which are delinquent because of no fault of Owner, shall bear interest at the maximum rate allowed by law at the time and place of the Project.

ARTICLE 15 SUSPENSION OF WORK AND TERMINATION

15.01 OWNER MAY SUSPEND WORK

- A. Owner may, at any time and without cause, suspend the Work or any portion thereof for a period as Owner may deem necessary by notice in writing to Contractor and Engineer. If it should become necessary to stop work for an indefinite period, Contractor shall store all materials in such manner that they will not become an obstruction, nor become damaged in any way, and Contractor shall take every precaution to prevent damage or deterioration of the Work performed; provide suitable drainage by opening ditches and drains, and erect temporary structures where necessary. Contractor may request an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to any suspension if he makes a Claim therefor as provided in paragraph 11.01.

15.02 OWNER MAY TERMINATE FOR CAUSE

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor commences a voluntary case under any chapter of the Bankruptcy Code (Title 11, United States Code), as now or hereafter in effect, or if Contractor takes any equivalent or similar action by filing a petition or otherwise under any other federal or state law in effect at such time;
 - 2. a petition is filed against Contractor under any chapter of the Bankruptcy Code as now or hereinafter in effect at the time of filing, or if a petition is filed seeking any such equivalent or similar relief against Contractor under any other federal or state law in effect at the time relating to bankruptcy or insolvency;
 - 3. Contractor makes a general assignment for the benefit of creditors;
 - 4. a trustee, receiver, custodian or agent of Contractor is appointed under applicable law or under contract, whose appointment or authority to take charge of property of Contractor is for the purpose of enforcing a Lien against such property or for the purpose of general administration of such property for the benefit of Contractor's creditors;
 - 5. Contractor admits in writing an inability to pay its debts generally as they become due;
 - 6. Contractor persistently fails to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under paragraph 2.05 as revised from time to time);
 - 7. Contractor disregards Laws and Regulations of any public body having jurisdiction;
 - 8. Contractor disregards the authority of Engineer or Owner; or,
 - 9. Contractor otherwise violates any provisions of the Contract Documents.
- B. Owner may, after giving Contractor (and the Surety, if there be one) 7 days' written notice, and to the extent permitted by Laws and Regulations, terminate the services of Contractor, exclude Contractor from the Site, take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the site and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, finish the Work as Owner may deem expedient, and/or enforce the rights available to Owner under any applicable Performance Bond.

- C. In such case, Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, damages and expenses sustained by Owner arising out of or resulting from completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, damages and expenses exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, damages and expenses incurred by Owner will be reviewed as to reasonableness by Engineer and when so approved, incorporated in a Change Order, but when exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Where Contractor's services have been so terminated by Owner, the termination shall not affect any rights or remedies of Owner against Contractor or its Surety then existing or which may thereafter accrue. Any retention or payment of monies due Contractor by Owner will not release Contractor from liability.

15.03 TERMINATION FOR CONVENIENCE

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy, elect to terminate the Agreement. In such case, Contractor shall be paid (without duplication of any items):
 - 1. for completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination;
 - 2. for actual expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work; and
 - 3. for reasonable expenses directly attributable to protecting work as a result of termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.
- C. Upon such termination, Contractor shall:
 - 1. Immediately discontinue Work on the date and to the extent specified in the notice except to the extent necessary to protect Work in place;
 - 2. Place no further orders for materials, services, or facilities, other than as may be necessary or required for completion of such portion of Work under the Contract that is not terminated;
 - 3. Promptly make every reasonable effort to obtain cancellation upon terms reasonably satisfactory to Owner of all purchase orders and subcontracts to the extent they relate to the performance of Work terminated or assign to Owner those orders and subcontracts and revoke agreements specified in such notice;
 - 4. Reasonably assist Owner, as specifically requested in writing, in the maintenance, protection and disposition of property acquired by Owner under the Contract Documents, as may be necessary;
 - 5. Complete performance of any Work which is not terminated; and
 - 6. Deliver to Owner an affidavit regarding the identity of potential unpaid Subcontractors or Suppliers and the amounts due to each.

15.04 CONTRACTOR MAY STOP WORK OR TERMINATE

- A. If Owner has failed to pay Contractor any sum finally determined to be due in accordance with the time limits specified in paragraph 14.05, Contractor may upon 7 days' written notice to Owner and Engineer, stop the Work until payment of all amounts then due.
- B. If through no act or fault of Contractor, the Work is suspended for a period of more than 90 days by Owner, or under an order of court or other public authority, then Contractor may, upon 7 days written notice to Owner and Engineer and provided Owner or Engineer does not remedy

such suspension or failure within that time, terminate the Agreement and recover from Owner payment on the same terms as provided in paragraph 15.03.

- C. The provisions of this paragraph 15.04 shall not relieve Contractor of his obligations under paragraph 6.22 to carry on the Work in accordance with the Progress Schedule and without delay during disputes and disagreements with Owner.

ARTICLE 16 FINAL RESOLUTION OF DISPUTES

16.01 METHODS AND PROCEDURES

- A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this Article:
1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents and arising after final payment has been made.
- B. Final Resolution of Disputes: For any dispute subject to resolution under this Article, Owner or Contractor may:
1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 2. agree with the other party to submit the dispute to another dispute resolution process; or
 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, the following dispute resolution process shall be followed:
 - a. The parties shall submit the dispute to mediation under the mediation procedures outlined in the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Rules.
 - b. If the dispute is not resolved by mediation, the parties shall proceed to resolve the dispute by arbitration in accordance with the Construction Industry Arbitration Rules and Mediation Procedures of the American Arbitration Association. The decision of the arbitrator(s) shall be final and binding and is enforceable in a court of competent jurisdiction.

ARTICLE 17 MISCELLANEOUS

17.01 GIVING NOTICE

- A. Whenever any provision of the Contract Documents requires the giving of written notice to Owner, Engineer, or Contractor, it shall be deemed to have been validly given only if delivered:
1. in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended;
 2. by registered or certified mail postage prepaid to, the last business address known to the giver of the notice;
 3. or delivered in person to such person by a commercial courier service or otherwise to the recipient's place of business; or
 4. by secure file transfer with receipt documentation or other document control software.

17.02 COMPUTATION OF TIME

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

17.03 GENERAL

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and shall not be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Law or Regulation, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this paragraph shall be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.
- B. All representations, warranties and guarantees made in the Contract Documents shall survive final payment and termination or completion of this Agreement.

17.04 PROFESSIONAL FEES AND COURT COSTS INCLUDED

- A. Whenever reference is made to "claims, costs, losses, damages and expenses," it shall include in each case, but not be limited to, all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs.

17.05 NONDISCRIMINATION OF EMPLOYMENT

- A. Contractor shall covenant and agree not to discriminate against any employee or applicant for employment, to be employed in the performance of this Contract, with respect to his hire, tenure, terms, conditions or privileges of employment, or any matter directly or indirectly related to employment, because of race, color, sex, age, religion, national origin or ancestry, height, weight, or marital status, or any other classification protected by law, and to require a similar covenant on the part of any Subcontractor employed in the performance of the Contract.

17.06 POST COMPLETION DATE ENGINEERING AND INSPECTION COSTS

- A. All engineering and inspection costs incurred after the specified completion date shall be paid by Contractor to Owner prior to final payment authorization. However, Contractor shall not be charged with any post completion date engineering and inspection costs when the delay in completion of the Work is due to the following and Contractor has promptly given written notice of such delay to Owner or Engineer:
 - 1. to any preference, priority or allocation order duly issued by Owner;
 - 2. to unforeseeable causes beyond the control and without the fault or negligence of Contractor, including but not restricted to, acts of God, or of the public enemy, acts of Owner, acts of another contractor in the performance of a Contract with Owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, and abnormal and unforeseeable weather; and,
 - 3. to any delays of Subcontractors or Suppliers occasioned by any of the causes specified in this Article.
- B. Charges after the specified completion date shall be made at such times and in such amounts as Engineer shall invoice Owner, provided, however said charges shall be in accordance with Engineer's current rate schedule at the time the costs are incurred. Engineering and inspection costs so incurred shall be deducted from Contractor's progress payments.

17.07 WAIVER OF CONSEQUENTIAL DAMAGES

- A. Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract or the Work. This mutual waiver includes but is not limited to:
 - 1. damages incurred by Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
 - 2. damages incurred by Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit in connection with any other project or anticipated project.

- B. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination or default. Nothing contained in this Section shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents. Contractor also waives any Claim for consequential damages against Engineer where such Claims arise out of or relate in any way to the Project or the Contract Documents.

17.08 NO WAIVER

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

17.09 CONTROLLING LAW

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

17.10 HEADINGS

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

END OF SECTION 00 72 00

**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 "Substantial Completion" in shall 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: SME Geotechnical Report Dated (Draft dated January 25, 2024) and Point Blue Environmental Results of Laboratory Analysis (Tables 1 thru 4) plus Location Plan shown on Table 5.
- 2. Copies of the following reports and/or tests are attached as Exhibits: 1 and 2

C. SGC-5.03.D Additional Insured

- 1. Add the following language at the end of Article 5.03.A.4 of the Section 00 72 00 - General Conditions:

Additional named insured on Owner's and Contractor's Protective Policy shall include:

D. 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 shall be not less than the following:

SGC-5.04.A Worker's Compensation

Coverage A – Compensation: Statutory

Coverage B – Employer's Liability

Each Accident: \$3,000,000

Disease – Policy Limit: \$500,000

Disease – Each Employee: \$500,000

SGC-5.04.B Comprehensive General Liability

General Aggregate: \$1,000,000

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

Personal and Advertising Injury: \$500,000

Each Occurrence: \$500,000

Fire Damage (any one fire): \$50,000

Medical Expense (any one person): \$5,000

SGC-5.04.C Comprehensive Automobile Liability

Bodily Injury: \$500,000

Property Damage: \$200,000

or combined single limit: \$1,000,000

SGC-5.04.D Owner's Protective - Coverage shall be Occurrence Form and written with City of St. Joseph as the insured.

General Aggregate:\$1,000,000

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

E. 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.

F. 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 shall fail 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 shall be in default after the time stipulated in the Contract Documents. The liquidated damages charged shall be deducted from the Contractor's progress payments.
- b. Contractor shall not be charged with liquidated damages or any excess cost when the delay in Substantial Completion of the Work is due to the following and 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 Items A and B of this Article.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 00 73 00

SECTION 01 11 00 SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. This "Early Action Project" includes the construction of a new diversion chamber and approximately 800 linear feet of sanitary sewer, plus related site work on the City of St. Joseph Department of Public Works property, the Broad Street Right of Way, the Pri Mar Petroleum property and on portions of Pier 33 Marina/LECO Corporation property near the Morrison Channel..
- B. This project also calls for the contractor to design and use various temporary earth retention systems, excavation and disposal of non-hazardous, contaminated soil at a type 2 landfill. All dewatering shall be filtered and pumped directly to the Benton Harbor - St. Joseph Wastewater Treatment Plant. The ground water dewatering shall be completed in a manner acceptable and under the oversight of the Benton Harbor- St. Joseph Wastewater Treatment Plant.
- C. The City of St. Joseph has performed environmental sampling of the soils and groundwater along the alignment of the proposed sanitary sewers and new diversion chamber that are planned as part of the Early Action Project. The environmental sampling was performed as part of the pre-design due diligence activities for the project and because a portion of the project crosses the Pri Mar Petroleum property located at 1207 Broad Street, across the street from the City's Department of Public Works. The sampling was performed in cooperation with the owners of Pri Mar Petroleum. The City is aware that the Pri Mar Petroleum property is a site that has been identified as having previous soil and groundwater contamination.
- D. The environmental sampling was completed by Point Blue (as a subconsultant to Wade Trim). The environmental sampling report has been included as an attachment to the project manual that will be part of the bid documents. The results of the environmental sampling confirm that the contamination of the soils along the project route are non-hazardous, but contain small levels of various metals and small levels of some volatile organic compounds.
- E. The City's "Early Action Project" calls for the construction of a new 24-inch diameter sanitary sewer across the Pri Mar property (to replace the original 12-inch sanitary sewer). As part of the construction, the city has developed the following plan for handling of contaminated groundwater and soils from all properties disturbed during construction:
- F. For handling of contaminated soils – the design of the new 24-inch underflow pipe calls for the contractor to design, install and use a temporary earth retention system to limit the width of the utility trench. The intent of limiting the width of the utility trench is to help define and minimize the amount of contaminated soil that needs to be properly disposed. All excavated soil within any utility trench across the project will be hauled off and properly disposed at a Type II landfill.
- G. For handling of contaminated groundwater – the city has shared the results of the environmental sampling with the operators of the Benton Harbor – St. Joseph Joint Wastewater Treatment Plant (JWWTP). The contaminated groundwater is non-hazardous. The plant operators have reviewed the groundwater sampling results and none of the sampling results show levels of contamination that are above the JWWTP local discharge limits. Therefore, in cooperation between the City and the JWWTP, all groundwater that is dewatered during the construction of the project will be discharged to the City of St. Joseph sanitary sewer system and treated properly as part of the JWWTP's normal operation. The purpose of the temporary earth retention system is two-fold, in addition to limiting the width of the utility trench, it is also to reduce the rate and volume of groundwater dewatering required.
- H. All work must be coordinated with the property owners where the work is occurring. Access to project properties must be provided during construction.
- I. If the open cut across Broad Street occurs after the asphalt plants are closed for the season, the asphalt portion of the pavement section shall be temporarily restored with asphalt millings,

or an approved equal. The contractor shall maintain the temporary surface while mobilized on site. Should the contractor complete the underground work and demobilize from the site prior to the asphalt plants opening in the spring, St. Joseph Public Works will maintain the temporary asphalt surface until the plants reopen, at which time the responsibility shall return to the contractor.

- J. All work on the project shall be completed between October 1, 2024 and May 15, 2025. Substantial Completion shall be on or before May 1, 2025. A small portion of the project is located on Pier 33 Marina/LECO Corporation Property where a new sanitary manhole shall be installed over the existing sanitary sewer interceptor. Pier 33 marina has requested that all underground work on their property occur between October 1, 2024 and February 28, 2025 outside of the boating season. The underground work on Pier 33/LECO property shall be restored to grade within 3 weeks of the closure of the access drive.
- K. Access to Pier 33 Marina/LECO Corporation property for underground portion of the work shall be from Pri Mar Property requiring the removal and reinstallation of the chain link fence along the property line.
- L. Once the contractor has started work on Pier 33 Marina/LECO Corporation and Pri Mar properties, the contractor shall make every effort to continue working and finish the work in one continuous operation. This is desired to limit the duration of impact on the private properties.

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.
- B. The Department of Public Works, Pri Mar Petroleum and Pier 33 Marina/LECO Corporation properties will be active during the duration of this Project. All the properties will have ongoing activities, deliveries, employee movements and be open during this project. The Contractor shall coordinate with all property owners so that access is shared for the duration of the Project to ensure the orderly completion of the work, minimize disruption and the timely completion of the Contract.
- C. The Box Factory at 1101 Broad Street has a public event on November 30, 2024 that will draw traffic and cars to that location. The contractor should be aware that the parking lot across from 1101 Broad Street (i.e. on DPW property in front of the DPW site) will likely be full and highly utilized during that event. The DPW staff and employees of the Box Factory will be using the parking lot during the project. It is not for contractor use.

1.04 RIGHT-OF-WAY JURISDICTION/PERMITS

- A. Broad Street and Langley are under the jurisdiction of the City of St. Joseph, MI.
- B. The Morrison Channel and St. Joseph River are under the jurisdiction of the Michigan Department of Environment, Great Lakes, and Energy (EGLE). The Owner will apply for and obtain a Joint Permit for work within 500 feet of the Morrison Channel.
- C. Soil erosion and sedimentation control is under the jurisdiction of Berrien County. The Owner will be applying for this permit. The contractor will be required to pay for and pick up the permit from Berrien County.
- D. Contractor shall secure any permits required by the agency having jurisdiction, shall abide by all rules and regulations of each, and shall pay all costs in connection with the permits. Contractor shall pay for all permit and inspection fees as the agencies may charge to ensure compliance with their requirements.

1.05 COORDINATION

- A. Should water need to be shut off for construction operations, a shutoff notice shall 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 St. Joseph Water Department shall be notified. Valves shall be opened or closed only by the City of St. Joseph Department of Public Works Water Department.
- C. While both existing and new fire hydrants are in place, the Contractor shall clearly mark those hydrants not in service and notify the City of St. Joseph Fire Department of hydrants not in service.
- D. It shall be the responsibility of the Contractor to coordinate his operations and those of his 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 shall 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, he shall be responsible for making special written agreements with the property owners and shall furnish such copies of agreement to the Owner.

1.07 PHOTOGRAPHS

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

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 11 00

**SECTION 01 12 13
WORK SEQUENCE**

PART 1 GENERAL

1.01 SUMMARY

- A. A potential work sequence has been included on the notes sheet of the plan documents. The contractor is required to provide a written sequence of work and schedule to the Owner and Engineer for discussion at the preconstruction meeting and prior to beginning work.

1.02 PROJECT CONSTRAINTS

1.03 WORK SEQUENCE DESCRIPTION

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 12 13

**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 the Proposal. Contractor shall provide labor, material, tools, equipment and services required to complete the Work specified herein and indicated on the Plans.
- B. Owner will make no allowances for items not included in Section 00 42 43 - Proposal.

1.02 ITEMS OF THE PROPOSAL

A. **1**

A **V** **R** **S**

- 1. Audio-video route survey will be paid for at the Contract lump sum price as specified in the Proposal. Price paid shall be payment in full for all labor, material, equipment, and supplies necessary for furnishing an audio-video route survey in accordance with Section 01 33 00, Submittal Procedures and Section 01 11 00, Summary of Work.

B. **2**

I **D**

- 1. 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:
- 2. An Inspector Day shall 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 shall 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.
- 3. An Inspector Day shall 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 shall 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 Project Engineer. The cost of Inspector Days will be deducted from the monthly payments to the Contractor and paid to Engineer by Owner. 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.

C. **3**

M, **5** **M** **C** **P**

- 1. Mobilization will be paid for at the Contract Unit Price per lump sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary for all 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 the Contractor's, Engineer's, and Owner's field offices, and other facilities necessary to undertake the work on the project; and for other work and operations which must be performed, or for expenses incurred, prior to beginning work on the various contract items

on the project site. It shall also include preconstruction costs, including insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the contract. Payment for mobilization will be based upon the following schedule.

2. When 5% of the original Contract amount is earned, 50% of the Bid price for Mobilization is allowed.
3. When 25% of the original Contract amount is earned, 75% of the Bid price for Mobilization is allowed.
4. When 50% of the original Contract amount is earned, 100% of the Bid price for Mobilization is allowed.

D. Item 4

Maintenance Aggregate, LM

1. Maintenance aggregate for temporary walks, drives and roads, will be paid for at the Contract Unit Price per ton. Price paid shall be payment in full for all labor, material, and equipment required for furnishing and installing maintenance aggregate as shown on the plans or determined by the Engineer and shall include, but is not limited to, all construction, protection of existing improvements, excavation, compacting and fine grading subgrade, furnishing, placing and compacting backfill and subbase, furnishing and applying chemical additives and water, also for barricading, and for all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for maintenance aggregate will be determined by certified delivery tickets submitted to the Engineer or his duly authorized representative on the job site at the time of delivery. Delivery tickets submitted after the delivery will not be accepted for payment. Stockpiled maintenance aggregate shall be kept separate from other aggregate materials. The delivery tickets shall 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 the Engineer will be paid for at the tonnage basis. If the width of the maintenance aggregate is increased to accommodate the Contractor's operation, the additional material installed beyond the width specified on the Plans or as determined by the Engineer, will be at the Contractor's expense.

E. Items 5, 6, 7, 9, 10

Barricades, Traffic III, Highway Interchanges, Driveway Signs, Lane Signs, Flags

Barricades, Traffic III, Highway Interchanges, Driveway Signs, Lane Signs, Other

Preconstruction Traffic II Barricades, Traffic

Preconstruction Driveway, Flag Interchanges, Flags

Preconstruction Driveway, Flag Interchanges, Other

1. Traffic maintenance and control devices 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 furnishing, installing, operating, and maintaining traffic control devices, and shall include, but is not limited to, all barricades, lighted arrow boards, drums, warning flashers, repositioning devices, removing and replacing damaged devices, maintaining lights and flashers, and all other items necessary to complete the job, whether specifically mentioned or implied.

F. Item 8

Minor Traffic Devices

1. Minor traffic devices and flag control will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and installing minor traffic devices and flag control, and shall include, but is not limited to, all portable signs, paddles, cones, channeling devices, flagmen, removing and replacing damaged devices, installing and removing temporary pavement markings, and all other items necessary to complete the Work, whether specifically mentioned or implied.

G. Items 11, 12

Signs, Traffic B, Traffic, Portable Signs, Flags

Signs, Traffic B, Traffic, Portable Signs, Other

1. Temporary sign will be paid for at the Contract Unit Price per square foot. Price paid shall be payment in full for furnishing and installing temporary signs, and shall include, but is not limited to, furnishing and installing signs and posts, replacing damaged signs, removing signs at completion of project, and all other items necessary to complete the Work, whether specifically mentioned or implied.

H. Item 13

Traffic Control Regulation Control

1. Traffic Control Regulation will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing flag control, and shall include, but is not limited to, all portable signs, paddles, cones, channeling devices, flagmen, removing and replacing damaged devices, installing and removing temporary pavement markings, and all other items necessary to complete the Work, whether specifically mentioned or implied.

I. Item 14

Fencing, Traffic

1. Temporary fencing will be paid for at the Contract Unit Price per linear foot. Price paid shall be payment in full for all labor, material, and equipment required for furnishing, installing, and maintaining silt fence and shall include, but is not limited to, all excavation, preparation, furnishing and installing stakes and posts, connection to posts, drenching and toeing-in, backfilling, maintaining temporary fence, removal of temporary fence at project completion, protection of existing improvements, miscellaneous restoration and cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for temporary fence will be by linear feet determined by field measure in place.

J. Item 15

Silt Fence

1. Silt fence will be paid for at the Contract Unit Price per linear foot. Price paid shall be payment in full for all labor, material, and equipment required for furnishing, installing, and maintaining silt fence and shall include, but is not limited to, all excavation, preparation, furnishing and installing stakes and posts, connection to posts, drenching and toeing-in, backfilling, maintaining silt fence, removal of silt fence at project completion, protection of existing improvements, miscellaneous restoration and cleanup, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for silt fence will be by linear feet determined by field measure in place.

K. Item 16, 17

Item F

Temporary Gravel Construction Entrance/Exit

1. Soil erosion and sedimentation control devices 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 to furnish and install soil erosion and sedimentation control devices, and shall include, but is not limited to, furnishing and installing, inlet filters, check dams, ditch sediment traps, temporary gravel construction entrance/exit, and other devices, as shown on the plans or detailed, maintaining devices, replacement of ineffective devices, removal of temporary devices, miscellaneous cleanup and restoration, and all items necessary to complete the Work, whether specifically mentioned or implied.

L. Item 18

Utility Poles, Relocation

1. Relocation of utility poles will be paid for at the actual cost as invoiced by the utility companies involved. Price paid shall be payment in full for the relocation of utility poles, as shown on the plans, or as determined by the Engineer, and shall include, but is not limited to, the relocation of all attached parts and connections, removal and disposal of unsuitable materials, relocation of utility pole, furnishing, placing and compacting backfill, protection of existing improvements, barricading, and all items necessary to complete the job, whether specifically mentioned or implied. The Contractor will not be allowed any markups from the amount invoiced by the utility company. All costs for coordination with the utility company, backfilling, and any other related work necessary to complete this item of work, shall be incidental to the Project.

M. Item 19, 20

Structures, Removal

Structures, Removal

1. Removing structures, of the type specified, will be paid for at the Contract Unit Price on a per each unit basis. Price paid shall be payment in full for all labor, material, and equipment required for removal of existing structure and shall include, but is not limited to, all excavation, sheeting, shoring, bracing, and dewatering; protection of existing improvements, removal of the existing structures, removing and disposing of all 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 all items necessary to complete the job, whether specifically mentioned or implied.
2. Removing structures will be measured on an each unit basis for each structure removed.

N. Item 21

Structures, 36 inch, Removal

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

O. **Item 22**

Section 12, R

1. Removal of storm sewers and culverts will be paid for at the Contract Unit Price per linear foot. Price paid shall be payment in full for all labor, material and equipment necessary for removal of storm sewer and culvert, and shall include, but is not limited to, all 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 all items necessary to complete the job, whether specifically mentioned or implied.
2. Removing storm sewers and culverts will be field measured in linear feet.

P. **Item 23**

Part E, B

1. Removal of bituminous pavement, regardless of thickness, will be paid for at the Contract Unit Price per square yard. Price paid shall be payment in full for all labor, material and equipment necessary for removing bituminous pavement, and shall include, but is not limited to, all sawcutting, excavation, protection of existing improvements, removal and disposal of unsuitable material, barricading, miscellaneous restoration or cleanup, and all other items necessary to complete the Work, whether specifically mentioned or implied.
2. Measurement for removal of bituminous pavement will be by field measure of removed pavement is square yards.

Q. **Item 24**

Part C, G, R

1. Removal of concrete curb and gutter will be paid for at the Contract Unit Price per linear foot unit basis. Price paid shall be payment in full for all labor, material, and equipment necessary for the removal of concrete curb and gutter, as shown on the Plans or as determined by the Engineer, and shall 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 all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for removal of concrete curb and gutter will be in linear feet, determined by field measurement.

R. **Item 25**

Part S, D, R

1. Removal of concrete sidewalks or driveways six (6) inches or less in thickness, will be paid for at the Contract Unit Price per square foot unit basis. Price paid shall be payment in full for all labor, material, and equipment necessary for the removal of concrete sidewalks or driveways six (6) inches or less in thickness, as shown on the Plans or as determined by the Engineer and shall 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 all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for removal of concrete sidewalks or driveways six (6) inches or less in thickness will be in square feet, determined by field measurement.

S. Item 26

Allowance for Telemetry and Level Sensors

1. The Allowance for Telemetry and Level Sensors pay item has been set up as a lump sum allowance to allow the City of St. Joseph additional time to research and select the appropriate level sensors and data collection technology to measure the water height at three locations shown on the plans within the City's sanitary sewer system. During the construction phase, the City will identify the type of level sensor and data collection/reporting technology for purchase and installation by the contractor. All level sensor components, conduits, wiring and installation will be paid for at an agreed upon lump sum price. Price paid shall be payment in full for all labor, material, and equipment required for the removal of existing level sensor and data collection/reporting technology, potential modification or expansion of existing level sensor and data collection/reporting technology and installation of any new components that are identified. and shall include, but is not limited to, all preparation, protection of personal, traffic control, by-passing and controlling flow, miscellaneous restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Once the components have been identified, the contractor will be asked to provide a complete lump sum price within the allowance to complete the work.

T. Item 27, 28

Cast-in-place concrete structures of the size and type shown on the plans will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment required for constructing the cast-in-place structure and shall include, but is not limited to, all excavation, sheeting, shoring and bracing, dewatering, supported helical piles, forming, furnishing, placing, finishing and curing concrete, furnishing and placing reinforcing steel, water stops, embedded items, protection of existing improvements, protection against rain and cold weather, furnishing, placing, and compacting granular backfill, furnishing and installing frame, cover, bricks, blocks, steps, cone section, riser sections, barricading, restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.

1. Cast-in-place concrete structures of the size and type shown on the plans will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment required for constructing the cast-in-place structure and shall include, but is not limited to, all excavation, sheeting, shoring and bracing, dewatering, supported helical piles, forming, furnishing, placing, finishing and curing concrete, furnishing and placing reinforcing steel, water stops, embedded items, protection of existing improvements, protection against rain and cold weather, furnishing, placing, and compacting granular backfill, furnishing and installing frame, cover, bricks, blocks, steps, cone section, riser sections, barricading, restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.

U. Item 29

Connection to diversion chamber 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 connecting the new sewer to a proposed diversion chamber, and shall include, but is not limited to, all excavation, sheeting, shoring, bracing and dewatering, disposal of excess excavated material, tapping existing structure, connection to structure, sand backfill, removal and disposal of unsuitable material, removal of existing flow channel and construction of new flow channel, cleanout of structure, protection of existing improvements, placing and removing stoppers, bulkheads and flumes, pumping and bypassing flow, removal and disposal of debris, and all other items necessary to complete the job, whether specifically mentioned or implied.

1. Connection to diversion chamber 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 connecting the new sewer to a proposed diversion chamber, and shall include, but is not limited to, all excavation, sheeting, shoring, bracing and dewatering, disposal of excess excavated material, tapping existing structure, connection to structure, sand backfill, removal and disposal of unsuitable material, removal of existing flow channel and construction of new flow channel, cleanout of structure, protection of existing improvements, placing and removing stoppers, bulkheads and flumes, pumping and bypassing flow, removal and disposal of debris, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for connection to diversion chamber will be per each.

V. Item 30

Existing CSO Diversion Chamber Expansion of the size and type shown on the plans will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment required for expanding the cast-in-place structure and

1. Existing CSO Diversion Chamber Expansion of the size and type shown on the plans will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment required for expanding the cast-in-place structure and

shall include, but is not limited to, all excavation, sheeting, shoring and bracing, dewatering, supported helical piles, forming, furnishing, placing, finishing and curing concrete, furnishing and placing reinforcing steel, water stops, embedded items, protection of existing improvements, protection against rain and cold weather, furnishing, placing, and compacting granular backfill, furnishing and installing frame, cover, bricks, blocks, steps, cone section, riser sections, barricading, restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.

W. I 31

C B

1. Concrete bollard will be paid for at the Contract Price per each. Price paid shall be payment in full for labor, material and equipment necessary to furnish and install bollards, and shall include, but is not limited to, construction, excavation, furnishing and installing post, concrete footing, filling with concrete, painting, and other items necessary to complete the Work, whether specifically mentioned or implied.

I 32

S G

1. Site Grading will be paid for at the Contract Unit Price on a per lump sum basis. Price paid shall be payment in full for all labor, material, and equipment necessary to grade the site to the lines, grades and cross sections shown on the plans, and shall include, but is not limited to, the removal and disposal of all unsuitable material, the excavation and stockpiling of topsoil, grading, shaping, excavating, filling, and compacting the site, the removal and disposal of all excess or unsuitable material, the providing of all earth and topsoil necessary to conform to the cross sections shown on the Plans, spreading and grading topsoil, removal and disposal of miscellaneous items, and for all other items necessary to complete the work, whether specifically mentioned or implied.

Y. I 33, 34

A S, P

A S, I

1. Adjusting structures will be paid for at the Contract Unit Price on a per each basis. Price paid shall be payment in full for all labor, material, and equipment required to either raise the frame and cover on an otherwise sound structure not more than 12 inches or lower them not more than six (6) inches, and shall include, but is not limited to, all sawcutting, removal and disposal of pavement, excavation, construction, bricks, blocks, precast adjustment rings, masonry plaster coat, sand backfill, concrete pavement, installation of frame and cover, cleanout of structure, and all items necessary to complete the job, whether specifically mentioned or implied.
2. Adjusting structures will be measured on an each unit basis for each structure adjusted.

I 35

E E

1. Earth excavation will be paid for at the Contract Unit Price per cubic yard basis. Price paid shall be payment in full for all labor, material, and equipment necessary for excavation to the lines and grades shown on the plans, and shall include, but is not limited to, all excavation and disposal of all unsuitable material including, but not limited to, all 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 all other items necessary to complete the job, whether specifically mentioned or implied.

2. Payment for earth excavation will be per cubic yard. The quantity of earth excavation was calculated from existing and proposed grades. The quantity paid will be 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.

AA. 1000 36

E 000000 000

1. Fill for embankments will be paid for at the Contract Unit Price per cubic yard unit basis. Price paid shall be payment in full for all labor, material, and equipment required to construct embankment and shall include but is not limited to providing, placing, and compacting the fill material required for the construction of the embankment, stripping and stockpiling topsoil, all necessary subgrade preparation, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for embankment will be determined by one of the following methods:
3. For pavement with curbs, it will be determined by the average end area method. The limits of the end area section shall include the height and the width. The height is determined by taking the average of the difference in elevations between the existing ground and the bottom of the subbase, pavement, or base course, whichever is lower, at the back of both curbs and at the centerline of the pavement. The width is equal to the width of the pavement, measured from back of curb to back of curb, plus two (2) feet on each side. Measurement shall also include the area of the triangular portion of the embankment lying between the 1 on 1 slope and the line two (2) feet behind the back of curb. The height and base of the triangle shall be equal to the height of the average end area section described in 1, above. The material, placement, and compaction required to construct the triangular portion of the embankment from the 1 on 1 sloped surface to the existing ground as specified on the Plans or determined by the Engineer, shall be considered incidental to the price paid for the embankment.
4. For pavement with shoulders, it will be determined by the average end area method. The limits of the end area section shall include the height and the width. The height is determined by taking the average of the difference in elevations between the existing ground and the bottom of the subbase, pavement, or base course, whichever is lower, at the outer edge of both shoulders and at the centerline of the pavement. The width is equal to the width of the pavement and shoulders measured from the outer edge of shoulder to the outer edge of shoulder plus two (2) feet on each side. Measurement shall also include the area of the triangular portion of the embankment lying between the 1 on 1 slope and the line two (2) feet behind the shoulders. The height and base of the triangle shall be equal to the height of the average end area section described in 1, above. The material, placement, and compaction required to construct the triangular portion of the embankment from the 1 on 1 sloped surface to the existing ground as specified on the Plans or determined by the Engineer, shall be considered incidental to the price paid for the embankment.
5. Payment for embankment will be per cubic yard. The quantity of embankment was calculated from existing and proposed grades. The quantity paid will be plan quantity unless there is a field change which affects plan quantity. No field measurement for payment of embankment will be done at the time of construction.

BB. 1000 37

S 000000 U 0000000 (21AA)

1. Subgrade undercut excavation and backfill will be paid for at the Contract Unit Price per cubic yard unit basis. In cut areas, the price paid shall be payment in full for all labor,

material, and equipment necessary for undercut excavation and disposal of all unsuitable material, as determined by the Engineer, below the proposed subgrade elevation, and shall include, but is not limited to, providing, placing and compacting the undercut backfill material. In fill areas, the price paid shall be payment in full for all labor, material, and equipment necessary for undercut excavation and disposal of all unsuitable material, as determined by the Engineer, below the existing ground elevation and shall include, but is not limited to, the placement and compaction of the undercut backfill material to existing grade.

2. Measurement for subgrade undercut excavation and backfill will be determined by field measurement.

CC. Item 38

A **B** **C**, **21AA L**

1. Aggregate base course, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per ton unit basis. Price paid shall be payment in full for all labor, material, and equipment necessary for the aggregate base course, compacted in place, and shall include, but is not limited to, all 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 all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for aggregate base course will be in tons, with the installed tonnage determined by certified delivery tickets submitted to the Engineer or his duly authorized representative. The delivery tickets shall 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 the Engineer will be paid for at the tonnage basis. If the width of the base course is increased to accommodate the Contractor in placing forms, etc., the additional material installed beyond the width specified on the Plans or as determined by the Engineer, will be at the Contractor's expense.

DD. Item 39, 40, 41, 42

B **W** **C**, **36A, 1.5**

B **W** **C**, **5EML, 1.5**

B **L** **C**, **4EML, 2**

B **B** **C**, **4EML, 3**

1. Bituminous pavement, of the type and thickness specified on the Plans, will be paid for at the Contract Unit Price per ton. Price paid shall be payment in full for all labor, material, and equipment necessary for the bituminous pavement and shall include, but is not limited to, all excavation, protection of existing improvements, also compacting and fine grading subgrade, also furnishing, placing and compacting backfill and subbase, also the furnishing, placing, rolling and compacting the various bituminous lifts or courses, also the furnishing and applying of prime and bond coats, barricading, restoration, and for all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for bituminous pavement will be in tons, with the installed tonnage determined by certified batch plant delivery tickets submitted to the Engineer or his duly authorized representative, at the time of placement.

EE. Item 43

Hot Patching Bituminous Materials

1. Patching with bituminous materials, of the type specified on the Plans, will be paid for at the Contract Unit price per ton. Price paid shall be payment in full for all labor, material, and equipment necessary for the bituminous patching and shall include, but is not limited to, all construction, saw cutting, chipping, removing and disposing of unsuitable materials, also furnishing and applying of prime and bond coats, preparation of existing pavement base, also the furnishing, placing, rolling, tamping, and compacting of the bituminous patching material, also for protection of existing improvements, barricading, restoration, and for all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for patching with bituminous materials, of the type specified, will be in tons, with the installed tonnage determined by certified batch plant delivery tickets submitted to the Engineer or his duly authorized representative, at the time of placement.

FF. Item 44

Concrete Curb and Gutter, D4

1. Concrete curb and gutter of the type and width specified will be paid for at the Contract Unit Price per linear foot unit basis. Price paid shall be payment in full for all labor, material, and equipment necessary for the concrete curb and gutter section and shall include, but is not limited to, all 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 for all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for concrete curb and gutter will be in linear feet, determined by field measurement of curb and gutter in place.

GG. Items 45, 46

Sidewalks, Concrete, 4 inch

Sidewalks, ADA, Concrete, 6 inch

1. Sidewalks, sidewalk ramps, and driveway approaches, of the thickness specified on the Plans, will be paid for at the Contract Unit Price per square foot. Price paid shall be payment in full for all labor, material, and equipment necessary for sidewalks, sidewalk ramps and driveway approaches and shall include, but is not limited to, all 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 for all items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for sidewalks, sidewalk ramps, or driveway approaches, will be in square feet, field measured 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.

HH. Item 46A

Concrete Pavement, 8-inch

1. Concrete pavement of the type and thickness specified will be paid for at the Contract Unit Price per square yard unit basis. Price paid shall be payment in full for all labor, material, and equipment necessary for the concrete pavement and shall include, but is not limited

to, all 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 for all items necessary to complete the job, whether specifically mentioned or implied.

2. Measurement for concrete pavement will be in square yards, determined by field measurement of the concrete in place.

II. **Item 47**

Fencing, 8 Fencing, Concrete Lining, Installation of Gate

1. Fencing, of the type specified, will be paid for at the Contract Unit Price per linear foot offence in place. Price paid shall be payment in full for all labor, material, and equipment necessary for fencing and shall include, but is not limited to, all fittings and hardware, excavation, concrete foundations, line posts, end posts, corner posts, angle posts, intersection and intermediate braced posts, rails, tension wire, bracing, post caps, post extensions, barbed wire, fence fabric, gate posts, gates, gate hardware, pickets, stretcher bars, tie wire, fasteners, backfilling, restoration, cleanup and all other items necessary to complete the job, whether specifically mentioned or implied.

JJ. **Item 48**

Gate, 8 Fencing, Work, 40 Fencing

1. Gate, of the size and type specified, will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment required for furnishing and installing a gate, as shown on the plans or specified, and shall include, but is not limited to, all construction, steel framing, steel posts, excavating and setting posts, concrete post foundations, fencing, hardware, bracing, caps, locks, hinges, and all other items necessary to complete the job, whether specifically mentioned or implied.

KK. **Item 49**

Watering, Fertilizing and Cultivating, 3 Times, Trenching, Sowing, Fencing, Mowing

1. Watering, fertilizing and cultivating, (for the establishment period specified) will be paid for at the Contract Unit Price per lump sum. Price paid shall be payment in full for all labor, material, and equipment required for maintaining all planted material in a vigorous, healthy, sound growing condition and shall include, but is not limited to, cultivating, weeding, pruning, watering, fertilizing, mulching, reguying, repairing or replacing damaged, diseased, dead, or infested plant material, and all other items necessary to complete the job, whether specifically mentioned or implied.

LL. **Item 50**

Soil Disposal (2 Lining)

1. Soil disposal, at the type of landfill specified will be paid for at the Contract Unit Price per Cubic Yard. Price paid shall be payment in full for labor, material, and equipment necessary to properly handle, manage, characterize, stockpile, load, transport, and dispose of waste material generated onsite during the Work. Price for this pay item shall also include, but is not limited to obtaining the necessary permits, including paying all fees associated with said permits; providing proper notifications to applicable regulatory agencies and other authorities; furnishing and maintaining plastic sheeting, physical boundaries or barriers, soil erosion and sedimentation control measures, suppressants and foams for dust control, as needed for stockpiled materials; testing, classifying and

determining waste characterization; separating materials based on said characterization, as necessary, for each type of waste; transporting materials to approved licensed facilities, including manifests, records or other documentation; decontamination of trucks leaving the site and proper coverage to prevent soil and/or dust from leaving the truck during transport; and other items necessary to complete the job, whether specifically mentioned or implied.

MM. Items 51, 52, 53, 54, 55, 56, 57

- S 18 inch, D 18 inch, T 18 inch B S**
- S 24 inch, D 24 inch, T 24 inch B S**
- S 30 inch, D 30 inch, T 30 inch B S**
- S 36 inch, D 36 inch, T 36 inch B S**
- S 24 inch, D 24 inch, T 24 inch B S, S 24 inch H 24 inch P**
- S 36 inch, D 36 inch, T 36 inch B S, S 36 inch H 36 inch P**
- S 24 inch, PVC SDR 26, T 24 inch B S**

1. Sanitary sewer, of the type, diameter and depth indicated in open cut will be paid for at the Contract Unit Price per linear foot. Price paid shall be payment in full for all labor, material, and equipment necessary for sanitary sewer pipe in open cut trench and shall include, but is not limited to, all excavation, sheeting, shoring and bracing, dewatering, construction, protection of existing improvements, sand backfill, supported helical piles, sand, stone or concrete pipe bedding, as set forth on the Plans or Specifications, wye and tee branches, placing and removing of stoppers and bulkheads, final inspection which includes cleaning, closed circuit television inspection and testing, stubs in manholes, connections to manholes and sewers, barricading, restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Measurement for sanitary sewers in open cut trench, will be in place, by length in linear feet, from center-to-center of standard manholes, with no deduction in length for intermediate standard structures, and the depth of the sewer between any two (2) manholes will be determined by averaging the depths of the two manholes. However, where tee manholes or where special bid items, as indicated in the 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, and the nearest adjacent standard sanitary manhole.

NN. Items 58, 58A, 59, 60

- S 4-foot S 4-foot M 4-foot, 0 to 8-foot-D (S MH 2 to 3)**
- S 4-foot S 4-foot M 4-foot, 0 to 8-foot-D (S MH 8, 10, 11 to 12)**
- S 4-foot S 4-foot M 4-foot, 0 to 8-foot-D, S 4-foot H 4-foot P (S MH 4 to 6)**
- S 5-foot S 5-foot M 5-foot, (24 inch to 30 inch), 0 to 8-foot-D (S MH 7)**

1. Manholes, of the type and diameter indicated, for depths up to eight (8) feet and for the first eight (8) feet of deeper manholes will be paid for at the Contract Unit Price on a per each basis. Price paid shall be payment in full for all labor, material, and equipment necessary for a complete manhole, and shall include, but is not limited to, frame and cover, adjusting rings, cone section, bottom section, flexible joint connections, excavation, sheeting, shoring and bracing, dewatering, sand backfill, supported helical piles, and all other items necessary to complete the job, whether specifically mentioned or implied.

2. In addition, a vertical linear foot unit price, as set forth in the bid schedule, will be paid for each foot or tenth thereof of manhole depth in excess of eight (8) feet from the invert of the outlet pipe to the top of the cover.
3. In addition, a vertical linear foot unit price, as set forth in the bid schedule, will be paid for each diameter of drop connection from the invert at the top of the drop to the invert at the bottom of the drop.

OO. Item 61, 62, 63

A 48" Diameter Storm Manhole, 48" Diameter, 0' 8"-D

A 60" Diameter Storm Manhole, 60" Diameter, 0' 8"-D

A 72" Diameter Storm Manhole, 72" Diameter, 0' 8"-D

1. Manholes, of the type and diameter indicated, for depths up to eight (8) feet and for the first eight (8) feet of deeper manholes will be paid for at the Contract Unit Price on a per each basis. Price paid shall be payment in full for all labor, material, and equipment necessary for a complete manhole, and shall include, but is not limited to, frame and cover, adjusting rings, cone section, bottom section, flexible joint connections, excavation, sheeting, shoring and bracing, dewatering, sand backfill and all other items necessary to complete the job, whether specifically mentioned or implied.
2. In addition, a vertical linear foot unit price, as set forth in the bid schedule, will be paid for each foot or tenth thereof of manhole depth in excess of eight (8) feet from the invert of the outlet pipe to the top of the cover.
3. In addition, a vertical linear foot unit price, as set forth in the bid schedule, will be paid for each diameter of drop connection from the invert at the top of the drop to the invert at the bottom of the drop

PP. Item 64, 65

C 4'-Diameter Storm Manhole 15'-Diameter, 0' 8"-D (SMH 9)

C 6'-Diameter Storm Manhole 30'-Diameter, 0' 8"-D (SMH 1)

1. Construct manhole over existing sewer 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 shall be payment in full for all labor, material, and equipment required for furnishing and installing a complete, new manhole over the existing sewer and shall include, but is not limited to, all excavation, sheeting, shoring and bracing, dewatering, frame and cover, adjusting rings, cone section, bottom section, flexible joint connections, sand backfill, supported helical piles, disposal of excess excavated material, tapping existing sewer, connection to sewer, construction of flow channel, cleanout of structure, protection of existing improvements, placing and removing stoppers, bulkheads and flumes, pumping and bypassing flow, removal and disposal of debris, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. In addition, a vertical linear foot unit price, as set forth in the bid schedule, will be paid for each foot or tenth thereof of manhole depth in excess of eight (8) feet from the top of the base to the top of the cover.

QQ. Item 66, 67

S 12" Diameter, RCP, Trench Box

S 18" Diameter, RCP, Trench Box

1. Storm sewers and culverts, 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. Price paid shall be

payment in full for all labor, material, and equipment necessary for storm sewer pipe and culvert pipe in open cut trench and shall include but is not limited to, all 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 all other items necessary to complete the job, whether specifically mentioned or implied.

2. 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.

RR. Item 68, 69

S 4-**S** **M**, 0 **8-D**

C **B**

1. Standard storm drainage structures, of the type and diameter indicated, 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 on a per each unit basis. Price paid shall be payment in full for all labor, material, and equipment necessary for a complete standard storm drainage structure, and shall include but is not limited to, all excavation, dewatering, construction, frame, cover, bricks, blocks, cone section, riser sections, top section, bottom section, masonry plaster coat, steps, sand backfill, barricading, restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Additional depth of drainage structures, more than eight (8) feet of the type and diameter specified will be measured by the vertical foot, to the nearest tenth, for that portion of all drainage structures more than eight (8) feet in depth from the top of the base to the top of the cover.

SS. Item 70

C 4-**S** **S** **O** **E** 15 **S**, 0 **8-D**

1. Manhole over existing sewer, 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 shall be payment in full for all labor, material, and equipment necessary for a complete standard storm manhole constructed over an existing sewer, and shall include but is not limited to, all excavation, dewatering, construction, frame, cover, bricks, blocks, cone section, riser sections, top section, bottom section, masonry plaster coat, steps, sand backfill, connection to sewer, barricading, restoration, and all other items necessary to complete the job, whether specifically mentioned or implied.
2. Additional depth of drainage structures, more than eight (8) feet of the type and diameter specified will be measured by the vertical foot, to the nearest tenth, for that portion of all drainage structures more than eight (8) feet in depth from the top of the base to the top of the cover.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

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 shall request a Preconstruction Meeting from the Engineer. A minimum three (3) working days' notification to meeting participants shall be required.
- B. Schedule:
 - 1. Engineer will establish the meeting place, time and date, distribute agenda, notify participants, and administer the meeting. Contractor shall notify major Subcontractors.
- C. Attendance:
 - 1. Owner
 - 2. Engineer
 - 3. Contractor
 - 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 shall report corrections and comments within ten (10) days of receipt of minutes.

1.02 PROGRESS MEETINGS

A. Periodic Progress Meetings will be held as required by the progress of the Work.

B. Schedule:

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

C. Attendance:

1. Engineer
2. Contractor
3. Subcontractor as appropriate to the agenda.
4. Suppliers as appropriate to the agenda.
5. Others

D. Agenda:

1. Review minutes of previous meeting.
2. Review of work progress since previous meeting.
3. Review field observations, problems, conflicts.
4. Review problems which impede Construction Schedules.
5. Review of off-site fabrication, delivery schedules.
6. Review corrective measures and procedures to regain projected schedule.
7. Review revisions to Construction Schedules.
8. Review plan progress, schedule, during succeeding Work period.
9. Review coordination of schedules.
10. Review submittal schedules; expedite as required.
11. Review maintenance of quality standards.
12. Review proposed changes for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other Contracts of the Project.
13. Other business.

E. Minutes:

1. Engineer will prepare and distribute copies to participants and 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 01 31 19

SECTION 01 32 16 CONSTRUCTION PROJECT SCHEDULE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall be responsible for the Project construction schedule for the full Contract Time, including without limitation the following:
 - 1. Contractor's construction schedule updates shall 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 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 shall 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 shall 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 shall mean calendar day unless otherwise specifically designated. Contract Time computations shall be made in Days. Total Float and Contract Float values computed in Working Days shall 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 shall 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 Specifications.
- 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 shall 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; _____; 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 shall detail CPM Activities and logic ties as required to demonstrate the Contractor's approach to all the Work. CPM Activity durations shall equate to the days required to complete the associated Work. Activities shall 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 shall not be utilized unless approved in advance by the Engineer. Activities shall be cost and resource loaded.
 - F. The activities shall form a complete network wherein all activities (except for the start and completion milestones) shall have at least one predecessor and one successor. Each activity shall 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 shall last from fifteen (15) to forty-five (45) days unless a shorter or longer duration is required to properly depict the Work. The schedule shall provide not less than thirty (30) days for each submittal review or re-review activity and for each submittal shall include separate activities for review, resubmittal, 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 shall be separate activities. Contractor shall include weather contingencies and other anticipated/foreseeable events/conditions in the schedule and the schedule narrative.
 - I. Contractor shall 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 shall 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 shall 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 shall be explained.
 - K. 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.
 - L. Early Dates in the CPM Schedule shall 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 shall 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 shall show in detail the Contractor's approach to conforming with those sequences.
 - M. A narrative shall accompany all CPM Schedule Submittals which shall:
 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.
- N. The narrative shall 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.
- O. CPM Schedule Submittals shall 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) shall 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 shall 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 shall be identified in red color as the near critical path.
 11. Schedule update reports shall include the prior update baseline.
- P. Each CPM Schedule Submittal shall 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.

- Q. 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.

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.

- R. No CPM Schedule review by the Engineer shall 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.

- S. CPM Schedule reviews shall 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 shall 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 shall remain the sole responsibility of the Contractor.

- T. 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 shall 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 shall reflect Contractor's plan for the Work as awarded in full accordance with the Contract, and shall 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 shall 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 shall 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 shall 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.
3. **The first Progress Payment shall 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 shall represent the As-Planned Schedule, and shall 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 shall address Engineer's comments, revise and resubmit until approved by the Engineer. The cost-loaded CPM Schedule report and the DCB shall 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 shall not modify any activity value or pay item, unless otherwise authorized by the Engineer in writing. The Engineer may require reallocation of costs for uninstalled material, amounts not expended for bonds or insurances, or to properly reflect authorized Construction Change Directives or Change Orders. The 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.
4. CPM Schedule Updates. After approval of the Rev. 0 CPM Schedule Contractor shall 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 shall show the actual status of the Project as of the date of the updated CPM Schedule. CPM Schedule Updates shall progress the Record Schedule, and shall 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 shall 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 shall 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 shall 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 shall update the physical percent complete for each activity started or in progress, based on realistic assessment of earned value and work remaining. Contractor shall 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 all punch list work identified during Owner's pre-final inspection.

- d. Contractor shall include the CPM Schedule Update with its monthly Payment Submittal, which shall also include the 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 shall be the current Record Schedule and shall 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 shall 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.
5. Short-term look-ahead Schedules shall subdivide CPM Activities into detailed tasks and cover the prior two (2) weeks and the next four (4) weeks. Each installation task shall be cross-referenced to a CPM Activity and shall not combine the Work for more than one crew.
 6. Submittals shall segregate preparation from review and shall not combine items furnished by separate Suppliers.

1.05 CONTRACTOR'S SCHEDULER

- A. Contractor shall appoint a project scheduler with the following minimum qualifications (unless otherwise modified by the Owner or Engineer): At least five 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 shall 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 shall prepare the Baseline schedule, all schedule updates, look ahead schedules, time impact analysis, and recovery schedules required by the Contract Documents. Contractor's scheduler shall 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 shall 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 shall begin the Work on the date of commencement indicated in the Notice to Proceed. It shall carry the Work forward expeditiously with adequate resources, shall at all times adhere to the CPM Schedule, and shall 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 shall be undertaken and completed in accordance with the cost loaded CPM Schedule described in the Contract Documents. The parties shall use the CPM Schedule for planning and monitoring the progress of the Work. If the Contractor shall 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 shall 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 shall 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 shall 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 shall submit a schedule recovery plan and immediately take measures necessary to recover delay. Contractor's schedule recovery plan shall describe the cause of schedule slippage or delayed progress and the actions proposed and taken by the Contractor to recover schedule. Contractor shall 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 shall carry on the Work with due diligence during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements. Contractor shall 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 shall consult with Engineer and shall 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 shall restore the Project staff to the appropriate size.
- B. Contractor shall 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 shall 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 shall 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 shall immediately take such action as is necessary to mitigate and recover the delay.
1. Contractor shall 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 shall 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 shall 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 shall 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 shall be reasonable evidence that the Contractor is not prosecuting the Work with due diligence.

Any such Contractor failure, refusal or neglect shall 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 shall be bound by the foregoing provisions.

3.03 DELAYS AND EXTENSIONS OF TIME

- A. Extensions of the Contract Time shall 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 shall 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 shall 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 shall 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 shall be accompanied by native electronic XER files and shall 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 shall 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 shall 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 shall be conducted in the following sequential steps:
 - 1)
 - 2) Delays under paragraph 3.02.C shall 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 shall be noted to determine the extent of delays that are not within the responsibility of the Owner.
 - 3) 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 shall 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 shall 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 shall 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 shall be prepared in accordance with ACEI 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 shall 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 shall 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 shall 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 shall 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 shall 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 shall 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, shall 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 shall be the Contractor's sole remedy for any delay due to any of the causes identified under paragraph 3.02.C. In no event shall 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 shall not be entitled to any increase in Contract Price and/or Contract Time, and the Contractor shall 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 shall 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 shall 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 shall 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 shall 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 shall 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 shall consult with the Engineer regarding measures available to accelerate the work and shall take such measures as the Engineer shall 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 shall 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 shall furnish to Engineer a written notice of planned acceleration specifying the actions that Contractor intends to take and the reasons therefor. Owner shall 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 shall maintain cost records in accordance with applicable requirements of the General Conditions and shall submit for Engineer's signature daily time sheets showing overtime premiums paid. To the extent that Contractor demonstrates to Engineer's satisfaction that

3. Contractor had timely submitted a request for Contract Time extension justifying an extension of Time;
4. an extension of Time was justified under the Contract but not granted by Owner;
5. that the cause of the delay was not mitigated;
6. Contractor provided notice as specified before undertaking acceleration; and
7. that Contractor incurred additional overtime costs to accelerate its Work solely to recover such delay, Owner shall 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 shall be charged or due with respect to use of overtime work or the acceleration of performance.

- C. Each Subcontractor shall 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 shall be available to both the Contractor and Owner.
- B. The amount of Total Float available for sharing by the Owner shall 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 shall 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 shall not be entitled to any changes in Contract Price or Contract Time.

- D. Early Completion Schedules: Contractor's bid and the Contract Price shall be premised upon completion exactly on the Contract Time, without any contemplation of early completion. Contractor shall 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 shall 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 shall not justify an extension of Contract Time nor shall the Owner have any liability under any circumstances for any delay from a planned early completion date.

END OF SECTION 01 32 16

SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 PROGRESS SCHEDULES

- A. Contractor shall submit one (1) electronic copy in PDF format of Progress Schedules indicating the starting and completion dates of the various stages of the Work and estimated payments to the Engineer.
 - 1. Proposed Progress Schedules shall be submitted to the Engineer prior to the pre-construction meeting.
 - 2. Contractor shall distribute hard copies of the Progress Schedules during the pre-construction meeting for discussion.
 - 3. Progress Schedules shall be updated by the Contractor and submitted 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. Contractor shall submit one (1) electronic copy in PDF format of the Shop Drawing Schedule indicating the individual items and submission dates to the Engineer.
 - 1. A preliminary Shop Drawing Schedule in accordance with the requirements in Section 00 72 00 shall be submitted by the Contractor prior to the pre-construction meeting.
 - 2. Contractor shall distribute hard copies of the Shop Drawing Schedule during the pre-construction meeting for discussion.
 - 3. A final electronic copy of the Shop Drawing Schedule (in PDF format) shall be submitted by the Contractor at least ten (10) days prior to submitting the first Application for a Payment.

1.04 SCHEDULE OF VALUES

- A. Contractor, if applicable, shall submit one (1) electronic copy in PDF format Schedule of Values of the Work to the Engineer.
 - 1. A preliminary Schedule of Values shall be submitted by the Contractor prior to the pre-construction meeting.
 - 2. Contractor shall distribute hard copies of the Schedule of Values during the pre-construction meeting for discussion.
 - 3. A final Schedule of Values (in PDF format), prepared in accordance with the Section 00 72 00 and presented in sufficient detail to serve as the basis for payments during construction, shall be submitted to the Engineer for review at least ten (10) days prior to submitting the first Application for Payment.

1.05 APPLICATIONS FOR PAYMENT

- A. Contractor shall 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 shall 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.
- C. 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.
- D. Contractor shall submit a completed Payment Schedule with an executed Contractor's Application for Payment and Contractor's Declaration to the Engineer not more often than once per month.
- E. Engineer will certify payments with the use of Engineer's Certificate for Payment.

1.06 SHOP DRAWINGS

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

1.07 PRODUCT DATA

- A. Product Data shall be presented in a clear and thorough manner identified the same as the Shop Drawings. Included with the information shall be performance characteristics and capacities depicting dimensions and clearances required.
- B. Manufacturer's standard schematic drawings and diagrams shall be modified to delete information which is not applicable to the Work. Manufacturer's standard information shall be supplemented to provide information specifically applicable to the Work.

1.08 SAMPLES

- A. Samples shall be of sufficient size and quantity to clearly illustrate functional characteristics of the product with integrally related parts and attachment devices depicting full range of color, texture and pattern.

1.09 SUBMISSION REQUIREMENTS

- A. Contractor shall make Submittals in accordance with the approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor. No damages will be awarded, or extension of time granted, due to the Shop Drawing and product data review process.
- B. Contractor shall submit an entire package of Shop Drawings and Product Data information for major items of Work so that the Engineer can review the package as a unit.
- C. Contractor shall submit one (1) electronic copy in PDF format of Shop Drawings and Product Data information containing the following information at a minimum:
 1. Field dimensions clearly identified as such.
 2. Relation to adjacent or critical features of the Work or materials.
 3. Applicable standards, such as ASTM or Federal Specification Numbers.
 4. Identification of deviations from Contract Documents.
 5. Identification of revisions on resubmittals.
 6. Project Title, Date of Submission, Date of Previous Submission, and Specification Section number.
- D. Contractor shall initial or sign Shop Drawings and Product Data submittals, certifying 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 shall initial or sign Shop Drawings and Product Data submittal and shall indicate the status of the Submittal, or requirements for resubmittal. Engineer shall return to 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.
- 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. Not Approved - See Remarks
 - e. For Information 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" indicate that the Contractor may commence with construction, fabrication or purchase of such items.
 - a. Proceeds in strict accordance with the Engineer's notes and/or required corrections/deletions/additions indicated thereon;
 - b. Pending appropriate response by the Contractor as further noted.
 - 3. Elements marked "Revise and Resubmit" indicate that the Contractor must make the required corrections as shown or noted and resubmit such items to the Engineer for further review.
 - 4. Elements marked "Not Approved - Comments Attached" indicate that further comments or explanations have been affixed to the Submittal, which may require action(s) by the Contractor as further noted.
 - 5. Elements marked "For Information Only" indicate that the Engineer has not reviewed the Submittal for compliance with specifications or Plans, but acknowledges the Submittal for informational purposes only.
 - 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 shall make corrections or changes in the Submittals required by Engineer and resubmit. Contractor shall indicate any changes which have been made other than those requested by the Engineer.

1.12 MANUFACTURER'S OPERATION AND MAINTENANCE DATA

- A. Contractor shall submit one (1) electronic copy in PDF format and one (1) bound copy of all operation and maintenance data required per the various Specification sections.
 1. Prior to 50% completion of the Project, Contractor shall have submitted one (1) acceptable copy to the Engineer for review.
- B. Final copies of the operation and maintenance data shall be bound in a suitable number of 3-inch or 4-inch, 3-ring hard cover binders. Permanently imprinted on the cover shall be the words "Manufacturer's Operation and Maintenance Data", Project title, location of the Project, and the date. A table of contents shall be provided in the front of each binder to list the various sections in the manual.
- C. The information to be provided in each section of the manual, for each piece of equipment and project component shall include, but not be limited to, detailed equipment drawings; sections cut through all of the major equipment and subassemblies; installation and operational procedures; complete wiring and piping schematics; lubrication materials and procedures; maintenance procedures; and parts lists complete enough to permit identification of parts by nomenclature, manufacturer's part number and use.
- D. At the front of each section a maintenance schedule shall be provided for each piece of equipment in the section.
 1. The schedule shall display the daily, weekly, monthly, semi-annual, annual or fraction thereof, lubrication and preventative maintenance required in order to meet warranty conditions and the manufacturer's recommendations for optimum performance and life of the unit.
 2. A common schedule format is to be developed and used for all of the sections. Photocopies or reproductions of the manufacturer's literature will not be accepted.

1.13 AUDIO/VIDEO ROUTE SURVEY

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

- a. Audio/video route survey submission shall 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 shall include all surface features located within the public right-of-way, easement areas and adjacent private properties up to building line when such properties lie within the zone of influence of construction and will be supported by appropriate audio description made simultaneously with video coverage. Such coverage shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culvert, headwalls, retaining walls, and buildings located within such zone of influence. Video coverage shall be clear enough to identify cracks, depressions, holes and other defects in existing surfaces.
- E. Houses and buildings shall be identified visually by house number, when visible, in such a manner that structures of the proposed system can be located by reference. In all instances, however, location shall be identified by audio or visual means at intervals not-to-exceed 100 linear feet (30 m) in the general direction of travel.
- F. When conventional wheeled vehicles are used, the distance from the camera lens to the ground shall be not less than 12 feet (3.5 m) to ensure proper perspective. The rate of speed in the general direction of travel of the conveyance used during recording shall not exceed 30 feet/minute (10 m/min). Panning rates and zoom-in, zoom-out rates shall be controlled sufficiently such that stop action during play-back will produce clarity of detail of the object viewed.
- 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 shall 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 shall be done during times of good visibility. No recording shall be done during periods of visible precipitation, or when more than ten (10) percent of the ground area is covered with snow or standing water, unless otherwise authorized by 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 shall 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 shall be redone by the Contractor at no additional cost to the Owner.
- L. Each USB shall 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, the Contractor shall 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 shall be in digital format (i.e., JPEG, TIFF, GIF, PNG or PDF) and shall have a minimum resolution of 300 dpi.
- C. The following information shall be placed on the photo itself or embedded in the digital file:
 - 1. Project Title
 - 2. Contract Number
 - 3. Description of photo's content
 - 4. Date and Time of photo
- D. Contractor shall submit photographs monthly along with the Application for Payment as described in Article 14 of Section 00 72 00.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 33 00

SECTION 01 45 00 QUALITY CONTROL

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Sampling of materials will be made by the Engineer in accordance with the methods designated by the Specifications. Contractor shall furnish such facilities as the Engineer may require for collecting, storing, and forwarding samples to the Laboratory. Contractor in all cases shall furnish the required samples to the Owner without charge.

1.02 TESTS OF MATERIALS

- A. Materials in the Work shall meet the requirements of the Contract Documents.
- B. Tests of materials will be made as specified herein. Engineer shall at all times have access to all 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 the Owner. In any case materials may be either inspected or tested when received on the Project.
- C. Materials shall not be used until approval has been received from the Engineer. Approval of materials at the producing plant does not constitute a waiver of the Engineer's right for re-examination at the Project site.
- D. The standards for testing materials unless otherwise specified, shall be as established by the American Society for Testing and Materials (ASTM). Tests of materials will be made in accordance with the methods described or designated in the Specifications.
- E. The sampling and testing of all materials not specifically mentioned shall be done by generally accepted methods, unless otherwise specified by the Engineer.

1.03 CERTIFICATION OF MATERIALS

- A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the standards referred to in the Contract Documents.

1.04 SOURCE QUALITY CONTROL

- A. Testing identified in these specifications as Quality Control, which is required to establish quality of materials, equipment or fabricated items, shall be paid for by the Contractor unless otherwise noted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 45 00

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SITE ACCESS AND PARKING

- A. Contractor shall locate roads, drives, walks and parking facilities to provide uninterrupted access to construction offices, mobilization, Work, storage areas, and other areas required for execution of the Contract. Access drives and parking areas shall be hard surfaced unless otherwise approved by the Engineer.
- B. Contractor shall maintain driveways a minimum of 15 feet (5 meters) wide between and around combustible materials in storage and mobilization areas.
- C. Contractor shall maintain traffic areas as free as possible of excavated materials, construction equipment, products, snow, ice, and debris.
- D. Contractor shall not utilize existing parking facilities for construction personnel or for Contractor's vehicles or equipment, unless written permission from owner of parking facility is obtained.

1.02 TRUCKING ROUTE AND PUBLIC ROAD MAINTENANCE

- A. Prior to the start of construction, the Contractor shall submit for review a schedule and list indicating the streets and roads within the municipality that his equipment will use off the Project site.
- B. Contractor shall comply with all safety requirements, weight restrictions and speed limits.
- C. Gravel and dirt roads or streets used shall be maintained by grading, placing dust palliatives and maintenance gravel in sufficient quantities to eliminate dust and maintain traffic.
- D. Paved streets shall be maintained in a reasonable state of cleanliness and the Contractor shall remove accumulations of debris, dirt or mud caused by his operations. Removal shall be done in such a manner as to prevent the release of dust. This shall be done at least every day at the close of each day's operation or additionally when requested by the Engineer.
- E. Any roads or streets damaged by the Contractor's operations, shall be repaired or removed and replaced to satisfactions of the agency having jurisdiction at no additional cost to the Project.
- F. In order to ensure adequate street maintenance and restoration as outlined above, the Contractor may be required to deposit with the Agency having jurisdiction a 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 shall have the required maintenance or restoration work done and the cost incurred shall be deducted from the Road Protection Bond.
 - 2. At the completion of the Project, the Agency having jurisdiction shall return the Road Protection Bond less any monies expended by the Agency having jurisdiction and shall render to the Contractor an accounting of all monies so expended.
- G. Contractor shall not store any equipment, supplies, construction material or excess excavated material on any roads or streets unless otherwise approved by the Engineer.

1.03 EMERGENCY ACCESS

- A. Contractor shall 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 shall 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 shall maintain those portions affected by the construction operations in a passable condition until such time as final restoration of these improvements can be made as specified.
 - 1. If, in the opinion of 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 shall be backfilled with native material to provide for the necessary maintenance of traffic and safety; however, the native material shall be removed within 48 hours and the trench properly backfilled as specified.
- B. Where private roads are encountered throughout the community, the Contractor shall maintain those portions affected by its construction operations in a passable condition. These roads shall be maintained by the use of 21A road maintenance gravel, stone or slag.
 - 1. In the event the original subbase has been destroyed, the Contractor shall furnish and install 1-inch to 2-inch aggregate to stabilize the existing subbase.
- C. Upon completion of the construction activities, the Contractor shall shape and regrade these roads leaving them in a condition as good as or better than original, and adequate for normal travel.

1.05 WORK WITHIN RAILROAD COMPANY RIGHT-OF-WAY

- A. Contractor shall be responsible for complying with the requirements of the Railroad Company for all Work of the Project and/or temporary crossings for trucking routes. Unless otherwise provided by an item of these Specifications, the Contractor shall bear costs and expenses incidental thereto, including, but not limited to, protection, flagmen, construction engineering inspection by the railroad, and incidental work such as drainage facilities and removal, alteration and replacement of railroad fences.

1.06 ROAD CLOSING

- A. No street, road or section thereof shall be closed to through traffic unless otherwise provided for on the Plans, Specifications, or authorized by the agency with jurisdiction over the roads. Prior to closing a street, road, or section thereof, the Contractor shall 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 shall notify the local fire department, police department, local road authority, ambulance and emergency services, Department of Public Works, public transit authority and public school system daily as to what streets will be partly blocked or closed, the length of time the streets will be blocked or closed and when the streets will be reopened to traffic. Contractor shall designate one responsible employee to carry out the requirements of this condition.
- C. During the time that the road is closed, the Contractor shall make provision for trash, leaf, and rubbish pickup.

1.07 MAINTAINING TRAFFIC

- A. Contractor shall provide access for local traffic to property along the Project by means of temporary roads, drives, culverts or other means approved by the Engineer. Contractor shall grade, add surfacing materials, and dust palliatives to such temporary roads and drives as necessary for the proper maintenance of traffic.
- B. Where the shoulder is used to maintain traffic, the shoulder shall be graded, surfaced, treated for dust, constructed, or reconstructed, as specified herein or as shown on the Plans.
- C. If the construction work is suspended due to weather conditions, winter shut down or for any other reason, sufficient labor, materials and equipment shall be ready for immediate use at all times for the proper maintenance of traffic. Surfacing materials and dust palliatives shall be

applied at such times and locations and in such amounts as necessary to safely maintain traffic and as determined by the Engineer.

- D. Where shoulders are low, high, soft or rough, adequate provisions shall be taken to inform and protect the traveling public by means such as construction warning signs, barricades, lighted devices, etc. Such shoulder hazards shall be eliminated as soon as practicable.
- E. Contractor shall furnish, erect and maintain all signs, barricades, lights, and traffic regulators, in accordance with the requirements of the current "Michigan Manual of Uniform Traffic Control Devices".
 - 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 shall remain in effect until all necessary devices are in place and operational. The issuance of a stop Work order shall not be reason for granting additional compensation or an extension to the Contract Time.
 - 2. Furnishing, installing, and maintaining traffic control devices shall be incidental to the Project unless otherwise provided for in the Proposal.

1.08 EXISTING SIGNS

- A. No stop sign, traffic control or warning device or sign shall be taken down until the agency having jurisdiction over the roads has been notified and arrangements for the immediate reinstallation has been made. Contractor shall provide temporary signs, traffic control devices, warning devices, or watchmen continuously from the time the item is removed until it is reinstalled. Signs removed shall be replaced with signs meeting requirements of the agency having jurisdiction over the roads.

1.09 TEMPORARY ELECTRICITY AND LIGHTING

- A. Contractor shall be responsible for and pay all costs for the installation and removal of circuit and branch wiring, with area distribution boxes located so that power and lighting is available throughout the construction by the use of construction-type power cords and shall pay all costs of electrical power used.
- B. Electrical wiring and distribution shall conform to the National Electrical Code as adopted by the State of Michigan.

1.10 TELEPHONE

- A. Contractor is required by MIOSHA regulations to provide telephone service for contacting emergency services. Such emergency telephone service shall also be available for the use of 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 shall pay all costs for installation, maintenance and removal, and service charges for local calls to provide service for his construction site office as well as for the Engineer's field office. Toll charges for calls relating to Project business shall be at the Contractor's expense.

1.11 USE OF WATER

- A. Contractor shall acquire any and all permits, post any bonds and pay all fees required by the local agency having jurisdiction prior to using any hydrant or any other source of water. Contractor shall reimburse the local community for 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 shall 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 shall be observed, with precautions taken to avoid creating unsanitary conditions.

1.13 POTABLE WATER

- A. Contractor shall furnish a supply of potable water per MIOSHA requirements, available for use of construction personnel including the Owner and Engineer.

1.14 MEDICAL SERVICES AND FIRST AID

- A. Contractor shall furnish first aid supplies and a person trained in first aid with a valid first aid certificate, per MIOSHA requirements, available for use of construction personnel including the Owner and Engineer. Contractor shall also furnish a communication system for contacting emergency services. The telephone numbers of the physician, hospital, or emergency services shall be conspicuously posted at the job site.

1.15 POSTAL SERVICE

- A. Several or all residents of this Project area may receive their mail at roadside mailboxes. Since the postal service will not deliver mail to a resident without a mailbox or a mailbox that is not in its proper position, the Contractor shall relocate, replace and repair all mailboxes and posts in a condition and height acceptable to the post office within 24 hours of the removal.
- B. If required, the Contractor shall furnish new posts for the mailboxes if the existing posts are broken or rotted to the extent that they cannot be reused.
- C. Any mailbox damaged by the Contractor while carrying out his operations or by anyone else while the box is down due to the Contractor's operation, shall 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 shall be incidental to the Project unless otherwise specified in Section 00 42 43 - Proposal.

1.16 NEWSPAPER DELIVERY

- A. Residents of this Project area may receive their newspapers at roadside tubes. Since the resident arranges for newspaper delivery, the Contractor shall 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, shall be replaced as agreed between the Contractor and the newspaper who owns the damaged tube. The cost shall be incidental to the Project.

1.17 BUS STOPS AND SHELTERS

- A. Prior to the start of any construction, the Contractor shall notify the transit authority that has bus stops within the area of the Work. Removal, relocation and/or replacement of signs and/or benches shall be the responsibility of the Contractor in accordance with any requirements of the transit authority. The cost shall 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 shall furnish and maintain, for the exclusive use of the Engineer, an approved weatherproof building as a field office. The building shall 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 shall 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 shall furnish and maintain bottled water and sanitary facilities for the field office. Contractor shall clean the office at least once per week. Contractor shall 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 shall 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 shall 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 shall be included in the price bid for various items of Work under the Contract. The building shall be removed by the Contractor upon completion of the Contract and shall become his property.

1.19 BY-PASS PUMPING

- A. Contractor shall maintain flow in existing sewers at all times by pumping, bypassing, or fluming as necessary. During wet weather events, the flow in the sewer will rise rapidly and may become surcharged. Contractor shall maintain flow in such a manner as the existing flow can be adequately transported including wet weather flow. Contractor shall furnish, install, operate, and maintain temporary pumping facilities to service the upstream area including piping, temporary channels, pumps, sumps, controls, temporary plugs, and bulkheads.
- B. For sanitary sewerage, by-pass piping shall be PVC Schedule 80, ABS truss pipe, equivalent with solvent welded joints, HDPE with butt fused joints, or _____. Flexible hoses of whatever types are not acceptable. Bypassed flow shall be discharged to a sanitary sewer of acceptable size to handle the bypassed and existing flows. Contractor shall plan construction operations such that there will be no backups, leaks, or discharges of pollutants.
- C. Contractor shall also 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 shall provide an adequate labor force to oversee the by-pass pumping including providing labor to maintain 24 hour per day operation and emergency backup service.

- D. Costs for pumping and by-passing flow shall be included in the unit price bid for other items of Work unless otherwise specified in the Proposal.
- E. Contractor shall submit a by-pass pumping/diversion scheme to the Engineer for approval not less than 15 days prior to any anticipated by-pass pumping/diversion. By-pass plan shall include pumping capacity and expected flow rates.

PART 2 PRODUCTS

2.01 BARRICADES, ARROW BOARDS, TEMPORARY PAVEMENT MARKINGS, AND TEMPORARY SIGNS

- A. Barricades, Arrow Boards, Temporary Pavement Markings, Temporary Signs, and other traffic control devices shall be in accordance with the current edition of the MDOT Standard Specifications for Construction, and the current edition of the "Michigan Manual of Uniform Traffic Control Devices".

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 50 00

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 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 31 22 00 - Grading
- D. Section 31 23 13 - Subgrade Preparation
- E. Section 31 23 19 - Dewatering
- F. Section 31 23 33 - Trenching and Backfilling
- G. Section 31 35 00 - Slope Protection
- H. Section 32 92 19 - Seeding
- I. Section 32 92 23 - Sodding

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 shall secure all 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 shall 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 shall 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 shall 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 shall 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 shall not be used on this project. In lieu of these blankets, the Contractor shall 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) shall consist of long strand, residual, softwood fibers joined together by a high-strength, nontoxic adhesive. BFM shall be 100% biodegradable, and be non-toxic to fish, wildlife, and humans. Upon drying the matrix shall form a high strength, porous and erosion resistant mat that shall not inhibit the germination and growth of plants. BFM shall retain its form despite re-wetting.
- B. Bonded fiber matrix shall consist of:
 1. Seed and Fertilizer per Section 32 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 shall 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 shall be constructed of 100% continuous polyester needle-punched non-woven engineering fabric. Filter fabric shall be fabricated to provide a direct fit with the drainage structure cover. Filter fabric shall have the following minimum physical properties.
- 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 shall provide erosion protection of surrounding soils.
- B. Sedimentation control devices shall be installed prior to Contractor beginning Work. Soil erosion and sedimentation control devices shall be maintained in an effective functioning condition at all times during the course of the Work.
- C. Immediately bring earthwork to final grade and protect sideslopes and backslopes from erosion. Plan and conduct earthwork to minimize duration of exposure of unprotected soils.

3.04 INSTALLATION - GENERAL

- A. Install silt fences, ditch sediment traps, check dams, inlet filters, temporary gravel construction entrance/exits, turbidity barriers, erosion control blankets and other soil erosion control devices in accordance with the drawings and Storm Water Pollution Prevention Plan, or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.
- B. Deficiencies or changes on the drawings or SWPP shall be corrected or implemented as site conditions change. Changes during construction shall be noted in the SWPP and posted on the drawings.

- C. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.
- D. Remove temporary control devices after permanent measure are established. Remove and replace temporary control devices if they become ineffective at no additional cost to Owner.
- E. Contractor shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.
- F. Contractor shall permanently seed and mulch cut slopes as excavation proceeds to extent considered desirable and practical.

3.05 DUST CONTROL

- A. Keep dust down at all times, including during non-working periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming is not permitted.

3.06 APPLICATION OF BONDED FIBER MATRIX

- A. The slope shall be prepared and graded prior to application of bonded fiber matrix (BFM). Mixture of wood fiber mulch and polyacrylamide binder shall be blended, with the appropriate amount of seed and fertilizer per Section 32 92 19, according to manufacturer's recommendations.
- B. BFM shall be hydraulically applied to the soil as a viscous mixture, crating a continuous, three-dimensional blanket that adheres to the soil surface. BFM shall be mixed and applied at the rate as specified in 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 shall be applied in two applications from alternate directions to eliminate shadowing and shall be applied when no rain is expected for 12 hours.

3.07 DEWATERING DISCHARGE

- A. Should it be necessary for Contractor to do any dewatering during the course of construction, Contractor shall filter all discharge through a discharge filter bag or other sediment control device that will filter all discharge water.
- B. No dewatering discharge shall be allowed to flow unfiltered from the construction site.

3.08 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 shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to Owner.

3.09 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 shall be submitted to the agency having jurisdiction, as well as Owner and Engineer.
 - 2. Inspections shall be performed by a person familiar with the site, the nature of the major construction activities, and qualified to evaluate both overall system performance and individual component performance.

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 shall be properly authorized in accordance with the applicable General Permit to conduct the certified site storm water inspections.
- B. Inspection Frequency Reduction:
1. Inspection frequency may be reduced under the following conditions:
 - a. No active onsite construction activities.
 - b. Temporary cover has been provided across the entire site and no BMPs remain.
 - 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 shall 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 shall 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 01 57 13

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the requirements for the provision of temporary project signage to be provided at the site by the Contractor.
- B. Contractor shall provide labor, equipment, materials, and incidentals necessary to provide temporary project signage at the site.
- C. Contractor shall maintain the temporary project signage throughout the duration of the Contract through Final Completion.
- D. Contractor shall remove the temporary project signage from the site prior to final payment as approved by the Owner.

1.02 RELATED REQUIREMENTS

- A. Section 01 11 00 - Summary of Work
- B. Section 01 33 00 - Submittal Procedures

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Contractor shall coordinate with the Owner to determine the location(s) of project signage at the site.

1.04 QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
- B. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.05 REQUIRED SIGNAGE

- A. Contractor shall furnish, install and maintain the following signs throughout the duration of this Contract:
 - 1. Project identification sign.
 - 2. Traffic routings signs that show the Contractor's personnel, including but not limited to the subcontractors, suppliers, and delivery companies the Owner-approved routes for construction traffic at the facility.
 - 3. Parking areas for the Contractor's personnel, including but not limited to its subcontractors, suppliers, and delivery companies at the Owner-approved areas for Contractor parking.
 - 4. Contractor and subcontractors field trailers.
 - 5. Owner's field trailer.
 - 6. Safety signs as required by federal and State of Michigan OSHA and local laws, regulations, codes, standards, rules, and requirements.

1.06 SUBMITTALS

- A. Submit shop drawings of the required project signs specified in this Specification section to show the following:
 - 1. Materials of construction and installation details.

2. Removal details and restoration methods to demonstrate to Owner that areas affected by signage will be restored to original conditions or better.
3. Drawing of sign to show content of sign along with the text font type, font size, line spacing.
4. Proposed locations for each sign type.

PART 2 PRODUCTS

2.01 PERFORMANCE

- A. Contractor is responsible for furnishing high-quality, new project signs. Materials of construction shall be durable and designed and installed suited for the environment they are installed. The sign shall be in color and shall bear the following information:
 1. Project number, title and name of the Owner as shown on the Contract Documents.
 2. Owner's logo.
 3. Names and titles of Owner's key staff or designated personnel.
 4. Names of Engineer.
 5. Name of Contractor.

2.02 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
- B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
- C. Project sign will be 3/4 inch exterior grade medium density overlay (MDO) board with digitally printed graphics.
- D. Post and braces shall be exterior grade pressure treated lumber.
- E. Signs shall be installed and secured to withstand heavy winds so that signage does not become loose or otherwise unsafe.
- F. Signs shall be fabricated and installed so that there are no sharp edges or otherwise pose harm to personnel health and safety.
- G. Outdoor signs shall be reflective and installed at a lighted location of high public visibility, adjacent to main entrance.
- H. Indoor signs shall be installed in a lighted location.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Install sign surface plumb and level, with butt joints. Anchor securely.
- C. Paint exposed surfaces of sign, supports, and framing and surface material; one coat of primer and one coat of exterior paint.

3.02 MAINTENANCE

- A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing or sign.
- B. Signage that becomes deteriorated or otherwise unsatisfactory to the Owner, shall be replaced with new at the Contractor's expense.

3.03 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION 01 58 13

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 TRANSPORTATION AND HANDLING

- A. Contractor shall provide for expeditious transportation and delivery of materials and equipment to the Project site in an undamaged condition and on a schedule to avoid delay of the Work. Materials and equipment shall be delivered in original containers or packaging with identifying labels intact and legible.
- B. Contractor shall provide equipment and personnel at the site to unload and handle materials and equipment in a manner to avoid damage. Materials and equipment shall be handled only at designated lifting points by methods to prevent bending or overstressing.

1.02 STORAGE AND PROTECTION

- A. Contractor shall store materials and equipment immediately on delivery, and protect it until installed in the Work.
- B. Products subject to damage by elements shall be stored in weather-tight enclosures with temperature and humidity ranges as required by manufacturer's instructions.
- C. Loose granular materials shall be stored on solid surfaces to prevent mixing with foreign matter.
- D. The place of storage shall be located so as to minimize interference with traffic and to provide easy access for inspection. No material shall be stored closer than 5 feet (1.5 meters) to the edge of a pavement or traveled way open to the public.
- E. Materials that have been stored shall be subject to retest and shall meet the requirements of their respective specifications at the time they are to be used in the Work.
- F. Contractor shall provide protection of stored or installed materials and equipment as necessary to prevent damage from traffic and subsequent operations.

1.03 MANUFACTURER'S INSTRUCTIONS

- A. When the Contract Documents require that installation of Work shall comply with manufacturer's instructions, the Contractor shall obtain and distribute copies of such instructions to parties involved in the installation including two (2) copies to the Engineer.
- B. Contractor shall handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements. Should Project conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions.

1.04 PRODUCTS LIST

- A. Within four (4) days of request, the Contractor shall submit a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor, if applicable, to the Engineer.

1.05 CONTRACTOR'S PRODUCT OPTIONS

- A. For products specified only by reference standard, the Contractor shall select any product meeting that standard.
- B. For products specified by naming several products or manufacturer's the Contractor shall select any one of the products or manufacturers named, which complies with the specifications.
- C. For products specified by naming one or more products or manufacturers and "or equal," the Contractor must 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. Contractor shall perform a comprehensive startup and demonstration of equipment performance and compliance with the design requirements. When there is more than one mode of operation, the equipment shall be operated in every mode to verify proper operation.
- B. When equipment is to operate in conjunction with other equipment as a system, each piece of equipment shall be operated both by itself and automatically as a system to verify its proper operation.
- C. Contractor is to provide to 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. All equipment is to be inspected prior to operation for debris or other obstructions. Equipment is to be properly lubricated and calibrated prior to operation. Contractor shall make all adjustments necessary to assure correct operation. When required, equipment installation and operation is to be witnessed and checked by manufacturer.
- E. When required, the Contractor shall 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 01 60 00

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 shall be provided at the expense of the Contractor. Contractor shall furnish such labor and assistance as the Owner may require in setting the same.
- B. It shall 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 shall 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 shall 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 shall notify the Engineer immediately to assist in resolving the concern.

1.02 STAKING SCHEDULE

- A. Contractor shall 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 shall be submitted to the Engineer a minimum of three (3) working days prior to the start of construction.
- B. During construction, the Contractor shall 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 shall 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 shall be on a staking request form.

1.04 RELOCATION AND RE-ESTABLISHMENT

- A. Construction Stakes:
 - 1. Where change of location of stakes has been requested by the Contractor, or where the Contractor fails to properly preserve construction survey stakes, such resetting or relocations of stakes shall 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 shall bear all expense involved in re-establishing and/or resetting any survey control point, land survey point or monument lost or disturbed during his construction operation. Such Work shall be done under the direct supervision of a licensed land surveyor. Such survey control points shall be marked and flagged by the Engineer prior to construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 71 23

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

PART 1 GENERAL

1.01 CLEANING

- A. Contractor shall perform periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and wind-blown debris, resulting from construction operations.
- B. Waste material, debris and rubbish shall be periodically removed from the site and disposed of at legal disposal areas away from the site.
- C. Prior to Owner acceptance, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces, and Work areas, to verify that the entire Work is clean.
- D. Contractor shall broom clean exterior paved surfaces and rake clean other exterior surfaces of the site.

1.02 PROJECT RECORD DOCUMENTS

- A. Contractor shall deliver one (1) copy of all Specifications, Plans, Addenda, Shop Drawings and Samples, annotated to show all changes made during the construction process, to Engineer upon completion of the Work. Submittal of the record documents shall 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:
 - 1. Shall be a complete set based upon the fully conformed Project Manual. annotations shall include all changes during the execution of the work resulting from Requests of Information, Field Orders, Construction Change Directives, and the as-built conditions which differ from the proposed plans.
 - 2. Underground utilities installed as part of the Project and utilities exposed during execution of the Work shall be surveyed to record their location and elevation. The location shall be based upon available Project data (i.e.:coordinate system, benchmarks, etc.).
 - 3. The utility information shall include:
 - a. Straight run data every 100-feet.
 - b. Bends, valves, fittings, wyes/tees, hydrants, etc.
 - c. Crossings of other utilities.
 - 4. The record plans shall be in Portable Document Format (pdf), and full size (22" x 34").
 - 5. Annotations:
 - a. dimension changes with strike through and as built dimension.
 - b. changes clouded.
 - c. sketches, photos, etc. as appropriate.
- C. Documents shall be submitted in good order and in a legible condition.

1.03 OPERATION AND MAINTENANCE DATA

- A. Prior to final inspection or acceptance, Contractor shall fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and systems specified.
- B. Operation and maintenance data required by the individual Specification sections and the manufacturer's operation and maintenance data required in Section 01 33 00 - Submittal Procedures, shall constitute the basis of such instruction.

1.04 START UP

- A. Contractor shall 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. Written warranties from the manufacturer shall be provided for major equipment supplied under this Contract. The manufacturer's warranty period shall be concurrent with the Contractor's warranty period. The warranty from the manufacturer shall 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 shall be in accordance with the General Conditions.

1.07 FINAL PAYMENT AND ACCEPTANCE

- A. The final inspection, final application for payment and acceptance shall be in accordance with the General Conditions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION 01 77 00

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
- J. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. 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. Contractor shall comply with Section 01 57 13 - Temporary Erosion and Sediment Control. Contractor, at Contractor's expense, shall secure all permits, and post all bonds or deposits required to comply with the Soil Erosion and Sedimentation Control, requirements, being Part 91 of PA 451 of 1994 as amended.
- B. Contractor shall comply with all requirements of the National Pollutant Discharge Elimination System (NPDES) Storm Water Program for Construction Activities, Part 31 of PA 451 of 1994 as amended.
- C. Contractor shall provide, maintain and remove such temporary and/or permanent Soil Erosion and Sedimentation Control measures as specified on the Plans or as determined by the Engineer.
 - 1. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work.

2. Measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.

1.05 SUBMITTALS

- A. Written permission for the use of all disposal and borrow sites shall be obtained and copies shall be furnished to the Engineer.

1.06 PROTECTION OF PLANT LIFE

- A. All 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, shall be carefully protected from damage or injury during the various construction operations.
- B. Any tree, shrub or other type of vegetation not designated to be removed but which is damaged by the Contractor's operation shall 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. Existing culverts, sewers, drainage structures, manholes, water gate wells, hydrants, water mains, utility poles, overhead lines, underground conduits, underground cables, pavement, or other types of improvements within the construction limits, not designated on the Plans to be removed, shall be carefully protected from damage during the construction operations.
- B. Existing structure or improvement not designated to be removed, but which is damaged by the Contractor's operations shall be repaired or replaced by the Contractor, to the satisfaction of the 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 shall be cleaned out at the Contractor's expense.

1.08 MAINTAINING DRAINAGE

- A. Existing open drains, field and roadway ditches, drainage tile, sewers, enclosed drains, natural and artificial watercourses, surface drainage or any other types of drainage within the limits of the Work shall be maintained and free to discharge during construction.
- B. Drainage facility not designated to be abandoned, but which is damaged, or any drainage interrupted by the Contractor's operation shall be immediately repaired, replaced, or cleared by the Contractor.
- C. Costs incurred shall be incidental to the excavating, backfilling and compacting or grading operations.

PART 2 PRODUCTS

2.01 GRANULAR MATERIAL

- A. Bank run sand meeting the requirements of MDOT, Granular Material Class II.

2.02 AGGREGATE FOR SHOULDERS, PARKING AREAS, DRIVEWAYS OR ROADS

- A. Crushed limestone, natural aggregate or slag and meeting the requirements MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

- A. The area within the vicinity of the new Work shall be dewatered prior to commencing any construction activities. The depth of the dewatering shall be sufficient to allow the Work area to remain in a dry condition during the various construction operations.
- B. The costs incurred for furnishing, installing, maintaining and removing the dewatering equipment shall be at the Contractor's expense.
- C. Refer to Section 31 23 19 - Dewatering for additional requirements.

3.02 GENERAL

- A. The various construction operations shall be restricted to the existing right-of-way or the areas indicated on the Plans. If the Contractor requires additional area, the Contractor shall furnish the Engineer with written permission obtained from the property owner for any part of the operations he conducts outside of the right-of-way or limits indicated.

3.03 EXISTING IMPROVEMENTS

- A. Contractor shall expose existing sewers and structures to which the new Work is to be connected and notify the Engineer of same. Engineer will verify the vertical and horizontal locations of the existing system and shall 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, shall 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, shall perform construction operations in such a manner that the service will be uninterrupted.
- C. Contractor shall expose all existing utility lines prior to any excavation operation, to determine any conflict with the proposed improvement. Contractor shall be responsible for any relocation required as a result of any conflict of existing utilities shown on the plans, with the proposed improvement.
- D. Should it become necessary to move any utility structure, line or pole shown on the Plans or otherwise found necessary to be moved, the Contractor shall make all arrangements with the owner of the utility for the moving. Costs incurred for such moving shall be at the Contractor's expense unless indicated otherwise. However, before disturbing a utility line, structure or pole, the Contractor shall 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 shall be responsible for any removal or relocation required as a result of any conflict of existing utility poles (including street light poles, guy poles, telephone poles, etc.) with proposed improvements.
- B. Contractor shall make all arrangements for removing or relocating utility poles with the owner of the utility pole.
- C. Prior to disturbing any utility pole, the Contractor shall 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 shall temporarily support poles in the vicinity of the Work at no additional cost to the Owner. Support shall be in accordance with and to the satisfaction of the utility company.

3.06 EXISTING SEWERS, TILE, AND MAINS

- A. Existing sanitary sewers, storm sewers, drain tile, septic tank bed tiles, water mains or building services or leads, that are encountered during the performance of the Work that require relocation or are damaged, shall be restored with new materials equal in quality and type to the materials encountered.
- B. The new material shall be installed as specified in the Contract Documents and per the requirements of the local agencies. The bedding and backfill material, unless otherwise specified, shall be an approved Class II granular material, compacted to 95% of its maximum unit weight.

- C. Seepage bed tile and water mains shall be replaced in accordance with the requirement of the agency having jurisdiction.
- D. The relocation or protection of existing sewers, tiles, tile field, water mains or building services and leads shall 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 shall 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 shall 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, shall 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 shall 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 shall be maintained to a minimum which will allow for construction of the improvement.

3.09 REMOVAL OF SEWERS AND CULVERTS

- A. Unless otherwise specified in the Contract Documents, the Contractor, at Contractor's expense, shall remove any abandoned culvert, pipe, sewer, structure or part of a structure which is to be replaced or rendered useless by the new construction.
- B. When a sewer or culvert is removed at a structure, the Contractor shall 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 shall consist of removing and salvaging the existing frame and cover. The ends of the existing pipe shall be plugged and braced. The complete structure shall be removed entirely and disposed of. The excavation shall be backfilled with sand and compacted to 95% of its maximum unit weight. Maximum unit weight shall be determined by ASTM D698, Method B.
- B. If a structure is to be removed from a system that is to remain in service, a bypass system, approved by the Engineer, shall be installed and maintained by the Contractor, during the rebuilding period.

3.11 ABANDONING STRUCTURES

- A. The structure shall be broken down to at least 30 inches below the subgrade.
- B. Pipes connected to the structure shall be plugged with a brick, masonry or concrete bulkhead approved by the Engineer.
- C. The structure shall be backfilled 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. The remainder of the excavation shall be backfilled with a granular material, compacted to 95% of its unit weight, and shall meet with the approval of the Engineer. Maximum unit weight shall be determined by ASTM D698, Method B.

3.12 SALVAGED MATERIAL

- A. Salvaged materials shall become the property of the Contractor unless otherwise specified in the Contract Documents, and shall 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, a written agreement shall be arrived at by the Contractor and the crop owner as to the type and nature of the crop concerned prior to any construction within the area.
- B. Contractor shall be responsible for making full reimbursement to the owner of the crop damage on the basis of the following procedure:
 - 1. The area of the crop damage shall be determined by measurements taken by the Engineer, and this area shall include those portions of the crop which may extend into the public right-of-way.
 - 2. The average yield of the crop shall be established by the County Office of the U.S. Agricultural Extension Service.
 - 3. The cost of the crop shall be determined by using the prevailing price at the time of harvest as furnished by the U.S. Agricultural Extension Service.
- C. Contractor shall furnish 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 shall plant new trees, in approximately the same location as the existing trees, of size and species per the landscaping plans included in the Drawings.
 - 2. Contractor may remove and preserve the existing trees.
 - a. The trees shall be properly cared for and maintained in a healthy condition.
 - b. After the new improvement has been installed, tested, accepted and rough grading completed, the trees shall be replanted in approximately the same location.
 - c. Any trees damaged, destroyed or which die, shall be replaced at no additional cost.
- B. Trees, whether replanted or planted new, shall be guaranteed for a period of 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 shall consist of removing and disposing of pavement and shall include base courses, surface courses, integral and separate curbs, integral and separate curb and gutters, sidewalks and end headers.
- B. Pavement shall be removed to an existing joint or cut parallel to the existing pavement joints.
- C. Cutting shall be accomplished by using a power-driven concrete saw approved by the Engineer. The depth of the saw cut shall be a minimum of 6 inches, to insure that the removal of the old pavement will not disturb or damage the section of pavement remaining in place.
- D. Residual concrete pavement shall not be less than 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, the bituminous surface shall be cut the full depth by the use of 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 shall be considered as only one (1) pavement, whether or not there is a separation layer of earth, aggregate, or bituminous material between the old material and the concrete cap.
- G. Removal of Curb for Curb Drop:
 - 1. Where curb is to be removed for a curb drop, the operation shall be performed by saw cutting or by cold milling, 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 shall be performed by saw cutting. The limits of the removal shall be as called for on the Plans, or as approved by the Engineer. However, in no case shall the width of removal be less than 18 inches for sections with rolled or straight curb or less than 24 inches for mountable curbs.
- 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 shall be removed and replaced at the Contractor's expense.
- J. Earth removed during the pavement removal operation shall 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. Beam guardrail shall be relocated or shall be removed as specified on the Plans or as determined by the Engineer. If the existing material is damaged or destroyed, the Contractor shall replace the material at Contractor's expense.
- B. Where guardrail is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at the Contractor's expense, to a condition comparable to that prior to construction.
- C. After the guardrail removal or relocation operations are complete, all surplus material shall be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.
- D. Holes or voids resulting from the guardrail removal operation shall be backfilled with a Class II granular material, approved by the Engineer.

3.17 FENCES

- A. Fences shall be removed and replaced or shall be removed as indicated on the Plans. If any of the existing material is damaged or destroyed, the Contractor shall replace the material at Contractor's expense.
- B. Where fencing is encountered during construction, and its removal was not called for on the Plans, it shall be replaced or restored, at 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 shall be removed and disposed of by the Contractor, at Contractor's expense, unless otherwise called for in the Contract Documents.
- D. Holes or voids resulting from the fence removal operation shall be backfilled with a suitable material, approved by the Engineer.
- E. Where fences are encountered that are being used to confine livestock or to provide security, the fence shall be immediately replaced following construction. During construction, the

Contractor, at Contractor's expense, shall provide, install and maintain a temporary fence, meeting the approval of the Engineer.

3.18 HOLES

- A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable granular material. The material shall be placed by the controlled density method or other effective means having the approval of the Engineer and shall be compacted to 95% of maximum unit weight.
- B. Furnishing, placing and compacting of the backfill material shall be at the Contractor's expense.

3.19 RESTORATION IN RIGHT-OF-WAY AND YARD AREAS

- A. Right-of-way and yard areas not paved or aggregate surfaced shall be restored in accordance with the type and location specified herein unless indicated otherwise on the Plans. Disturbed areas may be shaped by "Machine Grading" or another method approved by the Engineer to achieve the cross section, line and grade shown on the Plans. Areas where slopes are 1 on 4 or flatter shall be restored with topsoil, seed and mulch. Slopes steeper than 1 on 4 shall be restored with sod.
- B. Excess material from the restoration operation shall be disposed of by the Contractor at Contractor's expense.
- C. Disturbed areas shall be graded to receive either topsoil and seed or topsoil and sod. The topsoil, seed, sod, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19 or 32 92 23.
- D. Contractor, at Contractor's expense, shall 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. The shoulder shall be regarded as the area between the edge of pavement and the ditch, or the area within 10 feet of the pavement, whichever is the lesser.
 - 2. The backfilling of trenches in the shoulder area shall be carried to within 5 inches of the existing surface as specified under Trench "A" or Trench "B" of Section 31 23 33. The remaining depth shall be backfilled with a minimum of 5 inches of compacted 22A or 23A aggregate with calcium chloride applied, at the rate of 6 pounds per ton of aggregate.
 - 3. Contractor, at Contractor's expense, shall furnish, place and compact all materials necessary to complete the backfilling and restoration operation within the shoulder area.
- B. Driveways and Parking Areas:
 - 1. Aggregate driveway areas shall be regarded as the area from the right-of-way line to the edge of the traveled roadway and shall include the shoulder area.
 - 2. Backfilling of trenches crossing aggregate surfaced driveways and parking areas shall be carried to the bottom of the proposed base course as specified under Trench "B". The remaining depth shall be backfilled with a minimum of 6 inches of compacted 22A or 23A aggregate, with calcium chloride applied at the rate of 6 pounds per ton of aggregate.
 - 3. Aggregate surfaced areas beyond the limits of the actual excavation which are disturbed, as determined by the Engineer, by such operations as temporary storage of materials or passage of equipment, shall be resurfaced, at the Contractor's expense.
 - a. The upper three 3 inches of disturbed areas shall be removed as necessary to allow the final elevation of the resurfacing course to be at the elevation of the drive or parking area which existed prior to excavation.

- b. Disturbed area shall be resurfaced with a minimum of 3 inches of 22A or 23A compacted aggregate, with calcium chloride applied at the rate of of aggregate.
 - 4. Contractor, at Contractor's expense, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the driveway and parking area.
- C. Roads and Streets:
 - 1. Backfilling of trenches crossing aggregate surfaced roads or streets shall be carried to within 12 inches of the existing surface as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling. The remaining depth shall 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, shall furnish, place, and compact all materials necessary to complete the backfilling and restoration operations within the roadway or street area.
 - 3. Also, settlement of the aggregate surface shall be restored by placing additional aggregate, up to the original grade, and shall be done at the Contractor's expense.
- D. Compaction
 - 1. Compaction of aggregate shall 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 shall furnish and provide the materials necessary to complete the backfilling and restoration operations, which shall include furnishing, compacting, forming, placing, rolling, floating, jointing, finishing, curing and providing protection against elements.
- B. Restoration of any roadways that are partially damaged shall include a minimum replacement of one (1), full width lane of roadway. The length of replacement shall be at least equal to the width.
- C. Concrete:
 - 1. The backfilling of trenches crossing concrete driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the proposed pavement as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling.
 - 2. Unless otherwise specified on the Plans or as determined by the Engineer, the concrete removed shall be replaced with 3500 psi concrete of the thickness removed and shall include reinforcing equal to the existing, if the existing pavement was reinforced.
 - 3. The construction of concrete pavements shall be in accordance with Section 31 23 33 - Trenching and Backfilling.
 - 4. Restoration of sidewalks shall also include the construction of sidewalk ramps at the intersection of the curb and shall conform to the current rules and regulations of the state of Michigan and to Section 32 13 15 - Sidewalks and Driveways, and unless otherwise indicated in the Proposal, shall be considered incidental to the Project.
- D. Bituminous
 - 1. The backfilling of trenches crossing bituminous driveways, sidewalks, roads, streets or parking areas shall be carried to the bottom of the base course as specified under Trench "B" of Section 31 23 33 - Trenching and Backfilling.
 - 2. Bituminous pavement or bituminous surface course with an aggregate base shall 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, shall be

resurfaced with an approved bituminous mixture the same thickness as removed, but in no case less than 2 inches in thickness. Replacement material shall extend to smooth-cut edges, shall be uniform in direction and shall be at an elevation which provides a uniform surface between the undisturbed abutting surfaces.

4. Restoration of any bituminous chip seal shoulders that are damaged or partially damaged, as determined by the Engineer, shall include complete replacement full width and length (extending a minimum of 25 feet beyond the damaged area both ways). Existing bituminous chip seal shoulders shall be brought to proper grade with compacted 22A or 23A aggregate and resurfaced with a double chip seal per Section 32 12 16 - Bituminous Paving .

3.22 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor shall comply with the requirements of Section 01 57 13. Prior to commencing any type of earthwork, the Contractor shall obtain a Soil Erosion and Sedimentation Control permit from the local enforcing Agency.
- B. Contractor shall obtain all approvals, secure all permits and post all bonds and deposits required to comply with the Soil Erosion and Sedimentation Control Act, Part 91 of PA 451 of 1994, as amended, and those of the enforcing agency.
- C. Contractor shall provide 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 shall be defined as all surplus earth material realized from the construction that is free of brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material.
- B. Contractor, when requested by the Owner, shall transport excess excavation to a site(s) designated by the Owner.
 1. Excess excavation shall be graded by the Contractor to provide positive surface drainage of the site(s).
 2. Grading shall be done such that adjacent properties are not damaged or affected. The grading shall include removal of all surface irregularities to provide a smooth surface ± 3 inches.
- C. When the excess excavation has not been requested by the Owner, the Contractor shall 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 shall be considered as a final cleanup item. No additional payment will be made for this item.
- E. Brush, roots, stumps, broken concrete, pipe, debris, and other extraneous material from the construction shall become the property of the Contractor, and shall be disposed of per all applicable Laws, rules or regulations. Removal and disposal of this material shall be considered as part of final cleanup. No additional payment will be made for this item.
- F. Owner approval of the final site(s) condition in writing will be required prior to final payment authorization.

END OF SECTION 01 89 00

SECTION 01 89 33
TEMPORARY BYPASS PUMPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide a complete sewer bypassing system including, but not limited to, the following:
 - 1. Developing a bypassing plan.
 - 2. Developing a spill prevention and emergency response plan.
 - 3. Submitting and obtaining approval from the Engineer/Owner for bypassing plan, spill prevention plan and emergency response plan.
 - 4. Implementing the bypassing and spill prevention and emergency response plan.
 - 5. Providing bypassing in accordance with the approved plans throughout the duration of the Work where bypass pumping is required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 12 13 - Work Sequence
- B. Section 01 33 00 - Submittal Procedures
- C. Section 33 34 00 - Sanitary Utility Force Mains
- D. Section 33 34 10 - High Density Polyethylene (HDPE) Pipe and Fittings
- E. Section 33 34 10.15 - Leakage Testing for HDPE Pipe

1.03 SYSTEM DESCRIPTION

- A. Flow control during construction shall be provided to meet the minimum flow rate(s) as listed on Schedule and shall perform reliably and continuously to provide uninterrupted sanitary service during the execution of the Work.
- B. Provide temporary flow control facilities that can be installed, operated, maintained, and removed without damage to existing structures.
 - 1. Under no circumstances shall sewage or solids be deposited onto the ground surface, streets, or into ditches, catch basins or storm drains, or natural drainage ways.
 - 2. In the event that the sewage backup occurs and enters dwellings or other structures, the Contractor shall be responsible for clean-up, repair, property damage costs, fines imposed by jurisdictional authorities, and claims arising therefrom.
- C. Spills shall be contained and returned to the sewer system unless the pumped liquid is approved by the authorities having proper jurisdiction to be discharged to surface waters of the State.

1.04 SUBMITTALS

- A. Flow Control Plan: Submit in accordance with Section 01 33 00, covering the items included under this Section. Submittal shall include:
 - 1. Schedule for installation and maintenance of bypass pumping system.
 - 2. Staging areas for pumps.
 - 3. Bypass pump sizes, capacity, number of each size to be on site and power requirements.
 - 4. Calculations of static lift, friction losses, and flow velocity
 - 5. Pump curves showing pump operating range.

6. Protection against main breaks.
 7. Plugging methods and bypass time duration for each sewer section.
 8. Size, length, material, location and method of installation for suction and discharge piping.
 9. Include tapping procedures.
 10. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.
- B. Method of noise control for each pump and/or generator.
1. Standby power generator size and location.
 2. Downstream discharging plan.
 3. Methods of protecting discharge manholes or structures from erosion and damage.
 4. Restraining lengths for piping. Thrust blocks will not be allowed as a method of restraint for bypass pumping systems.
 5. Location of fuel tank(s) and other potential contaminants.
 6. Control and reliability methods including float switches, visual and audible alarms, and pump controls.
 7. Overflow Prevention, Containment and Cleanup Plan.

1.05 EMERGENCY PERSONNEL

- A. Provide at least 2 contacts who can be contacted 24 hours per day by phone to address emergencies, along with their names, phone numbers, and working schedules. List shall be updated if there are any substitutions at least 2 days in advance. These contacts shall be connected to the control system automatic dialer (or equivalent).

1.06 QUALITY ASSURANCE

- A. Qualifications: Firms regularly engaged in bypass pumping systems, of types and sizes required, and whose systems have been used with successful results in similar service for not less than 5 years.

1.07 SEQUENCING

- A. Refer to Section 01 12 13 - Work Sequence, for sequence of construction requirements.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the project.
- B. Contractor shall provide, maintain, and operate temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, necessary power, and other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with work, carry it past the work area, and return it to the existing sewer downstream of the Work area.

2.02 DESIGN REQUIREMENTS

- A. Bypass pumping system shall be designed to provide adequate capacity for peak flows around the Work area as necessary for satisfactory performance of the Work.
- B. Contractor shall provide pipeline plugs, pumps and temporary discharge piping to ensure that the total flow of the main can be safely diverted.
- C. Bypass pumping system may be required to be operated 24 hours a day. Contractor shall provide necessary monitoring devices to notify the Contractor of any pump failure.

- D. Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each pump size utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.
- E. Design, installation, and operation of the temporary pumping system shall be the Contractor's responsibility.
- F. Bypass system shall meet the requirements of local, State, and Federal codes and regulations.
- G. Contractor shall not be permitted to stop or impede the main flows under any circumstances.
- H. Contractor shall maintain flow around the Work area in a manner that will not cause surcharging of sewers, damage to sewers, and that will protect public and private property from damage and flooding.
- I. Contractor shall protect water resources, wetlands, and other natural resources.

2.03 COMPONENTS

A. Pumps:

1. No electric pumps will be allowed; pumps must be diesel powered.
2. Pumps shall be specifically intended for use with sewage and shall be capable of passing a 3-inch diameter solid.
3. Pumps used for sewer bypassing shall be the submersible type and shall only be operated below ground in the sewer manhole or other designated facility. The use of above ground pumps or pumps not specifically designed for submersible service are not allowed.
4. Pumps shall be sized to fit in manholes or other designated areas necessary to successfully complete the sewer bypassing. Contractor shall ensure equipment used for bypassing will operate under the conditions required and the Contractor will be responsible for costs associated with changes to the bypassing system due to inappropriate equipment or non-conformance with the Contract Documents.
5. Pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. Pumps used must be constructed to allow dry running for long periods of time to account for the cyclical nature of effluent flows.
6. Contractor shall provide the necessary stop/start controls for each pump.
7. Contractor shall include one stand-by pump for each size to be maintained on site. Back-up pumps shall be on-line, isolated from the primary system by a valve.
8. Contractor shall provide an emergency standby power generator, sized to operate the bypass system at a minimum, to be used to operate the submersible pumps if electrical power is lost during the progress of the Work and a spill will occur.

B. Piping:

1. Discharge and suction piping sizing shall be determined according to flow calculations and system operating calculations. Provide piping designed to withstand minimum 1.5 times the maximum system pressure.
2. HDPE piping shall be in accordance with Section 33 34 10 - High Density Polyethylene (HDPE) Pipe and Fittings.
3. Rigid or hard piping shall be constructed with positive restrained joints.
4. Piping shall be maintained in a watertight condition and leaks shall be immediately repaired.

C. Flexible Hose:

1. Flexible hose and couplings shall be abrasive resistant and suitable for the intended services (i.e., fire hoses are not permitted).
 2. Flexible hose and couplings shall be rated for external and internal loads anticipated including test pressure.
 3. External load design shall incorporate anticipated traffic loadings, including traffic impact loading where applicable. When subjected to traffic loading, the system shall be composed of traffic ramps and covers maintaining an H-20 loading requirement while in use or as directed by Owner.
- D. System Controls:
1. Contractor shall continuously (while in use) monitor the operation of the bypass system and impacted facilities. Contractor shall submit, as part of their bypass plan, their system monitoring procedure and frequency. Contractor shall maintain a log of the monitoring in a manner acceptable to the Engineer.
 2. Control panel(s) equipped with necessary fused-switch combination starters, control transformer, Start-Stop controls, cycle controls, variable speed drive controls, and alarm systems. Provide all necessary relays, timers, interlocks, and control devices. If mounted outdoors enclosure shall be minimum NEMA 4.
 - a. Level controls such as float switches, pressure transducers, or level sensors along with the necessary wiring back to the temporary control panel shall be provided as required.
 - b. In lieu of providing manpower to continuously monitor the pumping equipment on a 24-hour basis a dialer may be provided that will alert the Contractor when an alarm condition exists. Contractor shall make arrangements to obtain temporary phone service for dialer system or the dialer shall be connected to the Owner's operating and control system, if shown.
 - c. Automatic switch over capabilities shall be provided to activate standby equipment.
 - d. Alarm when stand by equipment is operating.
 - e. Alarm when aeration tank effluent channel is outside of normal operating range.
 - f. Alarm when there is a power outage.
 - g. Alarm status indication consisting of alarm light, mounted in an easily visible location.
 - h. If shown the temporary flow control system shall be wired into the Owner's operating and control system.
 - i. Provide temporary lighting available for 24-hour per day pumping operations to aid with reliable system operation, maintenance and safety of personal.

PART 3 EXECUTION

3.01 PREPARATION

- A. Existing Utilities:
1. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipeline(s).
 2. Contractor shall locate bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner.
 3. Costs associated with relocating utilities and obtaining approvals shall be the responsibility of the Contractor.
- B. Precautions:
1. During bypass pumping operation, the Contractor shall protect the pumping station, sewer mains and local sewer lines from damage inflicted by any equipment.

2. Contractor shall be responsible for any physical damage to the pumping station, sewer mains and local sewer lines caused by human or mechanical failure.

3.02 INSTALLATION AND REMOVAL

- A. Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access locations indicated on the bypass pumping plan.
- B. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging devices. When plugging or blocking is no longer needed for performance and acceptance of Work, the plugging or blocking shall be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging, and/or causing other major disturbances downstream.
- C. When working inside a manhole, force main, or other designated facility, the Contractor shall exercise caution and comply with MIOSHA requirements for working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
- D. The bypass pipeline shall be located off streets sidewalks, and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, the Contractor shall place the bypass line in trenches and cover with temporary pavement or shall install the bypass pipeline by trenchless installation methods.
- E. Contractor is responsible for obtaining any approvals for placement of temporary pipelines from local agencies.
- F. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Owner, the Contractor shall remove all piping, restore property to pre-construction condition, and restore pavement, sidewalks and/or roadways affected by bypass pumping operations.

3.03 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Contractor shall perform leakage and pressure tests of the bypass pumping system after the equipment has been installed to demonstrate the system is in good working order, the units have been properly installed, will operate satisfactorily, and meet the specified conditions.
 1. Clean water shall be used for testing.
 2. Contractor shall give the Owner 24 hours' notice prior to testing.
- B. Contractor shall ensure that the temporary pumping system is properly maintained, and a responsible operator shall be on hand at all times when pump(s) is operating.
- C. Unless otherwise approved in the Flow Control Plan, there shall be minimum one responsible person or combination of responsible people available 24 hours per day to respond immediately and arrive onsite within 15 minutes to monitor and maintain the bypass and implement the emergency procedures if necessary. At a minimum, the Contractor shall inspect bypass pumping system every 2 hours to ensure that the system is working properly.
- D. Contractor shall immediately notify the Owner and the Engineer if a sanitary sewage overflow occurs and take the necessary action to clean up and disinfect the spillage to the satisfaction of the Owner or other governmental agencies.
 1. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up, and disinfect the spillage to the satisfaction of the property owner.
 2. In the event that sewage backup occurs and enters dwellings or other structures, the Contractor shall be responsible for clean-up, repair, property damage costs, fines imposed by jurisdictional authorities, and claims arising therefrom. Spills shall be contained and returned to the sewer system.
- E. Spare parts and materials for pumps and piping shall be kept onsite, as required.
- F. Adequate hoisting equipment for each pump and accessories shall be maintained onsite.

3.04 BYPASS PUMPING SCHEDULE

A. General:

1. Total anticipated Bypass Capacity for peak dry weather flow is 1.6 cubic feet per second (700 gpm)
2. Minimum No. Pumping Units: 2
3. Minimum No. Standby Pumping Units: 1
4. Pump Type: Submersible; Diesel-powered
5. Flow Stream to Be Bypassed: Raw Sanitary Sewage
6. Pump From: Upstream sanitary sewer manhole
7. Pump To: Downstream sanitary sewer

END OF SECTION 01 89 33

SECTION 02 41 00 DEMOLITION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work of this section includes, but is not limited to, demolition of and disposal of building materials, concrete and included reinforcement, brick or tile masonry, wood and metal framing, mechanical and electrical components, plumbing components, structural elements and appurtenances from structures and facilities as listed in this Section and/or identified on the Drawings which are required to be removed as necessary where encountered within the limits of excavation or as directed by the Owner:
 - 1. Demolish building, walkway, drive, steps, fencing and associated structures.
 - 2. Demolish all miscellaneous items as shown on the Drawings.
- B. Contractor shall coordinate with the agencies having jurisdiction with regard to requirements and permits.
- C. Notify Owner and adjacent neighbors of the date and time of the demolition at least 24 hours prior to commencing work.
- D. Contractor shall have competent Superintendent on site at all times when demolition work is taking place.
- E. Perform demolition work hours Monday through Friday between 7:00 AM and 6:00 PM. The Contractor may not start a demolition that cannot be completed in one day on a Friday. The Contractor may not leave a partially demolished site unattended over the weekend.
- F. Secure all necessary permits including, but not limited to, Building Permit to Demolish, Sewer Permit, and Hydrant Permit. If necessary, applicable sidewalk repair permit shall be secured. All permits are the Contractor's responsibility unless otherwise noted.
- G. Coordinate work performed to have utilities shut off for project location. Ensure there is no loss of utilities to surrounding properties.
- H. Notify MISS DIG prior to beginning work.
- I. Prior to demolition, walk through interior of structure to verify it is unoccupied and to confirm that all utilities have been properly disconnected.
- J. Take all necessary precautions to protect workers and the public, including but not limited to, warning signs, barricades, and fall protection. Eliminate unnecessary hazards before leaving the jobsite at the end of each day. Hazards such as missing sidewalks and demolition debris must be enclosed with yellow caution tape.
- K. Reinstall fall protection and safety precautions at the end of each workday.
- L. In the event of accidental damage to an adjacent property, speak with the property owner and notify Owner immediately. Contractor is liable for damage to neighboring property.
- M. Provide to Owner prior to, and as an additional condition of, payment for work performed, all pertinent verified original receipts from an approved land fill or dump site, evidencing that all waste material from the job site contracted herein was disposed of in a proper manner. Receipts shall bear the date, job address, location of land fill or dumpsite, cubic yardage dumped, and bear the signature of the Contractor's driver and receiving facility representative. In the event such land fill receipts are not provided, payment shall be withheld until it is received and approved thereof.
- N. Minimize noise, dust and inconvenience to neighbors. Contractor will provide labor and use hoses of sufficient length (minimum 100 lineal feet) to prevent the discharge of visible dust emissions to the outside air throughout demolition.

- O. Restore property as required herein and as shown on the Drawings.
- P. Property dimensions and quantities must be field verified.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 23 16 - Structural Excavation and Backfill

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; Current Edition
- B. NFPA 241 - Standards for Safeguarding Construction, Alteration, and Demolition Operations; 2013 Edition

1.04 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor shall adhere to and disposal of all demolition materials in accordance with the requirements of all applicable ordinances, codes, statutory rules and regulations of federal, state and local authorities.
- B. Protect persons and property throughout progress of work. Proceed in such manner as to minimize spread of dust and flying particles and to provide safe working conditions for personnel. Contractor shall take any necessary precautions to capture all particles and construction debris within the site limits.
- C. Maintain circulation of traffic within area at all times during demolition operations.
- D. Obtain permission from the Owner before abandoning or removing any existing structures, materials, equipment and appurtenances.
- E. Make necessary arrangements with and perform work required by utility companies and municipal departments for discontinuance or interruption of utility services due to demolition work.

1.05 SUBMITTALS

- A. Demolition Plan
 - 1. Submit to the Owner for review, a Demolition Plan describing proposed sequence, methods, and equipment for demolition and disposal of each structure.
 - 2. Pre-Demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by building demolition operations.
 - 3. Methods of demolition and equipment proposed to demolish each structure.
 - 4. Copies of any authorizations and permits to perform work.
 - 5. Submit documentation confirming acceptance by landfill(s) or other disposal facilities of demolition materials.
 - 6. Accurately record actual locations of capped and active utilities and subsurface construction.
 - 7. Statement of Refrigerant Recovery signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DEMOLITION - GENERAL

- A. Wet down work during demolition operations to prevent dust from arising.

- B. For structures identified for demolition on the drawings, the Contractor shall completely remove the foundation below ground surface as well as basement walls in their entirety, and fill to level of adjacent ground with suitable material and compact in a manner that complies with requirements stated elsewhere in the Specifications, particularly Section 31 23 16 - Structural Excavation and Backfill.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings. Where piping or electrical lines are removed back to a functioning point, cut/cap/properly terminate the remaining functioning component.
 - 2. When pipes, conduits other equipment are removed, all fasteners for that equipment shall also be removed and all holes/damage to the existing structures from which the equipment was attached shall be filled and repaired with like materials.
- D. Mechanical/Electrical (including but not limited to Process equipment, HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated:
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. When a piece of equipment is shown to be removed, it shall be assumed that the power feed to that piece of equipment including conduit/wire/starter shall also be removed unless shown otherwise.
 - 5. All piping interconnecting pieces of equipment and/or associated with the system to be removed shall be removed even if not specifically shown to be removed on the drawings. All pipe supports associated with removed piping shall be removed.
 - 6. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
 - 7. Remove concrete equipment bases for equipment to be removed to the building foundation/floor. Patch existing floor smooth with non-shrink grout or suitable epoxy finish for sure
 - 8. Where vents or other pipes/conduits that are to be removed pass through an existing roof/floor/wall that is to remain, the resulting hole in the roof/floor/wall shall be patched and made watertight to match the existing materials.
 - 9. All existing electrical equipment and fixtures to be removed shall be removed with such care as may be required to prevent unnecessary damage, to keep existing systems in operation, to allow for relocation where shown and to maintain the integrity of the grounding systems.
 - 10. Conduits and wires shall be abandoned or removed where shown. All wires in abandoned conduits shall be removed and disposed of off-site as required. Abandoned conduits concealed in floor or ceiling slabs or in walls, shall be cut flush with the slab or wall at the point of entrance. The conduits shall be suitable plugged and the area repaired in a flush, smooth and approved manner. Exposed conduits and their supports shall be disassembled and removed from the site.
- E. Protect Existing Work to Remain:
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.

3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.
- F. Building/Structure Demolition:
1. Demolish concrete and masonry in small sections.
 2. Wherever possible, sawcut materials to be removed. Where jackhammering or other destructive means are required, care shall be taken to protect existing remaining equipment/structures.
 3. Remove structural framing members and lower to ground by means of hoists, derricks, or other suitable methods.
 4. Remove structures to the lines and grades shown unless otherwise directed by the Engineer. Where no limits are shown, the limits shall be 4-inch outside the item to be installed. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Engineer with no additional compensation to the Contractor.
 5. After removal of parts of all of walls, slabs and like work which tie into new work or existing work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

3.02 BACKFILLING

- A. Do not use demolition debris as backfill material.
- B. Below-Grade Areas: Completely fill below grade areas and voids resulting from building demolition operations with granular backfill according to backfill requirements in Section 31 23 16 - Structural Excavation and Backfill.
- C. Backfill demolished areas to existing ground level or foundation level of new construction as specified elsewhere in the Contract Documents.

3.03 DISPOSAL

- A. Contractor shall dispose of reinforced concrete, masonry, contained steel or castings and other materials which are removed at an approved offsite location.
- B. Dispose of debris and other non-salvaged materials offsite in licensed landfills that are deemed appropriate for the types of debris to be disposed.
- C. Materials, equipment, and appurtenances removed, that are not designated for relocation, become property of Contractor. Haul from site and dispose of according to local, state and federal regulations.

3.04 RESTORATION

- A. Restore surface of areas affected by building demolition to match adjacent conditions or meet local codes, whichever is more stringent.

END OF SECTION 02 41 00

SECTION 02 41 13 SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall 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 shall be cut, abandoned and capped, or completely removed; miscellaneous clearing and grubbing of trees, brush, and vegetation at boundary area shall 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. Contaminated building materials shall not be salvaged and shall 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 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 shall be 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 shall be 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 shall describe the demolition tasks to be conducted and the quantities of asbestos containing materials specified for abatement.
3. Soil Erosion and Sedimentation Control: Contractor shall be 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 shall become the Contractor's property and shall be removed from the site with further 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, the Contractor shall submit a work plan which includes the means, methods and procedures proposed for the accomplishment of the removal and disposal work.
 - a. Means, methods and procedures shall provide 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. Procedures shall provide a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.
 - c. The name and location of disposal facilities for all removed materials shall be submitted in the Work Plan.
 - d. Work plan shall be based on work experience, and the guidance provided in this specification. The cost of work plan preparation is incidental to the project.
 2. Demolition Schedule: Contractor shall 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. Schedule shall 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: Contractor shall 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. Contractor shall also provide a copy of the results of tests performed to comply with the requirements of each disposal facility.
 4. Manifests: Contractor shall 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. All manifests shall be in accordance with the requirements of all the applicable federal, state and local regulations. Manifests shall be signed by the Owner or the Owner's 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. Contractor shall visit the site and inspect the existing facilities.
- 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 shall 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 shall be responsible for associated fees or expenses, unless indicated otherwise.
2. Electrical Disconnection: Contractor shall verify that on site electrical wiring entering all structures to be demolished or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or de-energized prior to proceeding with demolition operations.
 - a. Contractor shall 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: Contractor shall perform or verify that on-site water lines entering all structures or in close enough proximity to be damaged by the demolition operations shall be disconnected and/or capped prior to proceeding with demolition operations.
 4. Sewer Disconnection: Contractor shall locate and bulkhead all sewer connections from the building structure prior to proceeding to demolition. The work shall be performed as indicated on Site Plans in accordance with .
 5. Gas Disconnection: Contractor shall 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 shall be disconnected and/or capped prior to proceeding with demolition operations.
 6. Telephone and Cable Disconnection: Contractor shall 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 shall be 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. Contractor shall 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 shall contain the following information:
 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 shall 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 shall tag components and equipment designated for salvage.
- B. Contractor shall 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 Owner indicating that the Owner has received tagged items.

3.04 REPAIRS

- A. Contractor shall 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. Contractor shall repair all damages caused to adjacent facilities by demolition as directed by the Engineer at no cost to the Owner.
- D. Contractor shall make a detailed inspection after patching and repairing has been completed, and shall 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.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. Contractor shall remove and legally dispose of demolished materials, site debris, rubbish, and other materials resulting from demolition operations shall be promptly removed.
 1. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without 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 shall conform to Federal, State and local requirements.
 4. Removed materials shall 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 shall not be permitted on site.

3.06 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. Any material stockpiled for recycling shall be removed from the site prior to the contract end date and/or site restoration.

3.07 CLEANING

- A. During and upon completion of work, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition in Division 1.
- B. Contractor shall 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 02 41 13

SECTION 03 01 30 CONCRETE REPAIR AND REHABILITATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Section includes furnishing of materials, labor, tools, and equipment necessary to repair, patch, and restore poorly placed or deteriorated concrete; and repair of joints and reinforcing steel. This includes removal of deteriorated concrete, surface preparation and installation of repair materials at deteriorated areas, cracks, and joints in concrete floors, walls, and ceilings as indicated on the drawings and specified herein.
- B. Defects that require repair include tie holes, exposed steel, voids, holes, honeycombed areas, spalling, delamination, cracking, and other defects as determined by the Owner.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 03 11 00 - Concrete Forming
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 03 32 00 - Construction and Expansion Joints
- E. Section 03 60 00 - Grouting

1.03 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI 201.1R-08 Guide for Making a Condition Survey of Concrete in Service
 - 2. ACI 546R-04 Concrete Repair Guide
- B. American Society for Testing and Materials (ASTM)
- C. ASTM C109 Test Method for Compressive Strength of Hydraulic Cement Mortars.
 - 1. ASTM C157 Test Method for Length Change of Hardened Cement Mortar and Concrete.
 - 2. ASTM C666 Test Method for Resistance of Concrete to Rapid Freezing and Thawing
 - 3. ASTM C882 Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear
 - 4. ASTM D412 Test Methods for Vulcanized and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
 - 5. ASTM D624 Test Methods for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
 - 6. ASTM D903 Test Methods for Peel or Stripping Strength of Adhesive Bonds.
 - 7. ASTM D3359 Standard Test Methods for Measuring Adhesion by Tape Test.
- D. The Society for Protective Coatings (SSPC)
 - 1. SSPC – SP13/NACE No. 6 Surface Preparation of Concrete

1.04 SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 - Submittal Procedures.
- B. Submit manufacturer's data completely describing concrete repair materials for each type of product to be utilized in the concrete repair process. Include material descriptions; chemical composition, physical properties, test data, and mixing, preparation, and application

instructions. Submittals shall include a written statement from the Contractor that all products are compatible with each other, and consistent with the warranty requirements of the project.

- C. Concrete Rehabilitation Qualifications:
 - 1. Submit the name and experience record of the concrete rehabilitation Contractor. Include a list of at least 5 of the Contractor's previous utility or industrial installations rehabilitated, and identify the responsible officials, architects and engineers concerned with the project, contact information, and approximate contract price.
- D. Rehabilitation program: For each phase of the rehabilitation process, including protection of surrounding materials and site during operations, describe in detail the materials, methods, equipment and sequence of operations to be used for each phase of the work.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturer of the specified product shall have been in existence, for a minimum of 10 years.
- B. Installer Qualifications: Work must be performed by a firm having not less than 5 years successful experience in comparable concrete repair and rehabilitation projects, and employing personnel skilled in the restoration process and operations indicated.
- C. Source limitations: Obtain concrete patching and rebuilding materials, crack injection materials, corrosion inhibitors, sealants, all through one source from a single manufacturer.
- D. Construction Tolerances: Construction tolerances shall be as specified in Section 03 30 00 - Cast-in-Place Concrete, except as modified herein and elsewhere in the Contract Documents.
- E. Mockups: Install mockups for each type of concrete removal and patching, concrete repair, crack injection, and joint sealing to demonstrate the quality of materials and execution for approval by the Owner.
 - 1. Approved mockups may become part of the completed work if undisturbed at time of substantial completion.
 - 2. The independent testing agency, or other inspection party representing the Owner, shall be present during the construction of the mockups.
 - 3. Quality Control testing, as required by this Specification, shall be performed on each mockup.
- F. Pre-installation conference: Prior to beginning any concrete repair or rehabilitation work, the Contractor shall meet with the Owner to thoroughly discuss the proposed work, techniques and schedule. Representatives of the Manufacturer and Installer of repair and rehabilitation materials, as well as the independent testing agency, shall attend the pre-installation conference.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.
- B. Store and condition the specified product as recommended by the Manufacturer.
- C. Store in a suitable location approved by the Owner at all times. Keep area clean and accessible. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970.
- D. Handle materials carefully to prevent inclusion of foreign materials.
- E. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

1.07 PROJECT/SITE CONDITIONS

- A. Existing Conditions:

1. Hot Weather: ACI 305
2. Cold Weather: ACI 306
3. Do not place concrete repair mortar during precipitation, unless adequate protection is provided.
4. Coordinate coatings application with other trades to assure adequate illumination, ventilation, and dust-free environment during application and curing of coatings.
5. Maintain a safe work environment in accordance with Federal, State, Local and project site regulations and guidelines.

PART 2 PRODUCTS

2.01 REPAIR MORTAR

- A. Provide repair mortar as a pre-packaged, 2-component, polymer-modified, cementitious, non-sag mortar, specifically formulated for the repair of surface defects.
- B. Provide the mortar with a penetrating corrosion inhibitor.
- C. Repair mortar shall have the following properties:

Physical property	Value	ASTM Standard
Compressive strength (min) at 1 day at 7 days at 28 days	3000 psig 6000 psig 7000 psig	C109
Bond strength (min) at 28 days	2200 psig	C882 (modified)
Freeze/Thaw resistance (min) 300 cycles	98 percent	C666

- D. Provide a minimum repair thickness of 1/4 inch, unless otherwise indicated.
- E. Repair Mortar Manufacturer, or Equal:
 1. Sika Corporation, SikaTop 123 Plus

2.02 NON-SHRINK GROUT

- A. Provide non-shrink grout conforming to the requirements of Section 03 60 00 - Grouting.

2.03 CONCRETE MATERIALS CEMENT

- A. Cement:
 1. Use Type II Portland cement unless otherwise indicated.
- B. Repair Concrete:
 1. Where required, provide repair concrete composed of structural concrete with maximum one- inch coarse aggregate meeting the requirements of Section 03 30 00 - Cast-in-Place Concrete.
 2. Provide a minimum repair thickness of 3 inches.
- C. Cement Grout:
 1. Provide cement grout that meets the requirements of Section 03 60 00 - Grouting.
 2. Provide a minimum repair thickness of one inch.
- D. Miscellaneous Materials
 1. For concrete construction materials not covered specifically in this Section, conform to the requirements of Section 03 30 00 - Cast-in-Place Concrete.

2.04 AGGREGATE

- A. Obtain the permission of the manufacturer and Owner before using aggregate to extend repair mortar and non-shrink grout products.
- B. If allowed and unless otherwise indicated, provide aggregate consisting of 3/8-inch clean, washed gravel or crushed stone as required in Section 03 30 00 - Cast-in-Place Concrete.

2.05 BONDING AGENT AND ANTI-CORROSION COATING

- A. Provide a bonding agent that is a solvent-free, moisture-tolerant, epoxy-modified, cementitious product, specifically formulated as a bonding agent and anti-corrosion coating.
- B. Bonding Agent Manufacturer, or Equal:
 - 1. Sika Corporation, Armatec 110 EpoCem.

2.06 EPOXY GROUT

- A. Provide an epoxy grout conforming to the requirements of Section 03 60 00 - Grouting.

2.07 EPOXY RESIN

- A. For crack injection, provide a 2-component, moisture-tolerant, low-viscosity, high-strength epoxy resin adhesive that is specially formulated for that usage.
- B. Provide a minimum bond strength of 2900 psig when tested per ASTM C 882 at 14 days, moist cured.
- C. Epoxy Resin Manufacturer, or approved Equal:
 - 1. Sika Corporation, Sikadur 35, Hi-Mod LV

2.08 PROTECTIVE COATING

- A. Waterproofing:
 - 1. Provide a 2-component, polymer-modified, cementitious waterproofing and protective slurry mortar for concrete.
 - 2. The waterproofing shall be certified as being in conformance with ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.
 - 3. Apply the material in 2 coats, with a coverage of 40 sq ft/gal/coat.
 - 4. Waterproofing Manufacturer, or Equal:
 - a. Sika Corporation, Sika Top Seal 107

2.09 FORMWORK

- A. Where needed, provide formwork that meets the requirements of Section 03 11 00 - Concrete Forming.

2.10 REINFORCEMENT STEEL

- A. Where required, provide reinforcing steel that meets the requirements of Section 032100.

2.11 POLYURETHANE SEALANT

- A. Provide a 2-part polyurethane, gun-grade sealant, certified as being in conformance with ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.
- B. Polyurethane Sealant Manufacturer, or approved Equal:
 - 1. Sika Corporation, Sikaflex – 2C

2.12 POLYURETHANE CHEMICAL GROUT

- A. Use polyurethane chemical grout for non-structural crack repair
- B. Polyurethane Chemical Grout Manufacturer, or approved Equal:

1. Sika Corporation, SikaFix HH

2.13 HYDROPHILIC WATERSTOP

- A. Provide hydrophilic waterstop conforming to the requirements of Section 03 32 00 - Construction and Expansion Joints.

PART 3 EXECUTION

3.01 GENERAL

- A. Repairs:
 1. Repair all defects immediately after form removal.
 2. Repair techniques will be reviewed during the pre-construction meeting between the Contractor and Owner.
 3. Contractor shall be familiar with the cause of deteriorated concrete and shall choose the right equipment, repair materials and techniques to be used for each particular repair.
 4. Choose repair materials to match the adjacent concrete surface in color and texture.
 5. Apply repair materials in strict accordance with the manufacturer's printed instructions, including temperature and moisture requirements throughout application and curing.
 6. Protect adjacent portions of the structure, including all pipes, and mechanical equipment, from debris generated by repair activities.
 7. For portions of the structure that are not identified to be repaired, maintain in their original condition.
 8. Dampen area to be patched and area at least 6 inches wide surrounding area to be patched for at least 24 hours to prevent absorption of water from patching mortar.
- B. Structural Stability:
 1. Use caution not to weaken the structural capacity of a beam, wall, slab, or other concrete member during concrete removal.
 2. For severely deteriorated concrete members, consult with the Owner before removing a major portion of any structural member.
 3. Shoring may be required in order to support the structure and to protect workers.
- C. Shoring:
 1. Contractor shall design the shoring to adequately distribute the load to the foundation in such a manner as to avoid damage to the structure.
 2. Maintain the shoring in place until all repairs are completed and structurally repaired areas have achieved their full 28-day design strengths.
- D. Provide off-site disposal of debris generated as a result of repair procedures.
- E. Provide concrete construction procedures not specifically addressed in this Section in accordance with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

3.02 SUGGESTED REPAIR SEQUENCING

- A. Unless otherwise indicated, perform concrete repairs in the following sequence, with no activity in an area being started until previous activities in that area have been completed, including curing, cleanup, and the like:
 1. Removal of equipment, miscellaneous metals, and other surface features that would interfere with the repair;
 2. Surface preparation hydroblasting over the entire area to be repaired;
 3. Embedded metal repair;

4. Crack repair;
 5. Spalled and delaminated concrete repair;
 6. Scaled concrete repair;
 7. Pop-out repair, and repair of other surface damage, deterioration, or defects;
 8. Patching of holes in concrete;
 9. New construction; and
 10. Application of protective coatings;
- B. For areas which require combinations of spalled and delaminated concrete repair, scaled concrete, and pop-out repair, perform these repairs at the same time.
- C. Limit the size of the repair area in order to permit the repairs to be performed together, without sacrificing the quality of the individual repairs.

3.03 EMBEDDED METAL REPAIR

- A. Unless otherwise indicated, repair anchor bolts, structural steel from temporary support system, and other embedded metal, except rebar, that are exposed at the concrete surface, as follows:
- B. Cut off or otherwise remove metal fastened at the surface;
1. Burn back embedded metals to a depth of at least 1.5 inches beyond the surface of sound concrete. When removing hollow structural members, completely fill and patch the void over the entire member thickness;
 2. Chip away unsound concrete around the embedded metal.
 3. Apply epoxy grout to the repair area until level with the surface of the surrounding sound concrete.
- C. Unless otherwise indicated, repair embedded rebar that is exposed at the concrete surface following the procedures outlined in the appropriate concrete repair subsection, below.

3.04 CRACK REPAIR

- A. Structural versus Non-Structural Cracks:
1. Cracks are defined by the Owner as non-structural cracks or structural cracks.
 2. Repair structural cracks with epoxy resin.
 3. Repair non-structural cracks with polyurethane chemical grout.
- B. Efflorescence:
1. Prior to the crack repair, clean efflorescence from the cracks and the surrounding area.
 2. Clean the efflorescence by light hydro-blasting or scrubbing.
- C. Pressure Injection:
1. General:
 - 1) The indicated repair materials have been selected to minimize the loss of material during the injection process. The areas selected for crack repair are to be identified by the Contractor and Owner.
 - 2) In order to avoid excessive loss of injected material at the lower exposed portions of the cracks, space the injection ports a distance no greater than the thickness of the wall being repaired.
 2. Structural cracks are to be repaired to deliver a water tight hydraulic structure. Cracks greater than a minimum 0.01" are to be injected unless they do not accept grout. Perform structural crack repairs by pressure injection in accordance with the manufacturer's

directions, and in accordance with the following basic procedure:

- a. Rout the crack when unsound and foreign materials are present on the surface to establish the surface as a sound material.
 - b. Remove any contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF 61 approved.
 - c. Install the injection ports in accordance with the manufacturer's directions.
 - d. Sealing:
 - 1) Seal the surface in order to keep the pressure injecting materials from leaking out before it has set or gelled.
 - 2) Seal a surface by brushing an epoxy over the surface of the crack and allowing it to harden.
 - 3) Use high injection pressures to cut-out the cracks in a 'V' shape, fill with an epoxy, and strike off flush with the surface.
 - 4) Surface patching or sealant shall be performed where needed to provide for complete penetration of the injected polyurethane grout and to prevent wastage. Seal surface of crack with fast setting hydraulic cement or high strength epoxy gel; i.e., Denepox Rapidgel by De Neef Construction Chemicals, Inc. or equivalent. The floor surface along the cracks shall be cleaned and all wasted grout and surface seal material shall be completely removed from the concrete surface following completion of the repair work
 - e. Inject the repair materials, with consideration of the following items:
 - 1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.
 - 2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, then cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled.
 - 3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.
 - 4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end, using low-viscosity repair material.
 - f. Cleanup:
 - 1) Remove the surface seal by grinding or other appropriate means.
 - 2) Coat fittings and holes at injection ports with an epoxy patching compound.
 - 3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.
3. Non-structural cracks are to be repaired to deliver a water tight hydraulic. All cracks greater than a minimum 0.01" are to be injected unless they do not accept grout. Perform non-structural crack repairs in accordance with the manufacturer's directions, and in accordance with the following basic procedure:
- a. Rout the crack when unsound and foreign materials are present on the surface to establish the surface as a sound material.
 - b. Remove contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF 61 approved.

- c. Install the injection ports in accordance with the manufacturer's directions.
- d. Moisture:
 - 1) For non-structural cracks, moisture must be present for the chemical grout to react.
 - 2) Prior to injecting the repair materials, inject the crack with a small amount of water in order to completely moisten the crack.
- e. Inject the repair materials, with consideration of the following items:
 - 1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.
 - 2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled, and then, starting again at the lowest port, re-inject into all ports in order to ensure that all voids are properly sealed off.
 - 3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.
 - 4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end.
- f. Cleanup:
 - 1) Remove excess surface material by grinding or other appropriate means.
 - 2) Coat fittings and holes at injection ports with an epoxy patching compound.
 - 3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3.05 SPALLED AND DELAMINATED CONCRETE REPAIR

- A. Repair spalls and delaminated concrete using repair mortar.
- B. Surface Preparation:
 - 1. Remove all delaminated concrete and all unsound concrete beyond the spalled or delaminated area.
- C. Boundaries:
 - 1. Determine the boundaries of the patch by sawcuts to a depth of at least 1/4 inch up to one-inch deep.
 - 2. Layout boundaries to reduce boundary edge length.
 - 3. Avoid excessive or complex edge conditions.
- D. Sawcuts:
 - 1. Perform sawcuts perpendicular to the surface or slightly undercut.
 - 2. Construct sawcuts in maximum 1/4-inch increments.
 - 3. After each incremental cut, inspect the cut surface in order to ensure that the existing reinforcement has not been cut.
 - 4. If at any depth the reinforcement becomes exposed, terminate the sawcut and notify the Owner.
 - 5. Chip away concrete within the repair area to a depth sufficient to expose sound concrete over the entire repair area, or to a minimum depth required by patching material, whichever is greater.

6. Base the selection of partial depth concrete removal equipment on the size of repair area, depth of concrete to be removed, and the location of the deteriorated concrete such as wall, slab-on-grade, underside or top of elevated slab.

E. Removal:

1. The maximum allowable pneumatic chipping hammer shall be a 30-lb class hammer.
2. Hydroblast removal shall use a maximum pressure of 40,000 psig.
3. Sand blasting is not permitted.
4. Hydroblast concrete removal is recommended for large area of surface defects.
5. Remove water blasting debris daily in order to prevent it from setting up.
6. If a chipping hammer is used, ensure that the existing reinforcement is not damaged during the concrete removal operations.
7. Remove protrusions, such as mortar spatter or fins, by grinding or by striking with a hammer or other tool.

F. Reinforcement:

1. Remove concrete from around reinforcement when the rebar is rusted, more than half the rebar perimeter is already exposed, the concrete bond around the rebar is broken, and if the concrete is unsound or honey-combed.
2. Remove concrete in order to provide a clear space of minimum one inch on each side of the reinforcement, such that the rebar can be cleaned and the repair material will completely surround the rebar.
3. Clean exposed reinforcement by water blasting or wire brushing.
4. After fully exposing and cleaning the reinforcement, check for steel deterioration, and if the cross-sectional area of the steel has been reduced by more than 10 percent, whether by deterioration, surface preparation, or a combination of both, provide additional reinforcement.
5. Consult with the Owner before adding or replacing rebar.

G. Repairing Surface Defects:

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning the reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.
4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

H. Repair Mortar:

1. Apply repair mortar in accordance with the manufacturer's recommendations.
2. Apply a minimum and maximum thickness of each lift of repair material in accordance with the manufacturer's recommendations, with the minimum thickness being not less than 1/4 inch.
3. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.

4. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
5. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
6. Float-finish the repaired surface using wood or sponge floats.
7. For repaired surfaces to receive a protective coating, brush-finish the surface in order to produce a roughened substrate for the coating.
8. Minimum and maximum ambient and surface temperatures shall be as recommended by repair material manufacturer.

I. Curing:

1. Curing of repair mortar to receive waterproofing shall be as follows:
 - a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
 - b. Weight the curing blankets or otherwise hold them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
 - c. Ensure that edges are continuously held in place; and,
 - d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.06 SCALED CONCRETE REPAIR

A. Repair scaling and pop-outs using repair mortar.

B. Surface Preparation:

1. Prior to repair, prepare the surface in accordance with the repair mortar manufacturer's recommendations with the following minimum requirement.
2. Remove unsound concrete from surfaces by high-pressure water blasting, using a minimum pressure of 10,000 psig and maximum pressure of 40,000 psig.
3. Clean exposed reinforcement by water blasting or wire brushing.

C. Repairing Surface Defects:

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.
4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

6. Apply repair mortar in accordance with the manufacturer's recommendations, using a minimum repair material thickness of 1/4 inch.
7. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.
8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
10. Float-finish the repaired surface using wood or sponge floats.
11. Provide strip joint in newly placed mortar at the location of repaired cracks.

D. Curing:

1. Curing of repair mortar to receive waterproofing shall be as follows:
 - a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
 - b. Weight the curing blankets or otherwise hold them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
2. Ensure that edges are continuously held in place; and,
 - a. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
3. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
4. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

E. Repair: REPAIR OF OTHER SURFACE DAMAGE, DETERIORATION, OR DEFECTS

1. Repair other pop-outs and surface damage, deterioration, and defects using the procedures described herein.

3.07 PATCHING OF HOLES IN CONCRETE

A. General:

1. For the purposes of this Section, holes are defined as penetrations completely through the concrete member and with interior surfaces approximately perpendicular to the surface of the existing member.
2. Interior surface areas which are inclined and do not meet this criteria shall be chipped as needed to meet this requirement.
3. The perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments.
4. Provide the minimum depth of placement for the material used; score the existing concrete by sawcutting, and chip as needed to meet this requirement.
5. Roughen the interior surface of holes less than 12 inches in diameter to a minimum of 0.125-inch amplitude, and roughen larger holes to a minimum of 0.25-inch amplitude.
6. At holes, coat the existing surface to be repaired with a bonding agent.

B. Patching Small Holes:

1. For holes which are less than 12 inches in their least dimension and extend completely through concrete members, fill with non-shrink grout as required in Section 03 60 00 - Grouting.
- C. Patching Large Holes:
1. Fill holes which are larger than 12 inches in their least dimension with non-shrink grout.
 2. Provide large holes which are normally in contact with water or soil with hydrophilic waterstop placed in a groove, approximately 1/16 inch deep.
 3. Grind the groove into the interior edge of the hydrophilic waterstop.
 4. Alternatively, bond the hydrophilic waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.
 5. Install the waterstop in accordance with the requirements of Section 03 32 00 - Construction and Expansion Joints.
 6. Provide reinforcing steel in layers matching existing reinforcement location, except that concrete cover as required in the Contract Documents for the service condition shall be provided.
 7. For holes smaller than 48 inches, provide reinforcement consisting of a minimum of No. 5 bars at 12 inches on center in each layer required.
- D. At holes larger than 30 inches, drill the reinforcement and grout into the existing concrete.
1. For holes larger than 48 inches, refer to the Drawings for reinforcement details.

3.08 PATCHING OF LINED HOLES

- A. General:
1. This work applies to those openings which have embedded material over all or a portion of their inside edge.
 2. The requirements for repairing holes in concrete, as indicated above, apply as modified herein.
 3. Engineer will determine whether the embedded material is allowed to remain.
 4. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface.
 5. Roughen or abrade the embedded material in order to promote good bonding to the repair material.
 6. Remove substances that interfere with good bonding.
 7. Completely remove embedded items that are not securely and permanently anchored into the concrete.
 8. Completely remove embedded items which are larger than 12 inches in their least dimension, unless they are composed of a metal to which reinforcing steel can be welded; where reinforcement is required, weld it to the embedded metal.
- B. The following requirements shall apply to concrete members which are in contact with water or soil:
1. Using epoxy grout, fill lined openings which are less than 4 inches in their least dimension;
 2. Using an epoxy bonding agent, coat lined openings which are greater than 4 inches but less than 12 inches in their least dimension, prior to being filled with non-shrink grout.

3. Using an epoxy bonding agent, coat lined openings which are greater than 12 inches in their least dimension, and provide a hydrophilic waterstop bonded to the interior of the opening with epoxy adhesive, prior to being filled with approved repair material.

END OF SECTION

SECTION 03 11 00 CONCRETE FORMING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes formwork for cast-in-place concrete, complete with furnishing, preparation, installation, coating, protection, adjustment, removal and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 15 00 - Concrete Accessories
- B. Section 03 20 00 - Concrete Reinforcing
- C. Section 03 30 00 - Cast-in-Place Concrete

1.03 DESIGN STANDARDS

- A. The formwork shall be designed for the loads, lateral pressure, and allowable stresses outlined in "Guide to Formwork for Concrete" ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the local building code. The design and construction of the formwork shall be the responsibility of the Contractor.
- B. The formwork shall be true in every respect to produce hardened concrete to the required shape, size, grade and alignment as indicated on the Plan, and of sufficient strength, bracing and rigidity to maintain their position and shape under the loads and operations incidental to placing and curing the concrete, as well as all other forces resulting from the movement of the forms.
- C. The forms shall be mortar-tight at the time concrete is placed in them and shall be so constructed that the surfaces of the finished concrete will be reasonably free from ridges, fins, offsets, or similar defects.
- D. Adequate and suitable means for removing the forms without injury to the surfaces or edges of the finished concrete shall be provided.

1.04 ALLOWABLE TOLERANCES

- A. Formwork shall be constructed such that the hardened surfaces shall conform to the tolerance limits of ACI 347R , except as modified below:
 - 1. Variation from plumb in lines and surfaces of piers, walls, or columns
 - a. In any 10 feet of length: 1/4 inch
 - b. Maximum for entire length: 1 inch
 - 2. Variation from the level or from the grades
 - a. In any 10 feet of length: 1/4 inch
 - b. Maximum for entire length: 3/4 inch
 - 3. Variation of distance between walls, columns and beams
 - a. In any 10 feet of distance: 1/4 inch
 - b. Maximum for entire distance: 1 inch
 - 4. Variation of the linear lines from established position as indicated on the Plan
 - a. In any 20 feet (6 m) of length: 1/2 inch
 - b. Maximum for entire length: 1 inch
 - 5. Variation in sizes and locations of sleeves, floor openings, and wall openings

- a. Minus: 1/4 inch
 - b. Plus: 1/2 inch
6. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls
- a. Minus: 1/4 inch
 - b. Plus: 1/2 inch
7. Variations of footing dimensions from plan dimensions
- a. Minus: 1/2 inch
 - b. Plus: 2 inch
8. Thickness \pm 5%, up to maximum of 1 inch

1.05 REFERENCE STANDARDS

- A. ACI 347R: Guide to Formwork for Concrete
- B. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field

1.06 SUBMITTALS

- A. Submit manufacturer's literature for form coating.
- B. Submit formwork layout plans, design data and procedures if requested by the Engineer.

1.07 STORAGE AND HANDLING

- A. Store and handle form coating to prevent contamination of coating in accordance with manufacturer's recommendations.

1.08 SEQUENCING

- A. Sequence installation of formwork with the Work of Section 03 20 00, Section 03 15 00, and Section 03 30 00.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Use lumber that is straight, uniform width and thickness, free from knots, offsets, holes, dents, warpage and other surface defects.
- B. Use plywood product of standard psi, waterproof, resin-bonded, exterior-type Douglas Fir, face adjacent to concrete shall be Grade B or better.
- C. Metal forms to be smooth metal plate free of surface irregularities.
- D. Chamfer Strips: Use clear white pine, surface against concrete planed, 1 inch bevel width or cant strip.

2.02 FORM COATING

- A. Use nonstaining form oil or other mineral oil which will neither discolor nor otherwise injuriously affect the concrete.

2.03 FORM TIES

- A. Use permanently embedded body type with removable end cones on outer ends, permanently embedded portion 1 inch back from concrete face.

2.04 FORMS - GENERAL

- A. Use forms that conform to ACI 347R. Fabricate with facing materials that produce the specified tolerance requirements outlined in Part 1 of this Section; produce true surfaces, sharp corners

and true lines; and are free of offsets, ridges, bulging, waves and concave or convex areas.

2.05 LAYOUT

- A. Use regular and uniform pattern; long dimension of panels vertical; joints horizontal, vertical and aligned; form ties uniformly spaced and aligned in horizontal and vertical rows.

PART 3 EXECUTION

3.01 PREPARATION

- A. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms and embedded materials shall be cleaned of any mortar from previous concreting and of all other foreign material or water before coating is placed in them.
- B. Forms shall be coated in accordance with manufacturer's recommendations before the form or reinforcement is placed in final position. Surplus coating on form surfaces, or any coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.02 INSTALLATION OF FORMS

- A. Forms shall be sufficiently tight to prevent loss of mortar from the concrete, set true to the lines and elevations indicated on the Plans, tied and braced to remain true during and after concrete placement within tolerances outlined in Part 1 of this Section. The Engineer may at any time condemn any section or sections of forms found deficient in any respect, and such form shall be promptly removed and replaced.
- B. No wooden spreaders shall be allowed to remain in the concrete. No metal shall be within 1 inch of any surface.
- C. Place chamfer strips in forms to bevel all corners, edges, joints and other structural elements exposed to view, including use of dummy chamfer and false joints to provide neat and uniform appearance. Exposed corners and edges shall have 3/4 by 3/4 inch - 45 degree chamfers, unless otherwise indicated on the Plan.
- D. Provide temporary openings at the base of wall forms and at the other points when necessary to facilitate cleaning and inspection immediately before depositing concrete.
- E. Secure in position wedges used for final alignment and items to be embedded in concrete.
- F. Forms for keyways shall be prepared in advance of pouring concrete. Keyway forms in slab edges and vertical wall joints shall be rigidly secured in place before the concrete is poured. Forms for keyways for horizontal joints in walls may be placed at the conclusion of the pour, but proper provision shall be made for obtaining and holding the full depth and form of the keyway.

3.03 ADJUSTMENT OF FORMS

- A. Positive means of adjustment should be provided to permit realignment or readjustment of shores if excessive settlement occurs.
- B. A pair of wedges may be used at the top or bottom of shores, but not at both ends, to facilitate vertical adjustment, to correct uneven settlements, or to facilitate dismantling of the formwork.
- C. Screw jacks for pipe shores or scaffold-type shoring may be used at both top and bottom so long as they are secured by the shore or scaffold leg against loosening or falling out, to avoid lateral deflections.
- D. During and after concreting, but before initial set of the concrete, the elevations, camber, and plumbness of formwork systems shall be checked, using telltale devices. Appropriate adjustments shall be promptly made where necessary. If, during construction, any weakness develops and the formwork shows any undue settlement or distortion, the Work shall be stopped, the affected construction removed if permanently damaged, and the formwork strengthened.

3.04 REMOVAL OF FORMS

- A. Forms, wedges or shoring shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all superimposed dead, temporary construction, and live loads. When forms or shoring are removed, there shall be no excessive deflection or distortion of the concrete. Forms shall be removed in an orderly fashion; with care to avoid surface gouging, corner or edge breakage, or other damage or injury to the concrete surface or physical property; and without impact or shock, to permit the concrete to carry its share of the loads gradually and uniformly. Form removal shall not impair the safety and serviceability of the structure or concrete members.
- B. Forms and shoring in the formwork used to support the weight of concrete in beams, slabs, and other structural members shall remain in place a minimum of 14 days or until the concrete has reached a minimum of 75% of the design compressive strength. The cylinder strength shall be based on test specimens cured in the field, as described in ASTM C31/C31M, under conditions which are not more favorable than the most unfavorable conditions for the portions of the concrete which the test specimens represent and shall be determined in accordance with Section 03 30 00.
- C. Formwork for columns, walls and other vertical members shall remain in place a minimum of five (5) days or until the concrete has attained a minimum of 75% of its design strength. Where such formwork also supports the formwork of beams and slabs, the removal times of the latter shall govern. Face and edge forms shall be removed as soon as practicable and permitted by the Engineer in order to facilitate effective repair of voids or broken corners before the surface has dried.
- D. Forms and shoring in the formwork shall not be removed without the approval of the Engineer. The minimum in-place times are for ordinary conditions and represent cumulative number of days, not necessarily consecutive, after the concrete was placed, during which the temperature of the air surrounding the concrete is above 50 degrees Fahrenheit. The times may be increased or decreased as directed by the Engineer, dependent on air temperatures, cement type, concrete additives or other conditions of the Work in accordance with ACI 347R.

3.05 RESHORING

- A. When removing forms before structural members are strong enough to carry dead load and/or construction loads, reshores shall be installed to assure safe distribution of loading. Reshoring operations shall be planned in advance and shall be subject to the Engineer's review. During reshoring, no construction loads shall be permitted on the new construction.
- B. Reshores shall be placed as soon as practicable after form removal, but in no case later than the end of the working day on which form removal occurs, and shall remain in place until the concrete has acquired the required strength.

END OF SECTION 03 11 00

SECTION 03 15 00 CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes joint fillers, joint sealants, waterstops, and miscellaneous embedded items in concrete.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 11 00 - Concrete Forming
- B. Section 03 20 00 - Concrete Reinforcing
- C. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCE STANDARDS

- A. ASTM A193/A193M: Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
- B. ASTM A194/A194M: Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- C. ASTM A563/A563M: Standard Specification for Carbon and Alloy Steel Nuts
- D. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- E. ASTM D994/D994M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
- F. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- G. ASTM D1752: Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
- H. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
- I. ASTM F436/F436M: Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
- J. COE CRD-C 513: Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops
- K. COE CRD-C 572: Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.04 SUBMITTALS

- A. Submit certified manufacturer's affidavits for expansion joint filler, joint sealant and waterstops to verify compliance with the applicable Specifications.
- B. Submit a schedule of concrete pouring and indicate locations of proposed construction and expansion joints. This schedule is subject to approval of the Engineer.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Environmental requirements relative to temperature for placing joint sealants are specified in Part 3 of this Section.

1.06 SEQUENCING

- A. Contractor shall sequence installation of miscellaneous embedded items with the Work of Section 03 11 00, Section 03 20 00 and Section 03 30 00.

PART 2 PRODUCTS

2.01 JOINT FILLER

- A. Preformed Expansion Joint Filler for Concrete (Bituminous Type) ASTM D994/D994M.
- B. Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) ASTM D1751.
- C. Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Concrete ASTM D1752.

2.02 JOINT SEALER

- A. Joint Sealants, Hot-Poured, For Concrete and Asphalt Pavements ASTM D6690 Type II.
- B. Joint Sealants, Hot-Poured, Elastomeric Type, for Portland Cement Concrete Pavements ASTM D6690, Type II or III.

2.03 WATERSTOPS

- A. PVC waterstops shall conform to COE CRD-C 572 polyvinyl chloride (PVC) or COE CRD-C 513 styrene-butadiene rubber (SBR). Flat ribbed type shall be used in joints in walls and slabs where shown on the plans. Center bulb type shall be used in expansion joints.
- B. Bentonite waterstops shall be a compound of 75% high swelling sodium bentonite and 25% butyl rubber. Bentonite waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.
- C. Hydrophilic rubber waterstop shall be a combination of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete. Hydrophilic rubber waterstops require an adhesive as recommended by the manufacturer to adhere the waterstop to the substrate.

2.04 CONCRETE ANCHORS

- A. General:
 - 1. Select type and size to achieve required loading capacity using information provided by manufacturer. If required type is not indicated, select type appropriate to conditions and item being fastened.
 - 2. Maintain critical edge distance and spacing per manufacturer's recommendations for all anchors. Provide tamper proof hardware when called for on the plans.
- B. Adhesive Anchors:
 - 1. Combination capsule adhesive and insert system; chisel pointed threaded rod with hex nut/washer, reinforcing bar, or internally threaded insert, installed into pre-drilled anchor hole using rotary hammer drill, crushing glass capsule containing two part epoxy acrylate resin (vinyl ester) with quartz aggregate and hardening agent, forming adhesive mortar.
 - 2. Threaded rod: ASTM A193/A193M Grade B7, ASTM A194/A194M Grade 2H or ASTM A563/A563M Grade DH nuts, and ASTM F436/F436M washers; plated in accordance with ASTM B633, SC1, with Type II yellow chromate treatment or Type 304 stainless steel when specified on the plans.
 - 3. Threaded Insert: Carbon steel tubular insert, internally threaded, plated in accordance with ASTM B633, SC1.
- C. Wedge Type Anchors:
 - 1. One piece body with expansion mechanism installed in pre-drilled hole using matching tolerance bit.

2. Carbon steel anchor body, washers, nuts and wedges, plated in accordance with ASTM B633, SC1, Type III or Type 304 stainless steel anchor body, washers, nuts and wedges when so indicated on plans.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Inspect the locations and surfaces to receive joint filler, joint sealer, or miscellaneous embedded items and correct defects or conflicts which will affect the proper performance of the item to be placed.

3.02 PREPARATION

- A. All accessories to be embedded into concrete shall have contact surfaces free of dirt, curing compound, protrusions of hardened concrete or any other foreign material which would affect bond with concrete.
- B. Prime surfaces in accordance with manufacturer's recommendations.

3.03 INSTALLATION OF JOINT FILLERS

- A. Details, including materials and methods of installation of joint fillers shall be as indicated on the Plans and as approved by the Engineer.

3.04 INSTALLATION OF JOINT SEALANTS

- A. Joints shall not be sealed when the sealant, air or concrete temperature is less than 40 degrees Fahrenheit. Bond breaker and backup material shall be installed where required as indicated on the Plans or manufacturer's recommendations.

3.05 INSTALLATION OF WATERSTOPS

- A. Waterstops shall be of maximum practicable length to minimize joints.
- B. Waterstops shall be positioned as indicated on the Plans in a manner to permanently retain flexibility.
- C. Splice in length or at intersections shall be performed by heat sealing and in accordance with manufacturer's recommendations.
- D. Reform splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. When cooled and bent by hand in as sharp an angle as possible, the splice shall show no sign of separation.
- E. Provide support and protection of the waterstops during the progress of the work. Any waterstop punctured or damaged shall be replaced or repaired at Contractor's expense. Concrete shall be thoroughly consolidated in the vicinity of the waterstop. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued.

3.06 CONCRETE ANCHORS

- A. Do not begin installation until substrates have been properly prepared. Do not proceed with installation if substrate preparation is unsatisfactory.
- B. Clean surfaces thoroughly prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Install in accordance with manufacturer's instructions and recommendations and as required by applicable code. Anchor applied items neatly, with item mounted plumb and level unless otherwise indicated.
- D. Engineer reserves the right to require the anchor manufacturer's representative to demonstrate proper installation procedures for post-installed anchors and to observe Contractor's installation procedures, at no extra cost to Owner. Engineer reserves the right to require pullout or shear

tests to determine adequacy of anchors, at no extra cost to Owner.

3.07 MISCELLANEOUS EMBEDDED ITEMS

- A. Inserts and other embedded items required for adjoining Work or for its support shall be placed prior to concreting.
- B. Embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

END OF SECTION 03 15 00

SECTION 03 20 00 CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the furnishing, fabrication, placement and care of material used as concrete reinforcement.
- B. Latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein. Copies of standards can be obtained from the American Concrete Institute.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 11 00 - Concrete Forming
- B. Section 03 15 00 - Concrete Accessories
- C. Section 03 30 00 - Cast-in-Place Concrete

1.03 ALLOWABLE TOLERANCES

- A. Fabrication:
 - 1. Sheared length: ± 1 inch
 - 2. Depth of truss bars: +0, -1/2 inch
 - 3. Stirrups, ties, and spirals: $\pm 1/2$ inch
 - 4. Other bends: ± 1 inch.
- B. Placement:
 - 1. Concrete cover to form surfaces: $\pm 1/4$ inch
 - 2. Minimum spacing between bars: -1/4 inch
 - 3. Top bars in slabs and beams:
 - a. Members 8 inches deep or less: $\pm 1/4$ inch
 - b. Members more than 8 inches but not 24 inches over deep: $\pm 1/2$ inch
 - c. Members more than 24 inches deep: ± 1 inch
 - 4. Crosswise of members: Spaced evenly within 2 inches of stated separation.
 - 5. Lengthwise of members: ± 2 inches
 - 6. Maximum bar movement to avoid interference with other reinforcing steel, conduits, or embedded items: 1-bar diameter, with approval from the Engineer.

1.04 SOURCE QUALITY CONTROL

- A. Reinforcing steel shall be subject to inspection at the source of supply, fabricator, or after delivery to the Project Site at the discretion of the Engineer.
- B. Contractor may be required to furnish additional test of reinforcing steel for each 100 ton or fraction thereof. Testing for bend, pull, elongation and weight to assure compliance with Specifications shall be in accordance with ASTM A370.

1.05 REFERENCE STANDARDS

- A. ACI SP-66: ACI Detailing Manual
- B. ACI 301: Specifications for Concrete Construction

- C. ACI 318: Building Code Requirements for Structural Concrete and Commentary.
- D. ASTM A184/A184M: Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- E. ASTM A370: Standard Test Methods and Definitions for Mechanical Testing of Steel Products
- F. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- G. ASTM A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- H. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
- I. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- J. ASTM C55: Standard Specification for Concrete Building Brick.
- K. ASTM E329: Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
- L. CRSI (DA4): Manual of Standard Practice

1.06 SUBMITTALS

- A. Contractor shall submit Shop Drawings indicating the size and dimensions for fabrication and placing of reinforcing steel, including bar schedules, stirrup spacing, and diameter of bend bars. Bar supports type and grade shall be indicated.
- B. Contractor shall submit test certificates of the manufacturer's laboratory, identifying chemical and physical analysis of each load of reinforcing steel delivered.
- C. Contractor shall submit test certificates of a qualified independent testing agency evaluation of the mechanical splice devices to assure compliance with ACI 318.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver reinforcement to Project site in bundles tagged and marked in accordance with CRSI (DA4).
- B. Reinforcing steel shall be stored above ground on platforms or other supports, in an orderly manner to facilitate inspection and checking, and be protected from physical injuries or contamination.

1.08 SEQUENCING

- A. Contractor shall coordinate placement of the reinforcing in a manner which will not prevent the proper and timely completion of dependent construction phases.

PART 2 PRODUCTS

2.01 REINFORCING BARS

- A. Reinforcement shall be of the grade and type as specified herein unless otherwise indicated on the Plans or Shop Drawing.
- B. Bars:
 1. Deformed and Plain Billet-Steel Bars: ASTM A615/A615M, Grade 60.
 2. Rail-Steel and Axle Steel Deformed and Plain Bars: ASTM A996/A996M, Grade 60.
 3. Low Alloy Steel Deformed Bars: ASTM A706/A706M.
- C. Mats:
 1. Fabricated steel bar or rod mats of the clipped type shall conform to ASTM A184/A184M.

2.02 WELDED WIRE FABRIC

- A. Welded wire fabric shall be in flat mats only.
- B. Plain:
 - 1. Conform to ASTM A1064/A1064M, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.
- C. Deformed:
 - 1. Conform to ASTM A1064/A1064M, 6 x 6 – w2.9 x w2.9 unless otherwise indicated on the Plans.

2.03 TIE WIRE

- A. Plain:
 - 1. Conform to Cold Drawn Steel Wire for Concrete Reinforcement ASTM A1064/A1064M, 16-gage minimum size.
- B. Deformed:
 - 1. Conform to Deformed Steel Wire for Concrete Reinforcement, ASTM A1064/A1064M, size D-4 minimum.

2.04 BAR SUPPORTS

- A. Metal bar supports shall be fabricated from cold-drawn steel wire in accordance with current CRSI Standards.
- B. Stainless steel supports shall be of Type 1, with stainless steel wire conforming to ASTM A493 attached to the tips of the support so the nonstainless wire will lie no closer than 1/4 inch from the form surface.
- C. Plastic coated supports shall be of Type 1, with plastic coating of polyethylene conforming to ASTM D1248 on the legs and tips.
- D. Precast concrete brick supports shall conform to ASTM C55, Type 1, Grade N.

2.05 FABRICATION

- A. Bars shall be bent cold to the shapes and dimensions as indicated on the Plans, or as required by the current "Manual of Standard Practice" of the CRSI. Steel shall not be bent or straightened in a manner that will injure the material. Bars with kinks or improper bends shall not be used.
- B. The diameter of bend measured on the inside of the bar for standard hooks, other than stirrups and tie hooks, shall not be less than the values of the following table.

Minimum Diameters of Bend	
Bar Size	Minimum Diameter
#3 through #8	6 bar diameters
#9, #10 and #11	8 bar diameters
#14 and #18	10 bar diameters

- C. Bends for stirrups and ties with number #5 bar and smaller shall not be less than four bar diameters. For bars larger than No.#5, shall be according to the "Minimum Diameter of Bend" table above.
- D. Bends for stirrups and ties for welded wire fabric shall not be less than 4-bar diameters for deformed wire larger than D-6 and 2-bar diameters for all other wires. Bends with inside diameter of less than 8-bar diameters shall not be less than 4-bar diameters from nearest welded intersection.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Contractor shall examine the areas in which the reinforcing steel is to be placed to assure proper lines and levels.

3.02 PREPARATION

- A. Remove dirt, grease, oil, loose mill scale, excessive rust, and foreign matter that will reduce bond with concrete or splicing method.
- B. Ends of bars to be butt spliced shall be cut square and smooth.

3.03 INSTALLATION - GENERAL

- A. Reinforcing shall be placed as indicated on the approved Shop Drawings, within allowable tolerances. Bar supports, as indicated on approved Shop Drawings, or in Specifications, shall be used for proper separation and support of reinforcing steel.

3.04 MINIMUM COVER AND SPACING

- A. Unless otherwise indicated on the Plans, the minimum spacing of bars shall be the following:
- B. Footings and other principal structural members in which the concrete is deposited against the ground shall have 3 inches of concrete between the bar and the ground contact surface.
- C. Concrete surfaces which, after removal of the forms, are to be exposed to the weather or in contact with the ground or liquids, shall be protected with 2 inches of concrete.
- D. The concrete protective covering for any reinforcement at surfaces not exposed directly to the ground, liquids or weather shall be 3/4 inch for slabs and walls and 1-1/2 inches for beams and girders.
- E. Column spirals or ties shall be protected everywhere by a covering of concrete cast monolithically with the core and shall be at least 1-1/2 inches .
- F. Concrete protection for reinforcement shall in all cases be at least equal to the diameter of bars, except for concrete slabs as noted above.
- G. The minimum center to center distance between parallel bars shall be 2-1/2 times the diameter of the bars. In no case shall the clear spacing between bars be less than 1 inch nor less than 1-1/3 times the maximum size of the coarse aggregate. The maximum center to center distance in parallel bars shall be 18 inches.
- H. Where reinforcement in beams and girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1 inch, and the bars in the upper layers shall be placed directly above those in the bottom layer.
- I. Welded wire fabric designated as load-carrying reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches. It shall be supported as required for reinforcing bars.

3.05 SPLICING

- A. Splices shall be avoided at points of maximum stress. Splicing of bars shall be in accordance with ACI 318.
- B. Splicing of bars shall be done by overlapping in accordance with ACI SP-66, and securely laced with wire unless indicated otherwise on the Plans or approved Shop Drawing.
- C. Lap adjoining wire mesh by no less than one (1) full mesh and lace securely with wire. Offset end laps in adjacent widths to prevent continuous splice.
- D. Welded wire fabric reinforcement shall be overlapped wherever successive mats are continuous in such a way that the overlap measured between outermost cross wires of each

fabric sheet is not less than one full mesh spacing plus 2 inches. The fabric shall extend across supporting beams and walls and to within four 4 inches of concrete edges. It may extend through contraction joints where alternate wires are field cut. It shall be adequately supported during placing of concrete to insure its proper position in the slab either by the methods of Part 3 of this Section or by laying the fabric on a layer of the fresh concrete of the correct depth before placing the upper layer of the slab.

- E. Vertical bars in columns shall be offset at least 1-bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.
- F. Bars of size #14 and #18 or larger, where size #11 bars are butt spliced to larger sizes and/or when approved by the Engineer shall be welded in accordance with ACI 301 by full penetration butt welds. Adequate jigs and clamps or other devices shall be provided by the Contractor to support, align and hold the longitudinal centerline of the bars in a straight line.
- G. Bars larger than #11 may be butt spliced by mechanical devices approved by the Engineer, in accordance with ACI 318. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories to support, align and hold the longitudinal centerline of the bars in a straight line.

3.06 SECURING REINFORCEMENT

- A. Reinforcement shall be securely laced with wire to supports or reinforcing to prevent displacement during the concrete placement, as required by the current CRSI (DA4).

3.07 FIELD QUALITY CONTROL

- A. Engineer shall inspect the reinforcing steel after it has been installed, and the reinforcing steel placement shall be approved by the Engineer prior to placement of concrete.
- B. Contractor shall avoid displacement of the reinforcing steel during concrete placement.

END OF SECTION 03 20 00

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes all monolithic cast-in-place concrete work complete with materials, mixes, installation and testing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 03 15 00 - Concrete Accessories
- C. Section 03 20 00 - Concrete Reinforcing
- D. Section 03 60 00 - Grouting
- E. Section 05 12 00 - Structural Steel Framing
- F. Section 07 10 00 - Dampproofing and Waterproofing
- G. Section 31 23 19 - Dewatering

1.03 REFERENCE STANDARDS

- A. ACI 312.3R: Report on Chemical Admixtures for Concrete
- B. ACI 301: Specifications for Concrete Construction
- C. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete
- D. ACI 305R: Guide to Hot Weather Concreting
- E. ACI 306R: Guide to Cold Weather Concreting
- F. ACI 318: Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete
- G. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- H. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field
- I. ASTM C39/C39M: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- J. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
- K. ASTM C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete
- L. ASTM C150/C150M: Standard Specification for Portland Cement
- M. ASTM C172/C172M: Standard Practice for Sampling Freshly Mixed Concrete
- N. ASTM C183: Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
- O. ASTM C231: Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- P. ASTM C260/C260M: Standard Specification for Air-Entraining Admixtures for Concrete
- Q. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- R. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete

- S. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
- T. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- U. ASTM C989/C989M: Standard Specification for Slag Cement for Use in Concrete and Mortars
- V. ASTM D75 / D75M - 19 Standard Practice for Sampling Aggregates

1.04 REFERENCE SPECIFICATIONS

- A. The latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein.
- B. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.05 TESTING AGENCY

- A. Inspections and tests required by this Section shall be performed by organizations acceptable to the Engineer.

1.06 ALLOWABLE TOLERANCES

- A. See Section 03 11 00 for the allowable tolerances for concrete surfaces.

1.07 DESIGN CRITERIA

- A. Mixes shall be designed and tested for each size and gradation of aggregates and for each consistency intended for use. Design quantities and test results of each mix shall be submitted for review.
- B. Necessary construction joints are shown on the Plans. Modification of location or placement of construction joints not indicated on the Plans shall be subject to approval of the Engineer. In general, they shall be located within the middle one-third of the span of slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam.
- C. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
- D. Expansion joint locations and details shall be as shown on the Plans. In no case shall any fixed metal be continuous through a expansion joint.
- E. Keyways shall be provided in all joints where required to provide for either shear or watertightness. Unless otherwise required, the width of keys shall be at least one-third the thickness of the section at that point and their depth at least one-third their width.

1.08 SOURCE QUALITY CONTROL

- A. Furnish tests of cement and aggregates. Material sampling shall conform to the following ASTM Standards:
 - 1. Cement C183
 - 2. Aggregates D75.
- B. Testing shall be in accordance with applicable ASTM Standards to assure compliance with Specifications.
- C. Make tests for the following quantities, or fraction thereof:
 - 1. Cement: 550 tons
 - 2. Fine Aggregate: 2,000 tons
 - 3. Course Aggregate: 2,000 tons

- D. Use same brand cement for any given structure produced by a single mill unless otherwise provided by authorization of the Engineer.

1.09 SUBMITTALS

- A. Submit Shop Drawings showing the location of joints. Included shall be a schedule of the concrete pouring. The location of joints and pouring schedule shall be subject to approval by the Engineer.
- B. Contractor shall submit test reports for cement and aggregates to assure compliance with the Specifications.
- C. Concrete mixture designs and test data shall be submitted for review by the Engineer with a written request for approval. No concrete shall be placed until the Contractor has received such approval in writing.
- D. Each mixture report shall include:
 - 1. Slump on which design is based.
 - 2. Total gallons of water per cubic yard (l/m³).
 - 3. Brand, type, composition, and quantity of cement.
 - 4. Brand, type, composition, and quantity of pozzolan or other mineral admixtures.
 - 5. Brand, type, composition, and quantity of ground granulated blast furnace slag.
 - 6. Specific gravity and gradation of each aggregate.
 - 7. Ratio of fine to total aggregates.
 - 8. Weight (surface dry) of each aggregate, lbs./c.y. (kg/m³).
 - 9. Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.
 - 10. Air content.
 - 11. Compressive strength based on 7-day and 28-day compression tests.
 - 12. Time of initial set.
- E. Submit manufacturer's literature of abrasive wear resistant floor finish and of chemical curing compound for review by the Engineer.
- F. Submit a sample concrete delivery ticket for review by the Engineer.
- G. Submit tickets collected at the site of concrete placement accompanying each load of concrete. A printout system for producing these tickets in connection with automatic batching will be permitted.
 - 1. Each ticket shall be serially numbered, show the charging time, quantity and grade of concrete, location of delivery and the signatures of inspectors at the plant and site. Transit mixed concrete tickets shall also include revolution counter reading at charging and mixing completion.
- H. Submit reports of the sampling and testing of slump, air content and strength performed.
- I. Submit reports of nondestructive, core and/or liquid retention testing required for acceptance of concrete in place.

1.10 MATERIAL STORAGE AND HANDLING

- A. Materials shall be stored and handled in accordance with ACI 304R and as specified below.
- B. When permission is given to store cement in the open, a floor at least 6 inches above the ground and a waterproof covering shall be provided and so placed as to insure runoff in case of rain.

- C. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by the Contractor by cleaning sacks mechanically or otherwise, or from discarded sacks of cement, shall not be used in the Work. The use of a fractional sack of cement will not be permitted unless the fractional part is measured by weight. At the time of its use in the Work, the cement shall be free from lumps.
- D. No aggregates which have become intermixed prior to proportioning shall be used. Sufficient aggregate shall be available at the site to preclude the possibility of damaging delays while placing the concrete.
- E. Cars used for shipping aggregates shall be clean and in good repair. The use of straw, marsh, hay or other similar materials for closing cracks or holes in cars will not be tolerated.
- F. Pozzolans and other cementitious materials shall be stored and handled in the manner of cement.
- G. Store and handle curing compound in a manner to prevent contamination.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Environmental requirements shall be in accordance with ACI 305R for hot weather concreting, and ACI 306R for cold weather concreting.
- B. Specific temperature requirements are contained in Part 2 of this Section for mixing and Part 3 of this Section for placing.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

- A. The materials shall meet the requirements of ACI 301, ACI 318, and MDOT Specification, Division 9.
- B. Concrete materials shall be tested and inspected as the Work progresses. The review and/or check-test of the proposed materials, securing of production samples of materials at plant stockpiles and/or review of the manufacturer's reports for compliance will be performed at no cost to the Contractor.
- C. Testing and inspection required due to substitution or change of materials requested by the Contractor shall be at the Contractor's expense.

2.02 CEMENT

- A. Cement shall be the type as indicated on the Plans or as specified.
 - 1. Type I and IA, conforming to ASTM C150/C150M, air-entraining Portland cement when special properties are not specified.
 - 2. Type III and IIIA, conforming to ASTM C150/C150M, air-entraining Portland cement for use when high-early strength is specified.
 - 3. Type IS and IS-A, conforming to ASTM C595/C595M, air-entraining Portland blast-furnace slag cement for use in general concrete construction.
 - 4. Type IP and IP-A, conforming to ASTM C595/C595M, air-entraining Portland-Pozzolan cement for use in general construction. The addition of suffix (MS) signifies that moderate sulfate resistance is specified. The addition of suffix (MH) signifies that moderate heat of hydration is specified.

2.03 AGGREGATES

- A. Washing will be required to eliminate the dust, clay, or silt coating. Aggregates which have been washed shall not be used sooner than 24 hours after washing, unless approved by the Engineer.

- B. Coarse aggregate shall be gravel or crushed rock, conforming to MDOT Section 902.03. Class 17A for members 8 inches or less in thickness and Class 6AA for other construction.
 - 1. Gravel shall consist of hard, clean, durable particles of rock or pebbles and shall be free from lumps of clay.
 - 2. Crushed rock shall consist of angular fragments of crushed hard heads or boulders or crushed igneous rock free from weathered rock and of uniform quality.
 - 3. All sieve and screen analyses determination of clay, silt, and dust content and percentages of objectionable particles will be based on dry weights and conform to MDOT Section 902.03, Table 902-1, "Grading Requirements for Coarse Aggregates, Dense-Graded Aggregates, and Open Graded Aggregates" and Table 902-2, "Physical Requirements for Coarse Aggregate, Dense Graded Aggregates and Open Graded Aggregates."
- C. Fine aggregate shall be sand size 2NS, MDOT, Section 902.08.
 - 1. Fine aggregates shall consist of sharp sand which shall be composed of clean, hard, durable grains and shall be free from lumps of clay and organic deleterious substances.
 - 2. Fine aggregates shall conform to MDOT Section 902.09 and Table 902-4, "Grading Requirements for Fine Aggregates."

2.04 ADMIXTURES

- A. Admixtures shall be used to achieve concrete as indicated on the Plans or specified herein. Calcium chloride shall not be used.
 - 1. Air-entraining, conforming to ASTM C260/C260M.
 - 2. Pozzolan and Fly Ash, conforming to ASTM C618, Class F.
 - 3. Water reducing, conforming to ASTM C494/C494M.
 - 4. Retarder, conforming to ASTM C494/C494M.
 - 5. Plasticizer, conforming to ASTM C494/C494M.
 - 6. Ground granulated blast furnace slag conforming to ASTM C989/C989M, grade 100.
- B. Abrasive wear resistant floor finish shall be packaged, dry combination of Portland cement, graded Quartz aggregate and dispersing agents formulated to produce an abrasive and wear resistant monolithic surface.

2.05 JOINT FILLER

- A. See Section 03 15 00.

2.06 WATER

- A. Water shall be free from oil, acid, alkali, organic matter, and any other deleterious substances. Water approved by the Local Board of Health may be used without testing. Water from other sources shall be tested before using.

2.07 CURING COMPOUND

- A. Shall be adequate to prevent checking, cracking and loss of moisture, conforming to ASTM C309.

2.08 MIXES

- A. Concrete shall consist of a mixture of air-entraining Portland cement, coarse and fine aggregate, Class F Fly Ash, and water with admixtures if required. Admixtures shall not be used without the Engineer's review.
- B. The mixture, combined in proportions, shall meet the requirements of MDOT, Specification Section 701, and ACI 211.1.

- C. Concrete shall be classified and proportioned on the basis of minimum compressive strength at 28 days when cured in a moist room at a temperature within the range of 68 - 75 degrees F. The desired strength of the concrete shall be shown on either the Plans or in the Specifications.
- D. Table 1 shows for each grade of concrete the minimum compressive strength, cement content, and the modulus of rupture. Concrete shall be 3,500 psi, unless otherwise shown on the plans.

Table 1 - Concrete Mixtures						
Concrete Grade	Coarse Agg	Type of Cement	Cement Content	Min Compressive Strength @ 28 days	Min Modulus of Rupture @ 28 days	% Air
4500 psi	6AA	I, IA, IS, IS-A	658 lbs/cyd	4500 psi	725 psi	4 - 6
4000 psi	6AA or 17A	I, IA, IS, IS-A	611 lbs/cyd	4000 psi	700 psi	4 - 6
3500 psi	6AA or 17A	IS, IS-A, IP, IP-A	564 lbs/cyd	3500 psi	650 psi	4 - 6

1. Maximum water cement ration shall be 0.45
 2. Structural concrete for walls and slabs shall be placed with a slump of 4 inches maximum.
 3. Ground granulated blast furnace slag (GGBFS) may be substituted for cement on a pound for pound basis from a minimum of 25% up to a maximum of 40% GGBFS and 60% cement
 4. Minimum fly ash content in the mix shall be 25%, additional fly ash may be substituted for cement on a pound for pound basis up to a maximum of 40% fly ash and 60% cement when approved by the Engineer.
 5. Maximum total replacement of cement shall not exceed 40%.
- E. Aggregates shall be proportioned by weight, except for small structures and for incidental Work requiring less than 10 cubic yards of concrete, in which case they may be proportioned by volume when approved by the Engineer.
 - F. Cement in bulk, when permitted, shall be proportioned by weight.
 - G. When proportioned by volume, the amount of each aggregate required for a single batch shall be measured separately and accurately. Shovel methods of measuring will not be permitted. The unit of volumetric measurement shall be 1 cubic yard.
 - H. When proportioned by weight, the amount of each aggregate required for a single batch shall be weighed in a separate container. The equipment for weighing shall be of an approved type, and of such accuracy that there shall not be an error of more than one (1) percent in any one (1) batch.

2.09 BATCHING ADMIXTURES

- A. The batching of admixtures to achieve and maintain production of the mix design of concrete shall be in accordance with ACI 212.3R.
- B. If the air content is found to be less or greater than the specified amount, the Contractor shall immediately discontinue Work and correct the air content.
- C. Decreasing the air content may be accomplished by blending air-entraining Portland cement with Portland cement, manufactured at the same mill, in a ratio which will reduce the air content to a value within the specified limits, this blending shall be reviewed by the Engineer.
- D. Increasing the air content may be accomplished by adding to each batch a sufficient amount of air-entraining admixture to bring the air content up to the designed amount.

- E. Pozzolan and ground granulated blast furnace slag shall be proportioned based on the mix design approved by the Engineer to produce watertight concrete.
- F. Water Reducer can be used to reduce the water requirement of concrete to obtain consistency of slump, modify workability, increase strength or any other approved use.

2.10 TEMPERATURE LIMITS OF MIXTURE

- A. The temperature of the cement, at the time of delivery to the mixer, shall not exceed 165 degrees F. The cement shall be stored at the Contractor's expense until cooled to that temperature.
- B. The temperature limits of aggregates and water entering the mixer shall be as follows:

Component	Minimum	Maximum
Water	75°F (24°C)	140°F (60°C)
Fine Aggregate	65°F (18°C)	140°F (60°C)
Coarse Aggregate	65°F (18°C)	110°F (43°C)
Concrete (resulting)	60°F (15°C)	90°F (32°C)

2.11 MIXERS AND MIXING

- A. Concrete mixing operations shall be in accordance with ACI 304 and MDOT, Section 701, and shall be subject to random inspection during the progress of the Work at no charge to the Contractor.
- B. Central Mixed Concrete:
 1. Mixers shall be capable of quickly and completely discharging without segregation or loss.
 2. Efficiency of the mixers shall be maintained at all times through repair or replacement of worn parts when necessary.
 3. Mixers shall be provided with readily adjustable, automatic devices which will measure the cement and water within one (1) percent and admixtures within three (3) percent.
 4. The drum of the mixer shall be kept free from hardened concrete and shall be completely emptied before recharging.
 5. Retempering or remixing concrete that has partially set will not be permitted.
 6. Mixer shall be cleaned thoroughly each time when out of operation for more than 1/2 hour.
 7. Recommended mixing time is a minimum time of 1 cubic yard, with an additional 15 seconds for each additional 1 cubic yard.
 8. Concrete shall be delivered to the site in clean, tight truck bodies designed for this purpose and painted with paraffin if necessary for easy dumping.
 9. The concrete at the point of delivery shall have the proper consistency and shall be free from segregation.
 10. Mechanical agitators in the truck bodies will be required if the period of time from the mixing plant to the point of dumping exceeds 30 minutes.
 11. No concrete shall be dumped if the elapsed time from the mixing plant to the point of dumping exceeds 60 minutes.
- C. Transit Mixed Concrete:
 1. Transit-mix concrete shall be in accordance with ASTM C94/C94M. If transit-mix concrete is used, it shall meet all the foregoing requirements specified for central mixed concrete and, in addition, the following:
 - a. The batched materials shall be properly proportioned and in a dry state. The proper amount of water shall be added to the mixer on the trucks, and no additional water

shall be added. No admixtures or accelerators shall be added except as herein noted, without the approval of the Engineer.

- b. Trucks shall not be loaded beyond their rated capacity and shall have mixing drums cleaned of all set-up materials at frequent intervals while in use. Trucks with leaking water valves shall not be used.
 - c. Recommended mixing speed should be no less than 12 revolutions per minute, with a minimum of 90 revolutions or until the mix is satisfactory.
 - d. Mixing shall be continuous after water is added to the mix in the drum, but no concrete shall be placed in the forms more than 90 minutes after water is added to the mix.
 - e. Truck-mixed concrete shall be delivered to the site of the Work and discharged from the mixer within the maximum period of 1-1/2 hours from the first introduction of water to the mix. Any concrete which remains in the mixer after this period and any concrete which appears too stiff to be properly workable or which appears to have begun to take its initial set shall be rejected and removed from the site of the Work.
- D. Owner may employ an independent testing laboratory to provide a qualified inspector to be present at the plant where batching of concrete occurs. The inspector shall verify the compliance of the mix with the Specifications and shall sign a form indicating the quantity of concrete and the concrete mixture of each load.

2.12 CHANGE OF MIXTURE

- A. If Contractor requests a change or substitution of approved batch proportioning, mixing, or delivery operations additional testing and/or inspection shall be at Contractor's expense.

2.13 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers of abrasive wear resistant floor finish include: Master Builders Company "Mastercon Aggregate," Sonneborn Building Products "Harcot," or equal.

PART 3 EXECUTION

3.01 VERIFICATION OF FORMWORK, REINFORCING, AND SUBGRADES

- A. Contractor shall inspect formwork, reinforcement and subgrades to confirm compliance with the related Work specified elsewhere.

3.02 EMBEDDED ITEMS

- A. Contractor shall verify the location, from certified vendor or applicable engineering drawings, of all embedded items including anchor bolts, wall sleeves, wall casting, railing post sleeves and miscellaneous pipes and conduits and shall install the items accurately at the locations determined.

3.03 BUILDING IN OTHER WORK

- A. Contractor shall make all necessary provisions in concrete Work for other Work installed by this or other contractors, and build in all required steel beams, frames, curbs, expansion joints, inserts, hangers, pipes, floor drains, pipe trench covers and frames, anchors, sleeves, floor ducts, fiber and steel conduit, pipe hanger sockets, and all other Work furnished by either this or other contractors.
- B. Contractor shall build in all anchors, ties, etc., specified under brick and other Work, in faces of concrete Work which are to be faced with masonry, and any other Work shown or noted to be built into concrete. In addition, Contractor shall provide all openings and holes in concrete Work as shown or as needed to accommodate other Work.

3.04 SPECIAL CONCRETE

- A. Contractor shall verify the use and/or locations of watertight concrete and/or high-early strength concrete.

3.05 PREPARATION

- A. Contractor shall notify the Engineer two (2) working days prior to placement of concrete.
- B. Before depositing new concrete on or against existing concrete the existing concrete shall be roughened, thoroughly cleaned of foreign matter and laitance and saturated with water. The cleaned and saturated surface of the hardened concrete, including vertical and inclined surfaces, shall be coated with a bonding agent or slushed with a minimum 2 inch thick coating of concrete without coarse aggregate grout against which the new concrete shall be placed before the mixture has attained its initial set.
- C. Before concrete is placed in any unit, the forms and the placing and fixing of all steel and incidental items shall be complete, and the forms, steel and adjacent concrete shall be thoroughly cleaned and wetted down.
- D. Where indicated on the Plans, the Contractor shall bridge the subgrade with at least 2000 psi, 3 inch thick lean concrete before placing the reinforcement. This shall be at no extra cost.
- E. No concrete shall be deposited in any unit until the area has been completely dewatered in accordance with Section 31 23 19, and not until after the Contractor has made satisfactory provisions to eliminate all possibility of water entering or flowing through the concrete while it is being poured or is taking its set. No concrete shall be placed under or on water.

3.06 CONVEYING

- A. Concrete handling equipment shall be of such a nature and shall be so located that the concrete after leaving the mixer will reach its destination with a minimum lapse of time, with no segregation, and loss of slump. The use of drop chutes, except at or in the forms, is prohibited.
- B. The interior hopper slope of concrete buckets shall be not less than 60 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least five (5) times the nominal maximum size aggregate and the area of the gate opening shall be not less than 2 square feet.
 - 1. Maximum dimension shall not be greater than twice the minimum dimension.
 - 2. Bucket gates shall be essentially grout tight when closed and may be manually, pneumatically or hydraulically operated except for buckets larger than 2 cubic yards shall not be manually operated.
 - 3. Design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.
- C. Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means for preventing segregation of the concrete at the transfer points and the point of placing.
- D. Concrete may be conveyed by positive displacement pump when authorized by the Engineer. The pumping equipment shall be piston or squeeze pressure type. The pipeline shall be rigid steel pipe or heavy duty flexible rubber hose. The inside diameter of the pipe shall be at least three (3) times the nominal maximum size coarse aggregate in the concrete mixture to be pumped. The maximum size coarse aggregate shall not be reduced to accommodate the pumps.
- E. The distance to be pumped shall not exceed limits recommended by the pump manufacturer. The concrete shall be supplied to the pump continuously. When pumping is completed, concrete remaining in the pipeline shall be ejected without contamination of concrete in place. After each operation, equipment shall be thoroughly cleaned, and flushing water shall be wasted outside of the forms.

3.07 PLACING

- A. Concrete shall be so deposited as to maintain the top surface level, unless otherwise shown on the Plans, and also as to avoid any appreciable flow in the mass.
- B. Where placing operations involve dropping the concrete more than 3 feet in the forms, it shall be deposited through sheet metal or other approved spouts or pipes. These spouts or pipes shall have suitable receiving hoppers at the upper ends, and the lower ends shall be kept within 6 inch of the newly placed concrete so as to prevent segregation and avoid spattering the reinforcing steel with mortar. Under no circumstances shall concrete that has partly hardened be deposited in the Work.
- C. Each layer of concrete shall be plastic when covered with the following layer and the forms shall be filled at a rate of vertical rise of not less than 2 feet per hour. Concrete vibrators shall penetrate the initial layer when placing the following layer. Vertical construction joints shall be provided as necessary to comply with these requirements.
- D. Concrete shall be placed and compacted in wall or column forms before any reinforcing steel is placed in the system to be supported by such walls or columns. The portion of any wall or column placed monolithically with a floor or roof slab shall not exceed 6 feet of vertical height. Concrete in walls or columns shall set at least two (2) hours before concrete is placed in the structural systems to be supported by such walls or columns.
- E. Concrete shall be set when top finished. All laitance, debris, and surplus water shall be removed from concrete surfaces at tops of forms by screeding, scraping, or other effective means. Wherever the top of a wall will be exposed to weathering, the forms shall be overfilled and after the concrete has settled, the excess shall be screeded off.
- F. No concrete shall be placed in contact with frozen ground. Time between charging and placement of concrete shall not exceed 1-1/2 hours.
- G. Concrete shall be compacted by continuous vibrating, tamping, spading or slicing. Care shall be taken to eliminate all voids and to provide full bond on reinforcing steel and embedded fixtures. Mechanical vibration shall be employed. Concrete shall be compacted and thoroughly worked with suitable tools combined with the use of vibrators applied internally and providing a frequency not less than 7,000 revolutions per minute. All such vibrating, including the methods and equipment, shall be subject to the review of the Engineer.
- H. The time of vibrating in any area shall only be sufficient to get efficient compaction, but shall in no case be carried to the point where there is segregation of the fine and coarse materials of the mix. There shall be an absolute minimum of direct vibration of the steel or forms during the process of vibrating. Vibrators shall be inserted and withdrawn from the concrete at numerous locations, from 18 - 30 inches apart, but shall not be used to transport concrete within the forms. Contractor shall have a stand by vibrator on the job site during all concrete pouring operations.

3.08 FINISHING UNFORMED SURFACES

- A. The unformed surfaces of all concrete shall be screeded and given an initial float finish followed by steel troweling.
- B. Screeding shall provide a concrete surface conforming to the proper elevation and contour with all aggregates completely embedded in mortar. All screeded surfaces shall be free of surface irregularities with a height or depth in excess of 1/4 inch as measured from a 10 foot straightedge.
- C. Screeded surfaces shall be given an initial float finish as soon as the concrete has stiffened sufficiently for proper working. Any piece of coarse aggregate which is disturbed by the float or which causes a surface irregularity shall be removed and replaced with mortar. Initial floating shall produce a surface of uniform texture and appearance with no unnecessary working of the surface. Floating shall be performed with hand floats or suitable mechanical compactor floats.

- D. Troweling shall be performed after the second floating when the surface has hardened sufficiently to prevent an excess of fines being drawn to the surface. Troweling shall produce a dense, smooth, uniform surface free from blemishes and trowel marks. The top surface of driveways, and sidewalks shall be given a broomed finish after troweling.
- E. Unless specified to be beveled, exposed edges of floated or troweled surfaces shall be edged with a tool having 1/4 inch corner radius.

3.09 FINISHING FORMED SURFACES

- A. After removal of forms, the finishing of all concrete surfaces shall be started as soon as its condition will permit.
- B. Grind all seams, fins or projections flush with the concrete surface.
- C. Fill and point all honeycomb, tie holes and voids.
- D. Dampen the surface with water and apply a cement and silica sand slurry to the entire surface to fill small defects and air voids.
- E. Remove excess slurry from concrete. Surfaces to be finished shall receive an application of dry Portland cement which shall be rubbed into the slightly dampened surface with a suitable cloth.
- F. After pointing and removal of projections as specified herein, exposed surfaces of concrete, including walls, columns, beams, pilasters and the undersides of slabs, shall be given a rubbed surface finish.

3.10 FLOORS

- A. Concrete floor finish shall be applied to all building floors not receiving further floor finish. At these locations, the concrete shall be brought to the proper elevation and screeded. The surface shall be given two (2) steel trowelings when the concrete has set sufficiently to finish smoothly. Floors shall be sloped uniformly toward floor drains at a slope of 1/8 inch per foot.
- B. The concrete finish on steps and loading platforms shall be wood troweled to true and uniform surface and then steel troweled. The surface shall then be slightly roughened with a broom or by dragging burlap across the surface.
- C. Concrete floors shall be finished with an abrasive resistant floor finish in the areas noted on the finish schedule on the Plans. Premixed floor hardener shall be applied to the surface of the freshly floated concrete floor, in strict accordance with the manufacturer's directions. Color to be selected by the Owner.

3.11 EXPANSION JOINTS

- A. Comply with the requirements of Section 03 15 00. Expansion joints shall have removable polystyrene joint caps secured to the top thereof and shall be accurately positioned and secured against displacement to clean, smooth concrete surfaces.
- B. Joint caps shall be of the size required to install filler strips at the desired level below the finished concrete surface and to form the groove for the joint sealant to the size shown on the Plans.
- C. Joint caps shall not be removed until after the concrete curing period.

3.12 CONCRETE CURING

- A. Concrete shall be cured for a period not less than seven (7) consecutive days. Contractor shall have adequate equipment and curing material on the job site before concrete placement begins, and it shall be adequate to prevent checking and cracking and loss of moisture from all the surfaces of the concrete. The concrete shall be protected from rain, flowing water, wind and the direct rays of the sun. Openings in concrete shall be sealed to prevent drying of the concrete during the curing period.
- B. Curing compounds shall not be used on surfaces to which additional concrete or other material are to be bonded.

- C. Curing compounds when used shall be applied in strict accordance with the manufacturer's recommendations.
- D. Concrete cured with water shall be kept wet by covering with ponded water or fog spraying to keep all surfaces continuously wet.
- E. Horizontal construction joints and finished surfaces cured with sand shall be covered a minimum thickness of 1 inch, uniformly, and kept saturated during the curing period.
- F. Burlap used for curing shall be treated to resist rot and fire and free of sizing or any substances that are injurious to Portland cement or cause discoloration. Strips shall be lapped by half widths. The burlap shall be saturated with water after placement and during the curing period.
- G. Straw or hay shall be in a layer no less than 6 inch thick and held in place by screens, wire or other means to prevent dispersion by the wind. Care shall be observed to avoid discoloration of the concrete surface from the vegetable fibers and for the flammability of the material. The straw shall be saturated with water after placement and during the curing period.

3.13 ENVIRONMENTAL CONDITIONS

- A. Contractor shall provide cold or hot weather protection in accordance with ACI and as specified herein. There shall be no additional cost for hot or cold weather protection of the concrete.
- B. Cold Weather Protection:
 1. When placing concrete in cold weather, the Contractor shall plan and prosecute his Work in a manner which shall assure results free from damage through freezing, contraction, and loss of concrete strength.
 2. No concrete shall be poured when the surrounding temperature is below 40 degrees F, unless the aggregates and water are properly heated. Concrete which has been poured at higher temperatures but has not attained a strength equal to 75% of the required strength of the class of concrete involved, shall be housed and protected in accordance with the provisions of this Section whenever the surrounding temperature falls below 40 degrees F.
 3. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.
 4. Aggregates may be heated only by steam coils or steam jets, except in the case of small quantities of concrete when other methods may be approved by the Engineer. A sufficient quantity of properly heated aggregates shall be on hand prior to starting the pouring of any unit.
 5. Concrete shall be properly housed with canvas, burlap, or other windproof material in such a manner that any necessary removal of the forms or finishing of the concrete can proceed without undue damage to the concrete from the elements. Heating of the housing shall be done in a manner which will maintain a temperature between 50 - 70 degrees F, at all times for at least five (5) days after the pour is complete and 12 hours before the pour begins. All supplemental heating units shall have exhaust vented to the exterior and shall not cause deleterious reactions or deposits to occur to concrete.
- C. Hot Weather Protection:
 1. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperature shall be less than 90 degrees F.
 2. In hot weather, suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided.

3.14 ADDITION OF WATER

- A. To increase workability, adding water to the mix shall be limited to a one time addition of 1 gallon per cubic yard and mixed with a minimum of 30 revolutions at a rate of 12 to 15 revolutions per minute. Addition of water shall be within the slump requirements.

3.15 CONCRETE DELIVERY TICKET

- A. A ticket system shall be used for recording the transportation of concrete from the batching plant to point of delivery. This ticket shall be issued to the truck operator at the point of loading and given to the Engineer upon delivery. The ticket shall as a minimum indicate the time of mixer charging, quantity of concrete, type of mixture including amount of cement, and the plant where the concrete was batched.

3.16 CONCRETE DELIVERY REJECTION

- A. Concrete not permitted for inclusion in the Work by the Engineer shall be removed from the site. Rejection of concrete will be determined through concrete testing and elapsed time from mixer charging to delivery.

3.17 CONCRETE TESTING AT PLACEMENT

- A. Tests shall be made of fresh concrete for each 50 cubic yards, or whenever consistency appears to vary. The sampling and testing of slump, air content and strength will be performed at no cost to the Contractor.
- B. Composite samples shall be secured in accordance with the Method of Sampling Fresh Concrete, ASTM C172/C172M.
- C. Slump Test:
 - 1. Slump Test shall be in accordance with ASTM C143/C143M. Contractor shall use the least slump possible consistent with workability for proper placing of the various classifications of concrete.
 - 2. A tolerance of up to 1 inch above the indicated maximum slump shall be allowed for individual batches provided the average for all batches or the most recent ten (10) batches tested, whichever is fewer, does not exceed the maximum limit.
- D. Air Content:
 - 1. Air content of normal weight concrete will be determined in accordance with ASTM C231, Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- E. Compressive Strength:
 - 1. A set of cylinders for compressive strength tests will consist of four cylinders per each set. The temperature of concrete sample will be determined for each strength test.
 - 2. Molding and curing specimens from each set shall be in accordance with ASTM C31/C31M. Any deviations from the requirements of this Standard shall be recorded in the test report.
 - 3. Testing specimens will be in accordance with ASTM C39/C39M. One (1) specimen shall be tested at seven (7) days for information and two (2) shall be tested at 28 days for acceptance.
 - a. Acceptance test results shall be the average of the strengths of the two (2) specimens tested at 28 days. If one (1) specimen in a test manifests evidence of improper sampling, molding or testing, it shall be discarded and the strength of the remaining cylinder shall be considered the test result.
 - 4. The strength level of the concrete will be considered satisfactory so long as the averages of all 28 day strength test results equal or exceed the specified 28-day strength and no individual strength test result falls below the specified 28-day strength by more than 500 psi.

5. If the strength test is not acceptable, further testing shall be performed to qualify the concrete.

3.18 TESTING OF CONCRETE IN PLACE

- A. Additional testing of materials or concrete occasioned by their failure by test or inspection to meet specification requirements shall be at the expense of the Contractor.
- B. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer to determine relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection.
- C. When required by the Engineer, cores at least 2 inch in diameter shall be obtained and tested in accordance with ASTM C42.
 1. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60° to 80°Fahrenheit (15°to 25°Celsius), relative humidity less than 60%) for 7 days before test and shall be tested dry.
 2. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C42.
- D. At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall be determined by the Engineer so as to least impair the strength of the structure. If, before testing, one or more of the cores shows evidence of having been damaged subsequent to or during removal from the structure, it shall be replaced.
- E. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 85% of and if no single core is less than 75% of the specified 28-day strength.
- F. Core holes shall be filled by low slump concrete or mortar.

3.19 RETENTION TESTING

- A. Tanks or structures designed to hold or retain water, wastewater or other liquids shall be retention tested.
- B. To test a tank or structure for leakage, the Contractor shall clean, disinfect (if required) and fill the tank or structure with water to its maximum level.
- C. The water shall be allowed to remain 24 hours with all associated valves and appurtenances tightly closed.
- D. During this 24-hour period, the water level as measured by a hook gage shall show no measurable loss.
- E. If this test fails, the Contractor shall dewater the tank or structure, make such repairs as necessary to achieve a watertight tank or structure, clean, disinfect (if required), and retest.
- F. Tests and repairs shall be repeated until the tank or structure is accepted by the Engineer.

3.20 DEFECTIVE CONCRETE

- A. If, in the opinion of the Engineer, the defects in the concrete are of such a nature as to warrant condemnation, that portion of the pour may be ordered replaced in its entirety and the Contractor shall promptly replace same without additional compensation.
- B. Defective concrete shall be repaired by cutting out the defective area and placing new concrete which shall be formed with keys, dovetails or anchors to attach it securely in place.

END OF SECTION 03 30 00

**SECTION 03 32 00
CONSTRUCTION AND EXPANSION JOINTS**

PART 1 GENERAL

1.01 SCOPE OF WORK

A.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A.

1.03 REFERENCE STANDARDS

A. The following is a list of standards and publications referenced in this Section:

1. American Society for Testing and Materials (ASTM) Publications:
 - a. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
 - b. ASTM C962 - Guide for Use of Elastomeric Joint Sealants.
 - c. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - d. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
 - e. ASTM D2835 - Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.
2. Corps of Engineers (COE):
 - a. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop.
3. Journal of the American Concrete Institute, June 1959: Waterstops for Joints in Concrete by B. Kellam and M.T. Loughborough.

1.04 SUBMITTALS

A. Shop Drawings:

1. Product data for materials including location where product is to be used.
2. Certification that materials meet the specifications.
3. Testing laboratory data substantiating results of waterstop zero water leakage tests conforming to test arrangement in the 1959 Journal of the ACI.
4. Manufacturer's application and installation instructions.
5. Samples of waterstops and joint fillers.
6. Color samples or charts for joint compounds.
7. Submit record documents and shop drawings marked to record actual construction.

PART 2 PRODUCTS

2.01 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in the manufacturer's sealed bags, unopened containers and banded pallets.
- B. Store materials off ground on platform or skid supports, and protect with covers from snow, rain and ground splatter.
- C. Store plastic products under cover in a dry cool location out of direct sunlight.

2.02 JOINT COMPOUNDS

- A. In surface facilities, provide joint compound for joints in horizontal and inclined surfaces less than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade P, Class 25. Provide type T compound in pedestrian and vehicular traffic areas, and type NT in non-vehicular areas. Provide preformed joint seals where indicated.
- B. In surface facilities provide joint compound for joints in walls inclined surfaces greater than 30 degrees from the horizontal conforming to ASTM C920, Type S or M, Grade NS, Class 25.
- C. Provide compatible joint compounds as recommended by manufacturer when they abut each other.
- D. Provide compound made for continuous submergence in liquid containing structures.
- E. Provide preformed polychloroprene elastomeric joint seal (compression seal) made of vulcanized elastomeric compound using polychloroprene as the only base polymer. Provide in expansion joints where indicated and conform to ASTM D2628.
- F. Provide one-component polychloroprene compound conforming to ASTM D2835 as lubricant for installation of elastomeric joint seal.

2.03 BOND BREAKER FOR JOINT COMPOUNDS

- A. Provide polyethylene tape, coated paper, or metal foil.

2.04 BACK-UP MATERIAL FOR JOINT COMPOUNDS

- A. Provide 100 percent closed-cell material, compressible, nonshrink, nonreactive with joint compound, and nonabsorbent.
- B. Extruded butyl or polychloroprene foam rubber is acceptable.
- C. Material impregnated with oil, bitumen, or similar substances is not acceptable.
- D. Provide back-up material which is compatible with joint compound as recommended by manufacturer and has same expansion/contraction capability as compound.

2.05 PREMOLDED-JOINT FILLER

- A. Provide premolded-joint filler conforming to ASTM D1752, Type I or Type II.
- B. Provide joint filler having same thickness as expansion joint width indicated.
- C. Provide maximum length filler manufactured to minimize field cutting.

2.06 POLYVINYLCHLORIDE WATERSTOP

- A. Provide in accordance with COE CRD-C 572.
- B. Provide waterstops of type and size indicated with looped galvanized steel wire along both edges. Manufacture from virgin polyvinyl chloride plastic compound that has a minimum tensile strength of 1750 psi.
- C. Provide waterstops having zero water leakage when tested to 50 psi minimum water pressure conforming to test arrangement in the 1959 Journal of the ACI.
- D. Provide factory-made and tested crosses, tees, and ells, manufactured using thermostatically controlled electric heat source.
- E. PVC waterstops to be manufactured by:
 - 1. Catalog No. RB9-12 as manufactured by Vinylex Corporation, Knoxville, TN.
 - 2. Wirestop Waterstop Part #CR-9380 as manufactured by Paul Murphy Plastics, Roseville, MI.
 - 3. No. 735 as manufactured by Greenstreak Plastic Products Company, St. Louis, MO.
 - 4. Or accepted equivalent product.

- F. Provide hydrophilic rubber gasket waterstops as manufactured by:
 1. Duroseal Gasket Waterstop manufactured by BBZ USA, Southington, CT;
 2. Adeka Ultraseal MC-2010M manufactured by Adeka North America, Spearfish, SD;
 3. Swellseal 8 manufactured by de neef Construction Chemicals, Inc., Waller, TX;
 4. Approved equal.

2.07 HYDROPHILIC PASTE WATERSTOPS

- A. Provide hydrophilic rubber paste waterstops of urethane paster, thixotropic vinyl monomer or similar materials.
- B. Hydrophilic rubber paste shall be compatible with waterstop material.
- C. Hydrophilic paste shall be 100% solids.
- D. Provide hydrophilic paste waterstops which meet or exceed the criteria in the following table:

Property	Test Methods	Limit
Ultimate Elongation	ASTM D638	50% minimum
Tensile Strength	ASTM D638	25 psi [170 kPa]
Ozone Resistance	ASTM D1149	No Failure
Volatile Loss	ASTM D1203	0.50% maximum
Hardness, Shore A	ASTM D2240	20 to 60

- E. Provide hydrophilic rubber paste as manufactured by:
 1. Duroseal Paste manufactured by BBZ USA, Southington, CT:
- F. Adeka Ultraseal P-201 manufactured by Adeka North America, Spearfish, SD;
 1. Swellseal Cartridge manufactured by De Neef Construction Chemicals, Inc., Waller, TX;

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Do not omit, add, or relocate construction and expansion joints without acceptance of the Engineer.
- B. Cast slabs and beams monolithically without horizontal joints.
- C. Do not use horizontal joints within footings and foundation mats.
- D. Place waterstops in joints, in location indicated, before concrete placement.
- E. Use factory-made and tested crosses, tees and ells at all corners and intersections where radius is less than 6 inches.
- F. Reject before placing concrete, all waterstops bent around corners and remove from the construction or expansion joint and replace with factory-made pieces at no additional cost to the Owner.
- G. Spark test all waterstop splices before installation in accordance with manufacturer's instructions.
- H. Clean all expansion joint sidewalls before installing joint compound and compression seals.

3.02 JOINT PREPARATION

- A. General:
 1. The joints shall be accurately located and constructed to produce straight joints; and shall be vertical or horizontal, except where walls intersect sloping floors.

2. The concrete pour shall not commence until after the joint preparation has been inspected by the Engineer.

3.03 PREPARATION OF CONSTRUCTION JOINTS

- A. Contractor shall terminate each day's pour with a construction joint, as shown on the Drawings or as approved by the Engineer, and a suitable bulkhead.
- B. Maintain on hand, at all times, sufficient keyway material, waterstops, and dowels for emergency use if a construction joint is required due to stoppage of concrete pour because of an emergency shutdown.
- C. Temporary stoppage of pouring concrete may result in a cold joint. Prior to resuming concrete placement on this plane, the surface shall be thoroughly cleaned of all laitance, loose or defective concrete, coatings, sand and other foreign material. The surface shall be prepared to a sufficient depth to expose sound concrete. Immediately prior to covering with fresh concrete the joint shall be wet sandblasted, washed with air-water jet and surface dried.

3.04 CONSTRUCTION JOINTS

- A. Prior to placing the abutting concrete, the contact surface shall be prepared according to this Section. The exposed portion of the reinforcing steel shall be cleaned of all concrete.
- B. Roughen the surface of the hardened concrete by one of the following methods:
 1. Sandblasting the foundation and reinforcing dowels after the concrete has fully cured to remove all laitance and spillage, and to expose sound aggregate.
 2. Water blasting the foundation and reinforcing dowels after the concrete has partially cured to remove all laitance and spillage, and to expose sound aggregate.
 3. In no case shall the roughening process cause microfractures on the treated surface.
- C. At least 2 hours must elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor or roof system and shall be placed monolithically therewith.
- D. Furnish key groove with key width one-third the thickness of the member in which the key is placed and a key depth of 1½-inch, unless otherwise indicated.
- E. Use tapered key groove forms, with taper being no greater than 2 inches per foot, to permit form removal without damage to groove after concrete has cured.
- F. Center waterstops in construction joints unless otherwise indicated.
- G. Secure waterstops in position by tie wire from loops to adjacent reinforcement every 12 inches along each edge both sides.
- H. Consolidate concrete during placement adjacent to key groove and around waterstop.
- I. Do not remove key groove forms until after concrete has been cured for 24 hours.
- J. Key groove forms left in place are not acceptable.
- K. Clean key groove of laitance, curing compound, foreign materials, protrusions of hardened concrete, roughen and blow out debris and dust with oil-free compressed air.
- L. Protect exposed key groove from damage.

3.05 EXPANSION JOINTS

- A. Provide expansion joints as indicated.
- B. Center waterstops in expansion joints unless otherwise indicated.
- C. Secure waterstops in position by tie wire form loops to adjacent reinforcement every 12 inches along each edge both sides.

- D. Consolidate concrete during placement adjacent to expansion joint and around waterstop.

3.06 POLYVINYLCHLORIDE WATERSTOPS

- A. Provide waterstops in continuous lengths to minimize field splices.
- B. Bending waterstops in forms is not permitted. Use factory-made and tested crosses, tees and ells at all corners and intersections where radius is less than 6 inches.
- C. Split waterstops are not permitted.
- D. Make all splices on a bench following manufacturer's splicing procedures and instructions.
- E. Maintain continuity through splice of characteristic features of waterstop cross-section, including ribs and center bulb.
- F. Remove looped steel wire along both edges of waterstop adjacent to saw-cut ends prior to splicing.
- G. Make splices by heat sealing adjacent surfaces using a thermostatically controlled electric heat source in accordance with manufacturer's printed instructions.
- H. Reform waterstop at splices using a remolding iron having pattern matching waterstop.
- I. After splice has cooled, spark test all splices in accordance with manufacturer's printed instructions. If splice shows any separation or lack of fusion reject the splice, recut back at least one inch from rejected splice each side, reweld and retest.
- J. Position and tie waterstop to form a continuous, watertight diaphragm in joint, to prevent leakage.
- K. Support and protect waterstop.
- L. Replace or repair, in accordance with manufacturer's printed instructions, damaged or punctured waterstop.
- M. Clean waterstop of curing compound, foreign materials, and protrusions of hardened concrete.
- N. Consolidate concrete during placement adjacent to waterstop.
- O. Maintain 2 inches minimum clearance between waterstop and reinforcement, and all embedded items.

3.07 PREMOLDED-JOINT FILLER

- A. Treat cut surface as recommended by manufacturer, when strips are cut.
- B. Place against the bulkhead form and fasten to the inside of the form with non-corrodible fasteners.
- C. Prevent disturbance of or damage to joint filler.
- D. Fill expansion joint completely.
- E. Secure wood strips to surfaces which are to receive joint compound.
- F. Use tapered wood strips with the smaller width being the same width as the expansion joint and of depth to install the joint compound and back-up materials as recommended by manufacturer.
- G. Use materials to secure joint filler and wood strips which will not harm concrete or affect the joint compound's bond to concrete.
- H. Do not remove wood strips until after the concrete curing period.
- I. Clean groove of laitance, curing compound, foreign materials, protrusions of hardened concrete; blow out dust with oil-free compressed air.

3.08 JOINT COMPOUND

- A. Seal, clean and dry concrete in accordance with manufacturer's printed instructions.

- B. Install back-up and bond breaker materials to prevent 3 sided bending.
- C. Prime concrete, fill flush with joint compound of required thickness, tool to concave joint and seal, all in accordance with the manufacturer's instructions, and ASTM C 962.
- D. Prevent spilling compound over adjoining surfaces. Use tape adjacent to joint if required. Remove all tape completely from concrete surface.
- E. Do not seal when compound, air, or concrete temperature is less than 40 F.

3.09 PREFORMED ELASTOMERIC JOINT SEAL

- A. Remove all joint fillers as recommended by manufacturer for installation of compression seal.
- B. Sandblast without damaging, the exposed joint faces until the surfaces are free of dust, dirt, curing compound, joint filler, and any other material that might prevent readily inserting and bonding of the joint seal to the concrete or stainless steel.
- C. Clean and dry expansion joints. The atmospheric and pavement temperatures must be above 40 F at the time of joint seal installation.
- D. After final cleaning and immediately prior to joint seal installation, blow-out the expansion joints with oil-free compressed air and leave completely free of sand and water.
- E. Lubricate and install the joint seal in accordance with the manufacturer's printed instructions.
- F. Install the joint seal in the upright position and free from twisting, distortion and stretching that exceeds 5 percent. Install the joint seal to a depth of 3/16-inch, $\pm 1/16$ -inch, from the finished surface.
- G. Make butt joints and intersecting splices with full contact. Use adhesive recommended by the seal manufacturer. Remove all dust, grease, or substances impeding the formation of the seal.
- H. When rain interrupts sealing operations, reclean and redry expansion joints prior to installing the joint seal.
- I. If joint seals in place fail to meet specified requirements remove them and install new seals at no additional cost to the Owner.

3.10 HYDROPHILIC WATERSTOP

- A. Use only where specifically shown in the Drawings or approved by the Engineer.
- B. Install in accordance with the manufacturer's written instructions.
- C. Locate the waterstop within the two curtains of vertical wall reinforcing bars as shown or provide a minimum of 2-1/2 inches of concrete cover over the waterstop.
- D. Apply adhesive to concrete surface and allow drying for specified time before applying waterstop strip.
- E. Butt ends of waterstop strip together at splices and corners and joins with sealant.
- F. For vertical and overhead applications, apply adhesive and secure waterstop with concrete nails as 12-inch maximum spacing.
- G. Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.

END OF SECTION 03 32 00

SECTION 03 34 00
CONTROLLED LOW STRENGTH MATERIAL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide Controlled Low Strength Material (CLSM or LSM), complete and in place, in accordance with the Contract Documents.
- B. CLSM shall be placed where indicated and may be used, if the Owner approves, for the following purposes:
 - 1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill and trench zone fill.
 - 2. Backfill CLSM shall be used adjacent to and above structures where structure backfill is indicated or in place of granular backfill at the Contractor's option. Additionally, Backfill CLSM shall be used for pipe abandonment and structure cavity fill.

1.02 CONTRACTOR SUBMITTALS

- A. Shop Drawings:
 - 1. CLSM mix designs which show the proportions and gradations of materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.
 - 2. If the Contractor proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33 - Concrete Aggregate, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to the Owner.
 - 3. The cost of batch laboratory tests on CLSM, and its components, shall be the Contractor's responsibility.

1.03 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Testing will be performed by a testing laboratory selected by the Owner at the Owner's expense, except as otherwise indicated.
- B. If tests of the CLSM show non-compliance with the specifications, the Contractor shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be the Contractor's responsibility.
- C. Correlation Tests:
 - 1. Contractor shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days after placing CLSM.
 - 2. Field correlation tests shall be performed in a test pit similar in cross section to the Work and at least 10-feet long at a location near the Work. The proposed location shall be acceptable to the Owner.
 - 3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. Tests shall be performed by a laboratory at the Contractor's expense.
 - 4. Testing shall be performed once every 2 hours during the first 8 hours, once every 8 hours during the first week, and once every 24 hours until the CLSM mix reaches the design strength.
 - a. Compression testing shall be in accordance with ASTM D 4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

- b. Setting test shall be in accordance with ASTM C 403 - Time of Setting of Concrete Mixtures by Penetration Resistance
- c. Density tests shall be in accordance with ASTM C 138 – Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.

PART 2 PRODUCTS

2.01 CONTROLLED LOW STRENGTH MATERIAL

- A. CLSM shall be a mixture of cement, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94 - Ready Mixed Concrete.
 - 1. For CSLM used as backfilling within the right of way, shall conform to the City of Cleveland CLSM requirements.
- B. Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.
 - 1. Mix proportions as necessary
 - 2. Entrained air content shall be between 0 percent minimum and 30 percent maximum.
 - 3. Water reducing agent content as necessary
- C. Properties:
 - 1. Normal CLSM density shall be between 120 PCF minimum and 145 PCF maximum.
 - 2. Backfill CLSM density shall be between 100 PCF minimum and 125 PCF maximum.
 - 3. Slump shall be as required by the Contractor's methods, but shall not promote segregation nor shall slump exceed 9 inches.
 - 4. Backfill CLSM used for pipe abandonment shall be highly flowable having a minimum 8 inch spread with no noticeable segregation when tested in accordance with ASTM D 6103.
- D. Compressive strength at 28 Days:
 - 1. Normal CLSM: Between 100 psi minimum and 300 psi maximum. Unless specifically indicated otherwise, CLSM shall be Normal CLSM.
 - 2. Backfill CLSM: Between 50 psi minimum and 150 psi maximum.

2.02 CEMENT

- A. Cement shall be Type I or Type II in accordance with ASTM C 150 - Portland Cement.

2.03 POZZOLAN

- A. Pozzolans are not permitted.

2.04 AGGREGATE

- A. Fine aggregate shall conform to ODOT Specification 703.03 Fine Aggregate for mortar or grout. The use of foundry sand or core sand is prohibited.

2.05 ADMIXTURES

- A. Air entraining admixtures shall be in accordance with ASTM C 260 - Air-Entraining Admixtures for Concrete.
- B. Water reducing admixtures shall be in accordance with ASTM C 494 - Chemical Admixtures for Concrete.

2.06 WATER

- A. Water shall be potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

PART 3 EXECUTION

3.01 PREPARATION

- A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 31 23 16 - Structural Excavation and Backfill.

3.02 BATCHING, MIXING AND DELIVERY

- A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to the OWNER and shall be delivered in standard transit mix trucks.

3.03 PLACEMENT

- A. CLSM shall be placed from a ready mix truck using conveyor belts, pumping equipment concrete chutes or other approved means. Placement of CLSM from a dump truck tailgate is not permitted. CLSM shall be directed in place by vibrator, shovel, or rod to fill crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.
- B. CLSM shall be continuously placed against fresh material unless otherwise approved by the OWNER or indicated in the Contract Documents. When new material is placed against existing CLSM, the placement area shall be free from loose and foreign material. The surface of the existing material shall be soaked a minimum of one hour before placement of fresh material but no standing water shall be allowed when placement begins.
- C. Temperature of the CLSM shall be between 50 and 90 degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.
- D. CLSM shall not be placed above the frost line, or closer than 3 feet from final grade unless otherwise shown on the drawings.
- E. CLSM shall not be placed in contact with aluminum pipe or fittings, or aluminum and aluminum-coated culverts.

3.04 FINISHING

- A. The finish surface shall be smooth and to the grade indicated or directed by the Owner.
- B. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

3.05 CURING

- A. CLSM shall be kept damp for a minimum of 7 days or until final backfill is placed.

3.06 PROTECTION

- A. CLSM shall be protected from freezing for 72 hours after placement.
- B. Apply no loads including fill and construction traffic loads to CLSM until it has gained sufficient strength to bear the load without loss of strength. As a minimum, apply no loads for a period of 48 hours following placement, or until ball drop tests conforming to ASTM D 6024 - Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application show an indentation of 3 inches or less, or until a compressive strength of 15 psi is demonstrated by testing acceptable to the Owner.
- C. CLSM shall be protected from running water, rain, and other damage until the material has been accepted and final fill completed.
- D. CLSM shall not be exposed to vehicular construction traffic other than the minimum necessary to cover with subbase or base material, temporary pavement, fill or the like.

END OF SECTION 03 34 00

SECTION 03 35 19 COLORED CONCRETE FINISHING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes construction of a decorative colored Portland cement concrete pavement, with or without reinforcement.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 03 11 00 - Concrete Forming
- C. Section 03 15 00 - Concrete Accessories
- D. Section 03 30 00 - Cast-in-Place Concrete
- E. Section 03 60 00 - Grouting

1.03 REFERENCE STANDARDS

- A. ACI 312.3R: Report on Chemical Admixtures for Concrete
- B. ACI 301: Specifications for Concrete Construction
- C. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete
- D. ACI 305R: Guide to Hot Weather Concreting
- E. ACI 306R: Guide to Cold Weather Concreting
- F. ACI 318: Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete
- G. ASTM C42: Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- H. ASTM C31/C31M: Standard Practice for Making and Curing Concrete Test Specimens in the Field
- I. ASTM C39/C39M: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
- J. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
- K. ASTM C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete
- L. ASTM C150/C150M: Standard Specification for Portland Cement
- M. ASTM C172/C172M: Standard Practice for Sampling Freshly Mixed Concrete
- N. ASTM C183: Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement
- O. ASTM C231: Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
- P. ASTM C260/C260M: Standard Specification for Air-Entraining Admixtures for Concrete
- Q. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- R. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete
- S. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
- T. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

- U. ASTM C989/C989M: Standard Specification for Slag Cement for Use in Concrete and Mortars
- V. ASTM D75 / D75M - 19 Standard Practice for Sampling Aggregates

1.04 REFERENCE SPECIFICATIONS

- A. The latest or current ACI Standards and Code Requirements for "Concrete and Reinforced Concrete" shall govern all concrete Work except where otherwise specified herein.
- B. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT).

1.05 TESTING AGENCY

- A. Inspections and tests required by this Section shall be performed by organizations acceptable to the Engineer.

1.06 CERTIFICATION

- A. Ensure that the Contractor has an ACI Certification for Flatwork Finishing and has Michigan Concrete Association (MCA) Decorative Concrete Certification, or proven equivalent manufacturer training and certification for placing decorative concrete.

1.07 SUBMITTALS

- A. Submit a plan showing types and locations of joints, reinforcement, and sequence of construction. Submit a report detailing the concrete mix designs to be used, including manufacturers and/or suppliers of mixture components.
- B. Concrete mixture designs and test data shall be submitted for review by the Engineer with a written request for approval. No concrete shall be placed until the Contractor has received such approval in writing.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

- A. The materials shall meet the requirements of ACI 301, ACI 318, and MDOT Specification, Division 9.
- B. Submit product data for proprietary materials and items, including admixtures, colorants, curing compounds, decorative concrete sealer, and others requested by the Engineer.
- C. Testing and inspection required due to substitution or change of materials requested by the Contractor shall be at the Contractor's expense.

2.02 CONCRETE COLORANT

- A. Use integral colorants from the following manufacturers or other sources as approved by the Engineer. Submit ASTM C979 test data to Engineer for all non-approved manufacturers.
 - 1. Decorative Concrete Resources: 989-792-9000
 - 2. Prism Pigments: 888-440-4250
 - 3. Brickform: 866-792-9009
 - 4. Vexcon Chemicals: 616-583-9767
- B. Concrete Integral Color: Pre-weighed and dry-packaged high-grade coloring pigment in either powder or granular form. Ensure materials comply with ASTM C 979 standards for integrally colored concrete.
- C. Use Prism Pigments: Ash Brown color at the rate of 22.56 lbs. per yard.

2.03 CURING COMPOUND

- A. Use transparent curing compound meeting subsection 903.05.B of the Standard Specifications for Construction. [ASTM C 309, Type 1 or 1D] Note: Standard curing compounds cannot be

used on colored or decorative concrete.

2.04 SURFACE SEALER

- A. Use a “crystal clear” Class A solvent acrylic decorative sealer from approved list below, or other as approved by the Engineer:
 - 1. Vexcon Chemicals:
 - a. AC 1315 solvent base sealer (with curing compounds)
 - b. Gloss Sealer FT solvent base sealer (without curing compounds)
 - 2. Brickform:
 - a. Gemseal GS-5

PART 3 EXECUTION

3.01 FIELD-CONSTRUCTED MOCK-UP

- A. Prior to installation of colored concrete paving work, construct sample panels in place to verify color and texture selections and processes for qualities of appearance, materials, and construction. Build mock-ups to comply with the following requirements:
 - 1. Size: Cast a minimum 8 foot by 8 foot mock-up to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
 - 2. Acceptance: If Engineer determines that mock-up does not meet requirements, demolish and remove it from the site, and cast another until the mock-up is accepted.
 - 3. Use: Keep accepted mock-up undisturbed during construction as a standard for comparison to completed paving. Undamaged mock-up may be incorporated into the Work or demolished and removed from the site when directed by the Engineer.

3.02 CONSTRUCTION

- A. Preparation: Carefully lay out the locations of forms and joints, taking into consideration the orientation of the pattern as shown on the Plans, intended aesthetics, and construction sequence.
- B. Integral Color: Comply with the color manufacturer's published recommendations and instructions for mix designs, admixtures, concrete temperature, mixing, installing, finishing, and curing. Coordinate colored concrete to ensure consistency in color, texture, and quality.
- C. Detailing: If slurry or dust is present near the joints from the joint sawing operation, a 4-inch grinder can be used to remove it.
- D. Sealing Decorative Surface: Approximately 24 hours after concrete placement is performed, seal the surface with approved sealer.

END OF SECTION 03 35 19

SECTION 03 41 00 PRECAST CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes precast structural concrete as indicated on the Plans complete with product design, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage and protection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 60 00 - Grouting

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO - American Association of State Highway and Transportation Officials
 - 2. ACI - American Concrete Institute
 - 3. AWS - American Welding Society
 - 4. ASTM - American Society for Testing and Materials
 - 5. PCI - Precast and Prestressed Concrete Institute

1.04 QUALIFICATIONS

- A. Manufacturer shall be a company specializing in providing precast concrete products and services normally associated with the industry for at least five (5) years. When requested by the Engineer, submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.
- B. Erector shall be regularly engaged for at least five (5) years in the erection of precast structural concrete similar to the requirements of this Project.
- C. Welders shall have qualified within the past year in accordance with AWS D1.1.

1.05 DESIGN CRITERIA

- A. Submit design calculations by a registered professional engineer, registered in the state where the Work is located, experienced in precast concrete design.
- B. Use in the design, applicable codes, ACI 318, or AASHTO Standard Specifications for Highway Bridges. Include in the design loads: all dead and live loads as indicated on the Plans, initial handling and erection stresses, and all other loads specified for members where they are applicable.
- C. Watertight Precast reinforced concrete structures shall be designed in accordance with ASTM C890, for A-16(HL-93) loading and installation conditions.

1.06 REFERENCE SPECIFICATIONS

- A. All local codes plus the following Specifications, standards and codes are a part of these Specifications:
 - 1. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 2. AWS D1.1 - Structural Welding Code.
 - 3. AWS D1.4 - Reinforcing Steel Welding Code.
 - 4. AASHTO Standard Specifications for Highway Bridges.

1.07 ALLOWABLE TOLERANCES

- A. Design deviations may be permitted only after the Engineer's review of the manufacturer's proposed design supported by complete design calculations and drawings.
- B. Provide an installation equivalent to the basic intent of the Work without incurring additional cost to the Owner.
 - 1. Length: +/- 1/8 inch per 10 feet (1 mm per meter), +/- 1/4 inch (5 mm) maximum
 - 2. Cross sectional dimensions:
 - a. Less than 24 inches (600 mm) +/- 1/4 inch, (5 mm) 24 to 36 inches (600 to 900 mm): +/- 3/8 inch (9 mm)
 - b. Over 36 inches (900 mm): +/- 1/2 inch (10 mm)
 - 3. Thickness: +/- 1/4 inch (5 mm)
 - 4. Position of anchors and inserts: +/- 1/2 inch (10 mm) of centerline location shown on the Plans.
 - 5. Horizontal alignment or sweep: 1/4 inch (5 mm) total or 1/8 inch per to-foot length (1 mm per meter), whichever is greater. Maximum of 1/2- inch (10 mm) gap between two (2) adjacent members due to sweep.
 - 6. End squareness: 3/8 inch (9 mm) maximum
 - 7. Blockouts: +/- 1/2 inch (10 mm) off centerline locations shown on the Plans.
 - 8. Out of square: 1/8 inch per six (6) feet (5 mm per 3 m) measured on the diagonal.
 - 9. Warpage, after installation: 1/8 inch per 6-foot (5mm per 3 m) length, or 3/8 inch (9 mm), whichever is greater.
- C. Vertical Alignment:
 - a. Bottom edges of members from line established at lower face: +/- 1/4 inch (5 mm).
 - b. Bottom surface from straight line between supports: 1/240 of clear span.

1.08 SOURCE QUALITY CONTROL

- A. Comply generally with applicable provisions of Prestressed Concrete Institute MNL-116, Manual for Quality Control for Plants and Production of Precast, Concrete Products.

1.09 SUBMITTALS

- A. The Contractor shall submit design calculations of products not completed and/or indicated on the Plans in accordance with the provisions of of this Section.
- B. Submit erection or production drawings showing:
 - 1. Drawings and/or elevations locating and defining all material furnished by manufacturer.
 - 2. Sections and details showing connections, cast-in items and their relation to the structure.
 - 3. Description of all loose, cast-in and field hardware.
 - 4. Field installed anchor location drawings.
 - 5. Erection sequences and handling requirements.
 - 6. Elevation view of each member.
 - 7. Sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, etc.
 - 8. Lifting and erection inserts.
 - 9. Dimensions and finishes.

10. Method of transportation.

- C. Submit test certificates identifying chemical and physical analysis of materials used for fabrication and physical analysis of the precast product.

1.10 DELIVERY AND HANDLING

- A. Perform transportation, site handling, and erection with acceptable equipment, methods, and by qualified personnel.

1.11 STORAGE

- A. Store all units off ground.
- B. Place stored units so that identification marks are easily discernible.
- C. Separate stacked members by battens across full width of each bearing point.
- D. Stack so that lifting devices are accessible and undamaged.
- E. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

1.12 SITE ACCESS

- A. Provide suitable access to the building and firm level bearing for the hauling and erection equipment to operate under its own power.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT

- A. Shall be Type I or Type III: ASTM C150.

2.02 AGGREGATES

- A. Lightweight aggregates for concrete: ASTM C330.
- B. Fine and coarse aggregate, other than lightweight aggregate: ASTM C33.

2.03 ADMIXTURES

- A. Air-entraining admixtures: ASTM C260.
- B. Water reducing, retarding, accelerating admixtures: ASTM C494.

2.04 WATER

- A. Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

2.05 REINFORCING STEEL

- A. Reinforcing bars and wire fabric: Per Section 03 21 00, Concrete Reinforcement.
- B. Strand Wire or low relaxation strands: Grade 270K, conforming to uncoated 7-wire stress-relieved strand for prestressed concrete: ASTM A416.

2.06 GROUT

- A. Grout: Per Section 03 61 00 - Mortar and Grout and complying with the following:
 - 1. Cement Grout: One (1) part Portland cement, 2-1/2 parts sand, sufficient water for placement and hydration.
 - 2. Nonshrink Grout: Premixed, packaged nonstaining, nonshrink grout.

2.07 BEARING PADS

- A. Use bearing pads of the type recommended by the manufacturer where indicated on the plans.

2.08 WELDED STUDS

- A. Shall be in accordance with AWS D 1.1.

2.09 CAULKING

- A. Shall be a nonstaining 1-part polymer acrylic base sealant.

2.10 CONCRETE MIXES

- A. Precast: The mixture and mixing of concrete shall be in accordance with ACI 304. The mixture shall produce concrete with the 28-day compressive strength no less than 5,000 psi (34.4 MPa)..

2.11 FABRICATION AND MANUFACTURE

- A. The fabrication and manufacture of precast products shall comply with the PCI Manual of Practice, and as specified herein.
- B. Provide for those openings ten (10) inches (250 mm) round or square or larger as shown on the Plans. Other openings may be located and field drilled or cut after the precast products have been erected. Openings shall be approved by the Engineer before drilling or cutting. No tension reinforcement shall be cut.
- C. Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.
- D. The manufacturer shall cast in structural inserts, bolts and plates as detailed or required by the Plans or shop drawings.
- E. No imperfections, honeycomb, or other defects shall be permitted. Provide smooth and dense surfaces, free of voids and projections.
- F. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the plans, and the specified design criteria.

2.12 ACCEPTABLE MANUFACTURERS

- A. Precast concrete decks shall be as manufactured by Price Brothers Company; Concrete Components, Inc.; Precast/Schokbeton; or equal.
- B. Precast concrete steps shall be as manufactured by Unit Step Company; Michigan Precast Concrete; or equal.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Examine the substrates and conditions under which the precast concrete is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.
- B. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.
- C. Shoring required for composite beams and slabs shall conform to all applicable building codes.

3.03 INSTALLATION - GENERAL

- A. Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector subcontracted by the Contractor. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

3.04 ALIGNMENT

- A. Members shall be properly aligned and leveled as required by the Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other

feasible method as recommended by the manufacturer and acceptable to the Engineer.

3.05 FIELD WELDING

- A. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

3.06 GROUTING AND CAULKING

- A. After installation of precast units are complete, joints shall be grouted and/or caulked as indicated on the Plans or determined by the Engineer. Joints shall be completely filled with grout. Any grout which seeps through joints shall be removed and surfaces cleaned before the grout hardens.
- B. Caulking shall be used at all underside joints between members and along bearing walls or beams. Concurrently with the caulking and grouting operation, any chipped or damaged sections or areas adjacent to openings or otherwise imperfect surfaces shall be carefully patched to match the precast surface.

3.07 ATTACHMENTS

- A. Subject to the approval of the Engineer, precast prestressed products may be drilled or shot, provided no contact is made with the prestressing steel.

3.08 FIELD QUALITY CONTROL

- A. Final inspection and acceptance of erected precast concrete shall be made by the Engineer to verify conformance with Plans and Specifications.

3.09 SCHEDULES

- A. Precast product quantity, location, surface finish and dimensions shall be as indicated on the Plans.

END OF SECTION 03 41 00

SECTION 03 41 33
PRECAST STRUCTURAL PRETENSIONED CONCRETE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes precast and precast prestressed structural concrete as indicated on the Plans complete with product design, manufacture, transportation, erection, and other related items such as anchorage, bearing pads, storage and protection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 03 15 00 - Concrete Accessories
- C. Section 03 20 00 - Concrete Reinforcing
- D. Section 04 05 11 - Mortaring and Grouting

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO LRFD: AASHTO LRFD Bridge Design Specifications
 - 2. ACI 304R Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 318: Building Code Requirements for Structural Concrete (ACI 318-19) Commentary on Building Code Requirements for Structural Concrete
 - 4. ASTM A416/A416M: Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete
 - 5. ASTM C33/C33M: Standard Specification for Concrete Aggregates
 - 6. ASTM C150/C150M: Standard Specification for Portland Cement
 - 7. ASTM C260/C260M:
 - 8. ASTM C330/C330M: Standard Specification for Lightweight Aggregates for Structural Concrete
 - 9. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete
 - 10. ASTM C913: Standard Specification for Precast Concrete Water and Wastewater Structures
 - 11. AWS D1.1/D1.1M: Structural Welding Code - Steel
 - 12. PCI MNL-117: Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
 - 13. PCI MNL-120: Design Handbook

1.04 QUALIFICATIONS

- A. Manufacturer shall be a company specializing in providing precast and/or precast prestressed concrete products and services normally associated with the industry for at least five (5) years. When requested by the Engineer, submit written evidence to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.
- B. Erector shall be regularly engaged for at least five (5) years in the erection of precast structural concrete similar to the requirements of this Project.
- C. Welders shall have qualified within the past year in accordance with AWS D1.1/D1.1M.

1.05 DESIGN CRITERIA

- A. Submit design calculations by a registered professional engineer, registered in the state where the Work is located, experienced in precast, prestressed concrete design.
- B. Use in the design applicable codes, ACI 318, or AASHTO LRFD.
- C. Include in the design loads: all dead and live loads as indicated on the Plans, initial handling and erection stresses, and all other loads specified for members where they are applicable.
- D. Watertight Precast reinforced concrete structures shall be designed in accordance with ASTM C890, for A-16 (HS20) loading and installation conditions.

1.06 ALLOWABLE TOLERANCES

- A. Design deviations may be permitted only after the Engineer's review of the manufacturer's proposed design supported by complete design calculations and drawings.
- B. Provide an installation equivalent to the basic intent of the Work without incurring additional cost to the Owner.
- C. Length: $\pm 1/8$ inch per 10 feet, $\pm 1/4$ inch maximum
- D. Cross sectional dimensions:
 - 1. Less than 24 inches: $\pm 1/4$ inch
 - 2. 24 - 36 inches: $\pm 3/8$ inch
 - 3. Over 36 inches 36 inches: $\pm 1/2$ inch
- E. Thickness: $\pm 1/4$ inch
- F. Position of anchors and inserts: $\pm 1/2$ inch of centerline location shown on the Plans.
- G. Horizontal alignment or sweep: $1/4$ inch total or $1/8$ inch per 10 feet, whichever is greater. Maximum of $1/2$ inch gap between two (2) adjacent members due to sweep.
- H. End squareness: $3/8$ inch maximum
- I. Blockouts: $\pm 1/2$ inch off centerline locations shown on the Plans.
- J. Out of square: $1/8$ inch per six (6) feet (5 mm per 3 m) measured on the diagonal.
- K. Warpage, after installation: $1/8$ inch per 6 feet length, or $3/8$ inch, whichever is greater.
- L. Vertical alignment:
 - 1. Bottom edges of members from line established at lower face: $\pm 1/4$ inch.
 - 2. Bottom surface from straight line between supports: $1/240$ of clear span.

1.07 SOURCE QUALITY CONTROL

- A. Comply generally with applicable provisions of PCI MNL-117.

1.08 SUBMITTALS

- A. Contractor shall submit design calculations of products not completed and/or indicated on the Plans in accordance with the provisions of this Section.
- B. Submit erection or production drawings showing:
 - 1. drawings and/or elevations locating and defining all material furnished by manufacturer.
 - 2. sections and details showing connections, cast-in items and their relation to the structure.
 - 3. description of all loose, cast-in and field hardware.
 - 4. field installed anchor location drawings.
 - 5. erection sequences and handling requirements.

6. elevation view of each member.
 7. sections and details to indicate quantities and position of reinforcing steel, anchors, inserts, etc.
 8. lifting and erection inserts.
 9. dimensions and finishes.
 10. prestress for strand and concrete strengths.
 11. estimated cambers.
 12. method of transportation.
- C. Submit test certificates identifying chemical and physical analysis of materials used for fabrication and physical analysis of the precast product.

1.09 DELIVERY AND HANDLING

- A. Perform transportation, site handling, and erection with acceptable equipment, methods, and by qualified personnel.

1.10 STORAGE

- A. Store all units off ground.
- B. Place stored units so that identification marks are easily discernible.
- C. Separate stacked members by battens across full width of each bearing point.
- D. Stack so that lifting devices are accessible and undamaged.
- E. Do not use upper member of stacked tier as storage area for shorter member or heavy equipment.

1.11 SITE ACCESS

- A. Provide suitable access to the building and firm level bearing for the hauling and erection equipment to operate under its own power.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT

- A. Shall be Type I or Type III: ASTM C150/C150M.

2.02 AGGREGATES

- A. Lightweight aggregates for concrete: ASTM C330/C330M.
- B. Fine and coarse aggregate, other than lightweight aggregate: ASTM C33/C33M.

2.03 ADMIXTURES

- A. Air-entraining admixtures: ASTM C260/C260M.
- B. Water reducing, retarding, accelerating admixtures: ASTM C494/C494M.

2.04 WATER

- A. Potable or free from foreign materials in amounts harmful to concrete and embedded steel.

2.05 REINFORCING STEEL

- A. Reinforcing bars and wire fabric: Per Section 03 20 00.
- B. Strand Wire or low relaxation strands: Grade 270K, conforming to uncoated 7-wire stress-relieved strand for prestressed concrete: ASTM A416/A416M.

2.06 GROUT

- A. Grout: Per Section 04 05 11, Mortaring and Grouting and complying with the following:
 - 1. Cement Grout: One (1) part Portland cement, 2-1/2 parts sand, sufficient water for placement and hydration.
 - 2. Nonshrink Grout: Premixed, packaged nonstaining, nonshrink grout.

2.07 BEARING PADS

- A. Use bearing pads of the type recommended by the manufacturer where indicated on the plans.

2.08 WELDED STUDS

- A. Shall be in accordance with AWS D1.1/D1.1M.

2.09 CAULKING

- A. Shall be a nonstaining 1-part polymer acrylic base sealant.

2.10 CONCRETE MIXES

- A. Precast, Prestressed
 - 1. The mixture and mixing of concrete shall be in accordance with ACI 304R. The mixture shall produce concrete with the 28-day compressive strength no less than 5,000 psi. The strength at initial prestress or form release shall be no less than 3,500 psi. Use of calcium chloride, chloride ions or other salts is not permitted.
- B. Precast
 - 1. Shall be the same requirements of precast, prestressed, except the mixture shall produce concrete with the 28-day compressive strength no less than 4,000 psi.

2.11 FABRICATION AND MANUFACTURE

- A. The fabrication and manufacture of precast and/or prestressed products shall comply with PCI MNL-117, and as specified herein.
- B. Provide for those openings 10 inch round or square or larger as shown on the Plans. Other openings may be located and field drilled or cut after the precast prestressed products have been erected. Openings shall be approved by the Engineer before drilling or cutting. No tension reinforcement shall be cut.
- C. Patching will be acceptable providing the structural adequacy of the product and the appearance are not impaired.
- D. Manufacturer shall cast in structural inserts, bolts and plates as detailed or required by the Plans or shop drawings.
- E. No imperfections, honeycomb, or other defects shall be permitted. Provide smooth and dense surfaces, free of voids and projections.
- F. Strands shall be recessed 1 inch and holes grouted. The ends of the member shall receive a smooth finish.
- G. Fabricate precast reinforced concrete structures in accordance with ASTM C913, to the dimensions indicated on the plans, and the specified design criteria.

2.12 ACCEPTABLE MANUFACTURERS

- A. Precast concrete decks shall be as manufactured by:
 - 1. Price Brothers Company Price Brothers Company;
 - 2. Concrete Components, Inc.
 - 3. Precast/Schokbeton

4. Engineer-approved equal.
- B. Precast concrete steps shall be as manufactured by:
 1. Unit Step Company
 2. Michigan Precast Concrete
 3. Engineer-approved equal.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Examine the substrates and conditions under which the precast concrete is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Providing true, level bearing surfaces on all field placed bearing walls and other field placed supporting members.
- B. Place and accurately align anchor bolts, plates or dowels in column footings, grade beams and other field placed supporting members.
- C. Shoring required for composite beams and slabs shall conform to all applicable building codes.

3.03 INSTALLATION - GENERAL

- A. Installation of precast prestressed concrete shall be performed by the manufacturer or a competent erector subcontracted by the Contractor. Members shall be lifted by means of suitable lifting devices at points provided by the manufacturer. Temporary shoring and bracing, if necessary, shall comply with manufacturer's recommendations.

3.04 ALIGNMENT

- A. Members shall be properly aligned and leveled as required by the Shop Drawings. Variations between adjacent members shall be reasonably leveled out by jacking, loading, or any other feasible method as recommended by the manufacturer and acceptable to the Engineer.

3.05 FIELD WELDING

- A. Field welding is to be done by qualified welders using equipment and materials compatible to the base material.

3.06 GROUTING AND CAULKING

- A. After installation of precast units are complete, joints shall be grouted and/or caulked as indicated on the Plans or determined by the Engineer. Joints shall be completely filled with grout. Any grout which seeps through joints shall be removed and surfaces cleaned before the grout hardens.
- B. Caulking shall be used at all underside joints between members and along bearing walls or beams. Concurrently with the caulking and grouting operation, any chipped or damaged sections or areas adjacent to openings or otherwise imperfect surfaces shall be carefully patched to match the precast surface.

3.07 ATTACHMENTS

- A. Subject to the approval of the Engineer, precast prestressed products may be drilled or shot, provided no contact is made with the prestressing steel.

3.08 FIELD QUALITY CONTROL

- A. Final inspection and acceptance of erected precast and precast prestressed concrete shall be made by the Engineer to verify conformance with Plans and Specifications.

3.09 SCHEDULES

- A. Precast product quantity, location, surface finish and dimensions shall be as indicated on the Plans.

END OF SECTION 03 41 33

SECTION 03 60 00 GROUTING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide grout, complete and in place, in accordance with the Contract Documents
- B. The following types of grout are covered in this Section:
 - 1. Cement Grout
 - 2. Non-Shrink Grout - Class I (cement-based)
 - 3. Non-Shrink Grout - Class II (cement-based)
 - 4. Non-Shrink Epoxy Grout
 - 5. Epoxy Anchor Grout for Post Installed Adhesive Anchors
 - 6. Topping Grout and Concrete/Grout Fill

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures
- B. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 318-19 - Building Code Requirements for Structural Concrete
 - 2. ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
 - 2. ASTM C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
 - 3. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - 4. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
 - 5. ASTM C580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, grouts, Monolithic Surfacing, and Polymer Concretes
 - 6. ASTM C648 - Standard Test Method for Breaking Strength of Ceramic Tile
 - 7. ASTM C695 - Standard Test Method for Compressive Strength of Carbon and Graphite
 - 8. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
 - 9. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 10. ASTM C882/C882M - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

11. ASTM C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
12. ASTM C1090 - Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
13. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
14. ASTM C1116/C1116M - Standard Specification for Fiber-Reinforced Concrete
15. ASTM C1339 - Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.04 SUBMITTALS

- A. Furnish the following submittals in accordance with Section 01 33 00:
 1. Certified testing lab reports for tests indicated herein.
 2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
 3. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.
 4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the Work, and location of use. The current ICC-ES or IAPMO-UES report shall be submitted for all epoxy anchor grouts for adhesive anchors.
 5. Manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 6. Submit manufacturer's written warranty as indicated herein.
 7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.05 QUALITY ASSURANCE

- A. Field Tests:
 1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the Owner. The specimens will be made by the Owner or its representative.
 2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C1107/C1107M at intervals during construction selected by the Owner. As a minimum, a set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
 3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 30 00, at intervals during construction selected by the Owner.
 4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579 at intervals during construction selected by the Owner. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
 5. The cost of laboratory tests on grout will be paid by the Owner except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the Work.

6. The Contractor shall assist the Owner in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.
- B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 30 00, unless indicated otherwise.
- C. Pre-Installation Demonstration and Training:
1. Cement and Epoxy-Based Non-Shrink Grouts:
 - a. The grout manufacturer shall give a demonstration and training session for the cement based non-shrink and epoxy grouts to be used on the project, before any installation of grout is allowed.
 - b. Training session shall use a minimum of 5 bags of cement-based non-shrink class I grout mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. Six cubes for testing at 1, 3, and 28 Days shall be made. The remaining grout shall be placed, and curing may be initiated on actual project placements such as baseplates and tie holes to provide on-the-job training for the Contractor and Owner. Contractor employees who will be doing the grouting shall participate in this training and demonstration session. The training session shall include methods for curing the grout.
 - c. The manufacturer shall mix enough cement-based non-shrink class II grout for a minimum of 15 tie holes and shall train the Contractor's employees in how to perform the Work and cure the grout. Contractor shall have the employees assisting in the mixing and sealing of the tie holes.
 - d. If the project includes patching, through bolt holes, epoxy anchors, and/or blockouts, the manufacturer shall also train the Contractor's employees in the mixing and curing of the epoxy grouts for each of these applications.
 - e. The Contractor shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the Owner.
 2. Epoxy Anchor Grout for Adhesive Anchors:
 - a. Special inspection for all adhesive anchor installations shall be provided:
 - 1) As recommended or required by the ICC-ES or IAPMO-UES report.
 - 2) As required by the enforceable building code.
 - 3) As otherwise indicated in the Contract Documents.
 - 4) The most stringent of the above requirements shall be used. The cost of special inspection of adhesive anchors shall be paid for by the Owner.
 - b. Before installing adhesive anchors in the Work, adhesive anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:
 - c. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading/torquing.
 - 1) Anchors installed in both the vertical and horizontal positions in a mock-up concrete panel of adequate size and thickness. Anchors shall be tested in tension. A minimum of 3 anchors shall be tested for each installation position.
 - 2) Anchors shall be tested at 2 times the published allowable tension load or 1-1/4 times the maximum design strength of the anchors in tension as indicated in the ICC-ES or IAPMO-UES report. The test load need not exceed 80 percent of the nominal yield strength of the anchor, based on steel strength, as determined by ACI 318-19 Chapter 17.

- 3) If any of the 3 test bolts in any installation position fail to reach the test loads, the installer shall be re-tested with the same procedure. Re-testing is required only for the failed installation position.
- 4) An installer who has 3 consecutive successful bolt tests in the first or second trial is considered qualified for adhesive anchor installation for this project. The manufacturer's representative shall issue a certificate to the qualified installer, and a copy of the certificate shall be filed with the Contractor and be submitted to the Owner.
- 5) The test anchor size shall be the largest size adhesive anchor used on the project. The anchor embedment length and edge distances shall be adequate to resist the test loads listed above.
- 6) Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.
- 7) The certification of each qualified installer shall be available for verification at the Special Inspector's request.
- 8) Defective anchors noted by the Special Inspector shall be replaced and re-installed by the Contractor without any additional compensation.

1.06 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty:

1. Furnish one-year warranty for Work provided under this Section.
 - a. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Application:

1. Unless indicated otherwise, grouts shall be provided as listed in below whether indicated on the Drawings or not.

Application	Type of Grout
Anchor bolts, anchor rods, and reinforcing steel required to be set in grout	Epoxy Anchor Grout
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink - Class I (Class II where placement time exceeds 20 min.)
Under precast concrete elements	Non-Shrink - Class II
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout
Toppings and concrete/grout fill greater than 3-inches thick	Structural Concrete per 03 31 00
Surface repairs unless indicated otherwise	Cement Grout
Surface repairs less than 4" in their least dimension	Non-Shrink Epoxy
Repair holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material	Non-Shrink - Class I
Repair of holes and defects in concrete members which are water bearing or in contact with soil or other fill materials	Non-Shrink - Class II

Any application not listed above, where grout is indicated	Non-Shrink - Class I, unless specifically indicated otherwise
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B. Cement Grout:

1. Cement grout shall be composed of one part of cement, 3 parts of sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland Cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4,000 psi.
2. Cement grout materials shall be as indicated in Section 03 30 00.

C. Non-Shrink Grouts (Cement-Based):

1. General:

- a. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
- b. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.
- c. Grout shall not contain chlorides or additives that may contribute to corrosion.
- d. Grout shall be formulated to be used at any consistency from fluid to plastic.
- e. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - 1) Minimum tensile splitting strength of 500 psi per ASTM C496.
 - 2) Minimum flexural strength of 1,000 psi per ASTM C580.
 - 3) Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C882/C882M.

2. Non-Shrink Grout – Class I:

- a. Non-Shrink Grout – Class I shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
- b. Non-Shrink Grout – Class I shall meet the requirements of ASTM C1107/C1107M, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
- c. Non-Shrink Grout – Class I shall have a maximum early age height change of 4.0 percent expansion and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M. The grout when tested shall not bleed or segregate at maximum allowed water.
- d. Non-Shrink Grout – Class I shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.
- e. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
- f. Non-Shrink Grout – Class I shall be Masterflow 713 Plus by BASF, Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, Duragrout by L&M Construction Chemicals; High-Flow Grout by Euclid Chemical Company, CG 200 PC by Hilti, or approved equal.

3. Non-Shrink Grout – Class II:

- a. Non-Shrink Grout – Class II shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at

a fluid consistency.

- b. Non-Shrink Grout – Class II shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M.
- c. Non-Shrink Grout – Class II shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C1090.
- d. Non-Shrink Grout – Class II shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827/C827M at temperature extremes of 45 to 90 degrees F in accordance with ASTM C1107.
- e. Non-Shrink Grout – Class II shall meet the requirements of ASTM C1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.
- f. The grout when tested shall not bleed or segregate at maximum allowed water content.
- g. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
- h. Non-Shrink Grout – Class II shall be Masterflow 928 by BASF, Five Star Fluid Grout 100 by Five Star Products, SikaGrout 212 by Sika Group, Crystex by L&M Construction Chemicals, or approved equal.

D. Non-Shrink Epoxy Grout:

- 1. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- 2. Epoxy grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C827/C827M , (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).
- 3. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested according to ASTM C531.
- 4. The epoxy grout shall develop a minimum compressive strength of 9,000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, Method B.
- 5. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
- 6. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C1339 for bearing area and flow.
- 7. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.
- 8. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
 - a. Minimum bond strength to concrete of 3,000 psi per ASTM C882/C882M, modified.
 - b. Minimum bond strength to steel of 1,700 psi per ASTM C882/C882M, modified.

- c. Minimum flexural strength of 2,500 psi per ASTM C580.
 - d. Minimum tensile strength of 2,000 psi per ASTM C307.
9. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Masterflow 648 CP Plus by BASF, Sikadur 42 Grout-Pak by Sika Corporation, or approved equal.
 10. Epoxy Anchor Grout
 11. Epoxy anchor grout for use in concrete shall be certified for use in accordance with ICC-ES AC 308.
 12. Epoxy anchor grout shall conform to ASTM C881/C881M, Type IV, Class B & C, Grade 3 with the exception of gel time.
 13. Heat deflection temperature per ASTM D648 shall be a minimum 120 degrees F.
 14. Manufacturer shall certify that the epoxy anchor grout will maintain 100 percent of its capacity up to a short-term temperature of 110 degrees F and 50 percent of its capacity up to a short-term temperature of 150 degrees F.
 15. Grout shall come in a two (2) chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
 16. Epoxy anchor grout shall be capable of being used in submerged applications once cured.
 17. Compressive strength per ASTM D695 shall be 10,000 psi minimum.
 18. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink grout and oversized holes.
 19. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar unless otherwise noted on the Contract Documents. Embedment shall not exceed 67 percent of the member depth.
 20. Epoxy anchor grout shall be PE1000+ by Powers Fasteners; HIT-RE 500-V3 by Hilti, SET-XP by Simpson Strong-Tie, or approved equal.
- E. Topping Grout and Concrete/Grout Fill:
1. Where fill thickness is 3-inches or greater, structural concrete, as indicated in Section 03 30 00, shall be used. Omit the coarse aggregate in topping grout used in clarifiers.
 2. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 30 00, shall apply unless indicated otherwise.
 3. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.
 4. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 inch	100
3/8 inch	90 - 100
No. 4	20 - 55
No. 8	5 - 30

No. 16	0 - 10
No. 30	0

5. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00, except that drying shrinkage tests are not required.
 6. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00 .
 7. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 5,000 psi.
 8. Topping grout used in clarifiers or where the fill thickness is 3 inches or greater shall contain synthetic fiber reinforcing, unless otherwise shown on the Contract Documents. Synthetic fiber reinforcing shall be in accordance with Section 03 30 00 and shall conform to ASTM C1116/C1116M , Type III.
- F. Curing Materials:
1. Curing materials shall be in accordance with Section 03 30 00, and as recommended by the manufacturer of prepackaged grouts.
- G. Consistency:
1. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.
 2. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.
- H. Measurement of Ingredients:
1. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.
 2. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the Owner.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the Work from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.02 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Grout shall be stored in accordance with manufacturer's recommendations.

3.03 GROUTING PROCEDURES

- A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the Owner, alternate grouting methods shall be submitted by the Contractor for acceptance by the Owner.
 - 3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.
- C. Drilled Anchors and Reinforcing Bars:
 - 1. General:
 - a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions and applicable ICC-ES or IAPMO-UES report requirements. Holes shall be drilled, brushed and cleaned in accordance with the manufacturer's instructions. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has cured for the full cure time indicated by the manufacturer and reached its indicated strength in accordance with the manufacturer's instructions.
 - b. Contractor shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the Owner if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
 - c. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
 - d. Core drilling of holes is not allowed.
 - e. Relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the Work and shall be provided at no additional cost to the Owner.
 - f. Abandoned drilled holes shall be filled with Epoxy Anchor Grout.
 - 2. Epoxy Adhesive Anchors:

- a. Grout shall be proportioned and mixed per the manufacturer's instructions.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
 - c. Holes shall be dry.
3. Cement Based Non-Shrink Grout used for Anchorage:
- a. In places of high temperature or fire hazard, anchor bolts and anchor rods shall be grouted in using cement based non-shrink grout, Class I.
 - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor bolt, anchor rod or reinforcing bar per the manufacturer's ICC-ES or IAPMO-UES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
 - c. When the anchor bolt or anchor rod diameter is one-inch or less, the hole diameter shall be a minimum of 2-inches. When the anchor bolt/rod diameter is greater than one-inch, the hole diameter shall be at least twice the anchor bolt/rod diameter.
 - d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
4. The non-shrink grout shall be placed in the holes in a non-sag (trowelable) consistency. The grout shall be placed in the holes before the anchor bolt/rod and then the anchor bolt/rod inserted and vibrated to ensure proper coverage.
- D. Topping Grout and Concrete/Grout Fill:
1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the Owner, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.
 2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
 3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) - Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
 4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the Owner, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.04 CONSOLIDATION

- A. Grout shall be placed in such a manner that the space to be grouted is completely filled.

3.05 CURING

- A. Cement-based grouts shall be cured per Section 03 30 00 and per the manufacturer's recommendations.

END OF SECTION 03 60 00

SECTION 07 92 00 JOINT SEALANTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Silicone joint sealants.
- B. Urethane joint sealants.

1.02 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.03 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two (2) 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Warranties: Sample of special warranties.

1.04 WARRANTY

- A. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.05 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

- A. **Compatibility:** Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. **Liquid-Applied Joint Sealants:** Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 1. **Suitability for Immersion in Liquids.** Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C1247. Liquid used for testing sealants is de-ionized water, unless otherwise indicated.
- C. **Stain-Test-Response Characteristics:** Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
- D. **Colors of Exposed Joint Sealants:** As selected by Engineer from manufacturer's full range.

2.02 SILICONE JOINT SEALANTS

- A. **Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant:** ASTM C920 , Type S, Grade NS, Class 25, for Use NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 799.
 - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000.
 - c. May National Associates, Inc.; Bondaflex Sil 200 GPN.
 - d. Polymeric Systems, Inc.; PSI-631.
 - e. Sika Corporation, Sikasil
 - f. Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus.
 - g. Tremco Incorporated; Tremsil 600.

2.03 URETHANE JOINT SEALANTS

- A. **Single-Component, Nonsag, Urethane Joint Sealant:** ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Pecora Corporation; Dynatrol I-XL.
 - c. Polymeric Systems, Inc.; Flexiprene 1000.
 - d. Sika Corporation, Sikaflex
 - e. Tremco Incorporated; Vulkem 116.

2.04 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330 , Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - 3. Remove laitance and form-release agents from concrete.

3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- D. Do not leave gaps between ends of sealant backings.
 - 1. Do not stretch, twist, puncture, or tear sealant backings.
 - 2. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.
 4. Provide flush joint profile where indicated per Figure 8B in ASTM C1193 .
 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C1193.

3.04 FIELD QUALITY CONTROL

- A. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between plant-precast architectural concrete paving units.
 - c. Joints between different materials listed above.
 2. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints between different materials listed above.

- e. Perimeter joints between materials listed above and frames of doors and louvers.
- f. Control and expansion joints in ceilings and other overhead surfaces.
- 2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 25.
- 3. Urethane Joint Sealant: Single component, nonsag, Class 25.
- 4. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - 2. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - 2. Vertical joints on exposed surfaces of interior unit masonry, concrete, walls and partitions.
 - a. Joints on underside of plant-precast structural concrete beams and planks.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors.
 - 3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

END OF SECTION 07 92 00

SECTION 08 31 13 ACCESS HATCHES

PART 1 GENERAL

1.01 SUMMARY OF WORK

- A. Access hatches shall be of single- or double-cover construction of the size and as shown on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 33 00 - Submittal Procedures

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Drawings for fabrication and installation of all floor, pit, and sidewalk doors and frames, including details of each frame type, elevations of door design types, anchorage, and accessory items.
 - 2. Product Data: Submit manufacturer's technical data and installation instructions for each type of access hatch assembly, including setting drawings, templates, and instructions and directions for installation of anchorage devices.
 - a. Include complete schedule including types, general locations, sizes, floor, pit, and sidewalk construction details, finishes, hardware information, latching or locking provisions, and other data pertinent to installation.
 - 3. Verification: Obtain specific locations and sizes for access hatches from trades and manufacturers requiring access to equipment, and indicate on Submittal Schedule.
 - 4. Special Size and Load Floor, Pit, and Sidewalk Doors: Use where required or requested as indicated on Drawing Schedule.
 - 5. Samples: 3 inches by 5 inches minimum size, of each cover face material showing factory finished color, pattern, and texture.
- B. Submittals Sequence: Submit Schedule, Product Data, and Shop Drawings at earliest possible date, particularly where acceptance must precede fabrication of other work (e.g., concrete work) which is critical in the Project Construction Schedule. Include the product data, samples, Shop Drawings of other work affected by access hatches, and other information essential to the coordinated review of same.

1.04 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide access hatches, frames, hardware, and related items produced by a single manufacturer capable of showing prior production of floor access hatches assemblies similar to those required.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of equipment, of types and sizes required, and whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Size Variations: Obtain Engineer's acceptance of manufacturer's standard size units which may vary slightly from sizes indicated.
- D. Coordination: Provide inserts and anchoring devices which must be built into other Work for installation of access hatches. Coordinate delivery with other Work to avoid delay.

1.05 PROJECT CONDITIONS

- A. Field Measurement: Where possible, field measure openings before fabrication to ensure proper fit of work; show measurements on final Shop Drawings. Coordinate fabrication with construction progress to avoid delay. If necessary, proceed with fabrication without

measurements, and coordinate tolerances to ensure proper fit.

1.06 WARRANTIES

- A. Special Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace components or entire units which fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to, structural failure including excessive deflection, excessive water leakage, faulty operation of hardware, deterioration of metals, metal finishes and other materials beyond normal weathering.
 - 1. Warranty period for access hatch units shall be 5 years after the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Bilco
 - 2. Halliday
 - 3. USF Fabrication

2.02 MATERIALS

- A. Provide each access hatch assembly manufactured as an integral unit, complete with all parts and ready for installation.
- B. Aluminum access hatches and frames: Fabricate units of continuous welded aluminum construction unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure frames to types of floor or walkway shown on Drawings.
- C. Covers: Covers shall be mill finish aluminum 1/4-inch diamond pattern, reinforced on the underside. Covers shall open to 90 degrees and lock automatically in that position.
- D. Channel Frame: Channel frame shall be 1/4-inch extruded aluminum with bituminous coating applied to the exterior of the frame and with full anchor flange and welded anchors for concrete installation around the perimeter.
- E. For watertightness, furnish frame with formed gutters a minimum of 3-inch wide by 3-inch deep, anchors, and a welded 1-1/2-inch drain coupling located on the right front corner of the channel frame or in another corner if shown on Drawings or specified otherwise. Fully weld gutter frame for absolute weathertightness.
- F. Hinges, Pins, Bolts, and Nuts: Provide the covers with heavy 12 gauge, No. 316 stainless steel hinges and stainless steel pins. Hinges shall pivot so the cover does not protrude into channel frame. Hinges shall be through-bolted to the cover with stainless steel lock bolts and shall be through-bolted to the frame with stainless steel bolts and lock nuts.
- G. Springs, Tubes, Shoes, Plates, Enclosures, and Operators: Provide the covers with manufacturer's standard springs, tubes and caps, tube or spring enclosures, operators, support plates, and shoes, which shall allow ease of operation through the entire 90-degree arc of opening, and act as a check in retarding downward motion when being closed. Tube and spring enclosures shall prevent accumulation of moisture, grit, and debris inside the tube and spring assembly.
- H. Hold-Open Arms: Provide the covers with hold-open arms with guides which automatically lock the covers in the open position. Vinyl covered release handles shall be provided and conveniently located for closing.
- I. Interior Snap Lock and Lock Strike: Provide a stainless steel snap lock and lock strike with a stainless steel fixed turn handle and appropriate stainless steel bolts mounted on the underside of the covers.

- J. Exterior Lift Handle: Provide the covers with a stainless steel lift handle designed to be flush with walking surface when not in use.
- K. Locking and Latching Devices: Provide the covers with the following locking or latching device and related hinged lid, flush gasketed removable screw plug, or threaded cover plug as noted:
- L. Interior access hatches shall have removable exterior latch handle with plug: Provide removable exterior stainless steel latch handle and latch release protected by a flush gasketed removable screw plug.
- M. Exterior access hatches shall have cylinder lock: Provide a brass cylinder lock with keyway protected by a threaded cover plug. Equip lock with cylinder and keys as specified.
- N. Hardware Finish: Except where noted otherwise, all hardware shall be zinc plated and chromate sealed.

2.03 ACCESSORIES

- A. Provide ladder safety posts at fixed ladders and manhole rungs located below access hatches. Safety posts shall be designed with telescoping section that locks automatically when fully extended. Up and down movement shall be controlled by a stainless steel spring balancing mechanism. Unit shall be completely assembled with fasteners for securing to ladder rungs in accordance with manufacturer's instructions. Finish to match ladder served.
 - 1. Safety post shall be Bilco Ladder Up, or approved equal.
- B. Provide fall prevention device below floor doors. The fall prevention device shall be permanently installed fall-through prevention system that is easily retractable for full access and allows visibility for inspection. The product must be FRP or stainless steel Type 316. Grating shall have a live load capacity of 100 pounds per square foot.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's instructions for installation of floor, pit, and sidewalk doors.
- B. Preparatory Work: For normal flush installation, set frames accurately in position, recessed below the finished grade or floor level with cover face panels plumb or level in relationship to adjacent finish surfaces. If unit is watertight type, unit should be set with slight pitch in direction of drain coupling. All four corners of the frame shall be in the same plane; verify that leaves are seated properly on frame all around. Securely attach units to supports.
- C. Method: For flush installation, pour concrete to top of frame. Aluminum surfaces in contact with concrete shall be coated with a bituminous coating prior to installation.
- D. Coordinate installation with Work of other trades.

3.02 ADJUSTING AND CLEANING

- A. Adjust hardware and covers after installation for proper operation.
- B. Remove and replace covers or frames which are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 31 09 13 GEOTECHNICAL INSTRUMENTATION AND MONITORING

GENERAL

1.01 SCOPE OF WORK

- A. The Work specified in this Section includes furnishing, delivering, installing, operating, monitoring, and removing geotechnical instrumentation to measure and monitor ground, structure, and tunnel lining movements within, around, and above open excavations, shafts, and tunnel excavations and to monitor groundwater levels as required under the Contract Documents. This work shall include the acquisition and monitoring of readings and measurements obtained from the geotechnical instrumentation.
- B. The Work includes, but is not limited to, drilling boreholes for instrumentation installation; furnishing, delivering, installing, operating, monitoring, maintaining, and abandoning surface settlement points, settlement monitoring markers, utility monitoring points, displacement monitoring points, standpipe piezometers, observation well piezometers, vibrating wire piezometers, inclinometers with or without spider magnets, borehole extensometers, and crack gauges; and furnishing, delivering, and operating associated geotechnical instrumentation equipment and software.
- C. Pre-construction and post-construction surveys, including photographs and videotapes, shall be performed in accordance with the requirements established elsewhere in the Contract Documents.
- D. Locations for the drilling and installation of instrumentation are shown on the Drawings and shall be coordinated with the drilling and installation of pumping wells and piezometers, earthwork operations, shaft and tunnel excavations, and open cut excavation.
- E. For instrumentation and monitoring associated with construction-induced ground vibrations refer to the requirements in Section 31 23 10 - Vibration and Noise Control.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 23 10 - Vibration and Noise Control

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A120 Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized Welded and Seamless, for Ordinary Uses)
 - 2. ASTM C778 Standard Specification for Standard Sand
 - 3. ASTM D1586 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

1.04 DEFINITIONS

- A. Surface Settlement Point (SSP): Instrument installed in a drilled borehole near the ground surface to monitor vertical ground deformations during construction. The end of the rod at depth bears on the soil. The end of the rod at the ground surface is monitored by optical survey methods.
- B. Settlement Monitoring Marker (SMM): SMM are control points as indicated on the Drawings and are used to determine settlement of pavement, concrete, or rigid material in relation to existing, pre-construction vertical elevations through vertical control survey.
- C. Displacement Monitoring Point (DMP): A control point consisting of an optical target, non-destructively and firmly attached or established on vertical and/or horizontal exterior surface(s) of a structure, used to monitor horizontal and vertical deformations and inclinations of structures.

- D. **Inclinometer (IS):** Inclinometer casing installed in a drilled hole. Inclinometers are used to monitor lateral movements in and around the ground using an inclinometer probe and readout unit. If indicated on the Drawings, spider magnets are attached to the inclinometer casing at defined elevations. Spider magnets are used to monitor for vertical deformations in relation to a datum ring magnet. The datum ring magnet is installed near the base of the inclinometer in stable ground as shown on the Drawings.
- E. **Groundwater Monitoring Point (GWMP):** A control point where an instrument is installed below the groundwater table at sufficient depth to detect variations in the groundwater level at specified locations. This includes but is not limited to:
 - 1. **Observation Well (OWPZ):** OWPZs are piezometers that shall consist of a slotted PVC well screen and a PVC riser pipe. The slotted well screen is installed in a sand filter at the base of the borehole. The top of the sensing zone is sealed with bentonite and the annulus around the riser pipe is filled with grout OWPZs are only where identified or agreed upon with the Owner in place of a VWPZ.
 - 2. **Vibrating Wire Piezometer (VWPZ):** VWPZs on this Project shall consist of multi-level pressure sensors capable of providing automatic, continuous measurement of groundwater levels with an electronic data logger. The VWPZs are fully encased in grout within the borehole.
- F. **Utility Monitoring Point (UMP):** An instrument used to monitor vertical movement (settlement or heave) of an existing underground utility
- G. **Borehole Extensometer (BX):** Device for monitoring the changing distance between subsurface anchor points in a borehole and a reference head at the borehole collar.
- H. **Optical Survey Target (OST):** An instrument consisting of a survey target device mounted on the surface of a structure to monitor horizontal, vertical and inclination movements during construction using an optical survey method and any other required supplemental method.
- I. **Review Level:** Value of instrumentation readings at which the Owner and Contractor jointly assess necessity of altering methods, rate or sequence of construction to control the effects of the construction.
- J. **Alert Level:** Value of instrumentation readings at which the Owner can order the Contractor to cease construction operations, make site and affected properties secure, and take necessary and agreed upon measures to mitigate unacceptable movements and to assure the safety of the work and the public.
- K. **Baseline Reading:** Value of instrumentation readings taken prior to construction to provide a consistent, repeatable (within a maximum deviation of 20% from their numerical average), established baseline against which all subsequent readings are compared.

1.05 SUBMITTALS

- A. **Qualifications:** Submit personnel qualifications in accordance with the requirements of this Section.
- B. **Shop Drawings:** Submit the Shop Drawings listed below, as prepared by qualified specialists submitted above.
 - 1. **Instrument Installation Schedule:** Submit the proposed schedule for installing instruments with reference to project construction activities, meeting the requirements specified herein or as approved by the Owner. Owner shall be informed 48 hours before installation operations commence for each instrument being installed.
 - 2. Drawings showing the details of proposed installation for each individual instrument type.
 - 3. Methods and equipment to be used for drilling and grouting, including manufacturer and model number of drill rigs, and method to be used for cleaning inside of casing or augers.
 - 4. Methods related to the installation and protection of all geotechnical instruments specified in this Section.

5. Method for overcoming buoyancy of instrumentation components during placement and grouting.
 6. Method of sealing joints in pipes and casings to prevent ingress of all fluids.
 7. Materials and mix portions for grout for installation of instruments.
 8. Method for conducting post-installation acceptance test.
 9. Following installation of the instruments, submit As-Built drawings showing the exact installed location, the instrument identification number, the instrument type, the installation date and time, the heading station, or portal or shaft excavation depth on the installation date, and the anchor, sensor or tip elevation and instrument length, when and where applicable. Include details of installed instruments, accessories and protective measures including all dimensions and materials used.
 10. Forms for reporting instrumentation data.
 11. Construction logs shall be in accordance with the requirements specified in this Section.
- C. Reports and Records: Provide reports of monitoring data to the Owner in accordance with the frequency and format requirements specified in this Section.
- D. Product Data and Samples
1. Submit all applicable manufacturer's literature describing the geotechnical instrumentation manufacturer's recommendations and instruction for installation, post-installation acceptance testing, monitoring, operation and maintenance procedures for the geotechnical instrumentation specified in this Section and as shown on the Drawings, including readout units, sensors, cables, micrometers, and probes. Provide manufacturer's brochures on each product and all related equipment and accessories.
 2. Certificates: For each instrument to be installed submit, as applicable, a certificate issued by the instrument's manufacturer stating that the manufacturer has inspected and tested each instrument before it leaves the factory to see that the instrument is working correctly and has no defects or missing parts.

1.06 QUALITY ASSURANCE

- A. Personnel Qualifications for Instrument Installation
1. Employ qualified technicians with a minimum of two (2) years' experience in the installation of geotechnical instrumentation similar to that specified herein. Written documentation of qualifications shall be submitted to the Owner before installation of instrumentation devices begins.
- B. Employ a registered Professional Engineer licensed in the State of Michigan, with a minimum of five (5) years' experience in the installation, maintenance, and interpretation of instrumentation specified herein, to supervise and direct technicians and be responsible for instrument installation and monitoring as required by the Drawings and Specifications. This person shall have experience on at least two prior projects similar in scope and size to this project. This person shall prepare and stamp instrumentation shop drawings and be physically present at the installation site(s) to directly supervise the installations.
1. Employ drillers for drilling instrumentation boreholes with a minimum of four (4) years of direct field experience in drilling boreholes.
- C. Installation of instrumentation shall, at all times, be performed in the presence of the Owner.
- D. Each instrument specified herein shall be the product of an acceptable manufacturer currently engaged in manufacturing geotechnical instrumentation hardware of the specified types.
- E. Surveyor Qualifications: Surveying for instrumentation installation and monitoring shall be performed by a registered Professional Surveyor licensed in the State of Michigan with at least five (5) years of previous experience surveying for the detection of structural and surface deformations.

- F. If utilizing any geotechnical instrumentation for monitoring within five (5) feet horizontally of existing underground utilities, vacuum excavation shall be performed prior to installation to excavate and clear utilities for the full instrumentation installation depth in soils. Vacuum excavation shall be performed by a Subcontractor with a minimum of five (5) years of experience in non-destructive vacuum excavation methods for utilities.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Follow all manufacturer's recommendations for storage and handling of geotechnical instrumentation supplies.

1.08 PROJECT/SITE CONDITIONS

- A. Secure applicable permits and secure written permission from property owners for access and installation of monitoring systems.
- B. Applicable ground conditions are described in the Geotechnical Baseline Report (GBR).
- C. Contractor will monitor the instruments.

1.09 TOLERANCES

- A. Tolerances specified herein may be modified by the Owner at any time, depending on location, construction progress, scheduling and efficiency of temporary Works, construction rates of movement, and other factors affecting of earth or structures that are subject to monitoring.
- B. Install instrumentation within five (5) feet of the horizontal locations shown on the Drawings unless otherwise approved by the Owner. Instrumentation for private residences to be coordinated with the Owner and approved in writing by property owners prior to installation.
- C. Install inclinometer (IS) casings, groundwater monitoring points (GWMP), surface settlement points (SSP), and settlement monitoring markers (SMM) within 0.50 feet of the vertical positions shown on the Drawings or as directed or approved by the Owner.
- D. Install inclinometer (IS) casings within 2 degrees of vertical for the entire length.
- E. Notify the Owner if actual field conditions prohibit installation at the location and elevations specified on the Drawings.
- F. Perform optical surveying to Third Order, Class 1 minimum accuracy.
- G. Establish the initial horizontal coordinates of each instrument installation to 0.10 feet accuracy.
- H. Establish the initial elevation of all instruments and their associated casings, probes, sensors, and reference heads/plates/magnets to 0.01 feet vertical accuracy.
- I. Survey, record, and report the subsequent elevations of all instruments to 0.01 feet vertical accuracy.

PRODUCTS

2.01 MATERIALS

- A. Surface Settlement Points (SSP):
 - 1. Surface settlement points shall consist of steel pipe casing of 2-1/2-inch outside diameter; 1-1/2-inch inside diameter black steel pipe conforming to ASTM A120, standard weight as shown on the Drawings; welded or threaded bottom steel tip; and steel pipe cap for read point. The combined length of the 1-1/2-inch black steel pipe and the bottom steel tip shall be 5 feet unless otherwise shown on the Drawings.
 - 2. Provide 18 x 18 x 5/16-inch steel plate with a central hole and steel pipe clamp to fit the 2-1/2-inch steel pipe casing. Steel plate and pipe clamp assembly shall be capable of transferring the total weight of the 2-1/2-inch pipe to the soil underlying the steel plate. The assembly shall also be capable of maintaining its position on the 1-1/2-inch steel pipe over time.

3. Sand, 6 inches thick shall fill the around the bottom of 2-1/2-inch steel pipe casing to the borehole wall. Grout shall fill the annular space above the sand up to the bottom of the steel plate. Prevent grout from entering the space between the pipe casing and the 1-1/2-inch pipe.
 4. Protect surface settlement points with 6-inch minimum dimension traffic rated cast iron valve box installed flush with the ground surface and extending at least 9-inches below grade. Provide locking iron cover and lifting rod or pull-up device for lifting top covers.
 5. Sand, 6 inches thick shall fill the hole from the base of the steel plate. Grout shall fill the space above the sand to the level of the ground surface.
- B. Settlement Monitoring Markers (SMM): Settlement monitoring markers shall be installed at the locations as directed by the Owner and as shown on the Drawings.
1. Settlement monitoring markers shall be 1/4-inch x 2-inch long masonry nail, as shown on the Drawings, or 3/8 inch x 5-1/8 inch long bolt equal to HAS Threaded Rods Super A193 B7 Steel with adhesive capsules equal to HVU (M10) manufactured by Hilti Fastening Systems, Tulsa, OK. SMM shall be installed with an identification tag as shown on the Drawings.
- C. Inclinerometers (IS):
1. Provide inclinometer casing, probe, cable, readout unit, spider magnets, and accessories as manufactured by Slope Indicator Company or Owner-approved equal.
 2. Inclinerometer casing shall be 2.75-inch outside diameter ABS or acceptable equivalent with broached internal keyways and twist tolerance better than 1-degree per 10-foot length. Couplings shall be of the flush-joint, non-telescoping type. Provide proper joint sealing associated with the selected type of casing such as solvent cement and tape or O-ring seals.
 3. Probe shall be a Slope Indicator Company Model 5032500 or Owner-approved equal. Probe shall be biaxial, consisting of two force balance accelerometers mounted at 90 degrees, with a 2-foot wheelbase. Probe shall be supplied in a carrying case.
 4. Cable shall be 100 feet long, sheathed with neoprene and have vulcanized rubber markers, and an internal wire rope core. Minimum cable outside diameter shall be 0.40 inches. Cable shall be supplied with Slope Indicator Company Model 50503100 slip-ring wheel or approved equal.
 5. Inclinerometer readout unit shall be a Slope Indicator Company "Digitilt DataMate" or Owner-approved equal. The time interval between recordings 2-feet apart in the casing shall be such that the reading stabilizes to within plus or minus 1 unit of display within eight seconds. Readout unit shall include a battery charger.
 6. Provide all necessary accessories for installation, monitoring, and maintenance. These accessories include, but are not limited to, end caps, tools and materials for attaching coupling and taking readings.
 7. Provide inclinometer software such as Slope Indicator Company "DigiPro for Windows" or Owner-approved equal.
 8. Factory calibrations of inclinometers shall include comprehensive calibrations of the force balance accelerometers before assemble in the probe. A final calibration shall include measurements made at 10 degree vertical intervals from minus 30 to plus 30 degrees with respect to vertical, and a comprehensive repeatability check over a smaller zone near vertical.
 9. Grout for inclinometer casings shall consist of Type II Portland cement, bentonite and water. The grout shall have approximately the same shear strength and compressibility as the surrounding ground.

10. Surface protection shall have a diameter adequate to follow attachment of cable support assembly, or shall allow for an inclinometer casing extension while readings are being taken. The length of the inclinometer casing extension shall not vary by more than 0.05-inch. Provide cap end consist of threaded pipe cap with hasp and padlock. Cap end shall be 3 inches above the inclinometer casing.
- D. Groundwater Monitoring Points (GWMP): Piezometers shall be installed as required by the groundwater control plan developed by the Contractor, in accordance with the requirements for Control of Ground Water and Surface Water established elsewhere in the Contract Documents, and as shown on the Drawings.
1. Observation Well (OWPZ)
 - a. OWPZ shall consist of 1-1/4-inch nominal diameter Schedule 40 PVC riser pipe with a vented cap attached to a slotted Schedule 40 PVC well screen. The well screen shall meet the following requirements:
 - 1) Length: 10 feet, unless otherwise noted and approved by Owner
 - 2) Slot width: 0.010 inch
 - 3) Number of rows of slots: 3
 - 4) Spacing between slots: 0.1875 inch
 - 5) Outside slot length: 1.375 inch
 - 6) Slots per row per foot: 61
 - 7) Riser pipe shall have flush joints.
 - b. Filter sand shall conform to ASTM C778, Standard Specification for Standard Sand, 20-30 sand.
 2. Provide a minimum 3-foot thick bentonite seal above the sand backfill using approved bentonite chips or pellets.
 - a. Granular bentonite shall be Enviroplug Medium, as manufactured by Wyo-Ben, Inc., Billings, Montana, or Holeplug 3/8-inch Grade, as manufactured by Baroid Industrial Drilling Products, Houston, Texas, or equal.
 - b. Water level indicator shall be an electrical indicator cable of appropriate length with graduations at 0.02 feet or smaller intervals. Provide two (2) indicators to enable independent readings by the Contractor and the Owner. Water level indicator shall be made by Slope Indicator or approved equal.
 - c. Provide low-shear-strength lean concrete with or without bentonite for backfill grout above the bentonite seal.
 - d. Vibrating Wire Piezometers (VWPZ): VWPZs shall provide fully automatic, continuous recording and reporting capabilities using a data logger, and are suitable for installation in a fully grouted borehole under the maximum possible water pressures anticipated for this project per the Geotechnical Baseline Report (GBR). The VWPZ shall meet the following requirements:
 - 1) Each VWPZ shall have the capability of installing and monitoring multiple sensors in the same borehole.
 - 2) Each VWPZ sensor shall be protected from damage during installation and grouting.
 - 3) VWPZ sensors shall be Slope Indicator Multi-Level Vibrating Wire Piezometer, Model 52611020, or Owner-approved an appropriate equivalent based on the anticipated installed ground water pressure range.
 - 4) VWPZ multi-level protective housing shall be Slope Indicator Model 52611100, or Owner-approved equivalent.

- 5) VWPZ signal cable shall be Slope Indicator Model 50613324, or Owner-approved equivalent.
- 6) Contractor to install VWPZ sensors on a vertical PVC pipe material recommended by the VWPZ manufacturer.
- 7) Contractor to supply and maintain one data recorder, along with all necessary accessories. VWPZ logger shall be Slope Indicator Model 52613500 or Owner-approved equal.
- 8) Contractor to supply, install, and maintain a cast iron or steel surface roadway box with locking cover at each well location.
- 9) Grout backfill for VWPZ to be made and placed per the VWPZ manufacturer's recommendations specific to the subsurface conditions at each VWPZ location based upon the logged soil boring conditions in the borehole and using the GBR for guidance as necessary.

E. Displacement Monitoring Points (DMP):

1. Each DMP shall be weather, water, dust, and UV resistant, proprietary brand of survey target suitable for use with the survey instrument proposed to achieve the specified movement measurements.
2. DMPs shall be a survey target for measurement of horizontal movement, vertical settlement, and tilt monitoring of structural elements, including but not limited to building walls, facades, columns, and pillars.
3. DMPs shall be the Rothbucher System Smart Target RS41 or Rothbucher System Smart Target RS40, or Owner-approved equal.

F. Utility Monitoring Points (UMPs):

1. Provide Schedule 40 PVC riser.
2. Provide fiberglass bar.
3. Provide epoxy mortar compatible with utility materials and borehole condition.
4. Provide traffic rated steel monument flush with surface.

G. Borehole Extensometers (BX):

1. Provide rod-type borehole extensometers (Geokon Model 1150 A-3 or similar) BX's with electrical transducers, mechanical and electrical readout devices, and all necessary accessories.
2. Extensometers rods shall be flush-coupled stainless steel encased in PVC pipe, or coiled fiber glass encased in plastic tubing. Anchors shall be the mechanical, packer, or grouted type and be Borros type hydraulic anchors (Geokon Model 1950 or similar) compatible with the anticipated soil types. Transducers shall be either DCDT (Geokon Model 1450 or similar) or linear potentiometer transducers (Geokon Model 1500 or similar), with minimum range of 6 inches for settlement and 2 inches for heave. The head shall include a method for backup mechanical reading concurrent with electrical readings and without disturbing electrical connections or transducers.
3. Provide cable from the same commercial source as the extensometers. Cable shall be as specified by the manufacturer of the instrument and shall be a shielded cable with a waterproof jackets.
4. Provide electrical readout and other terminal units, from the same commercial source as the extensometers. Readout devices shall consist of an electronic portable readout unit capable of measuring depths to anchor rods to an accuracy of ± 0.001 inch over a range of 8 inches.

5. Provide mechanical readout unit, with a calibration standard, from the same commercial source as the extensometers.
 6. Provide direct burial PVC jacketed-type cabling for remote readouts.
- H. Optical Survey Target (OST):
1. Each OST shall be weather, water, dust, and UV resistant, proprietary brand of survey target suitable for use with the survey instrument proposed to achieve the specified movement measurements.
 2. OSTs shall be a prism survey target for measurement of structural movements, such as GMP104 Mini Prism with L-bar by Leica or Owner-approved equal.

EXECUTION

3.01 GENERAL

- A. Instrumentation shall be installed in accordance with each respective manufacturer's recommendations at the locations shown on the Drawings, prior to start of any tunneling, shaft or open excavation construction (with the exception of instrumentation installed from inside tunnels and shafts) and as approved and directed by the Owner. Instruments shall be installed in accordance with the instrument installation schedule as required in this Section and be installed such that baseline readings are made as specified herein.
- B. Existing Conditions: Locate conduits and underground utilities in all areas where any subsurface instrumentation is to be drilled and installed. Notify all utility owners prior to instrumentation installation below ground surface. Locations of geotechnical instrumentation, described in this Section, shall be modified, as approved by the Owner, to avoid interference with the existing conduits and utilities. Repair damage to existing utilities resulting from instrument installations at no additional cost to the Owner.
- C. Instruments shall be clearly marked, labeled, and protected to avoid being covered, obstructed or otherwise damaged by construction operations or vandalized by the general public. Both protective housing and box or vault covers shall be marked.
- D. Surveying: Immediately following installation, the location of the top of all instruments shall be surveyed to provide horizontal and vertical coordinates.
- E. Drilling from the Ground Surface: Boreholes drilled from the ground surface for geotechnical instrumentation, described in this Section, shall be subject to the same permitting and drilling requirements as those for geotechnical exploration boreholes. Obtain necessary permits for each such instrument and conform to the permit requirements during drilling and installation.
- F. Where instrumentation is located within five (5) feet horizontally of existing underground utilities, vacuum excavation methods shall be used to excavate and clear utilities within the maximum anticipated depth below ground surface.

3.02 INSTALLATION SCHEDULE

- A. Install settlement monitoring markers, surface settlement points, displacement monitoring points, optical survey targets, and utility monitoring points a minimum of 15 days prior to start of excavation within 100 feet of the installation site.
- B. Install piezometers a minimum of 30 days in advance of start of dewatering and excavation operations near the installation site.
- C. Install inclinometers a minimum of 30 days prior to start of excavation near the installation sites.
- D. Install borehole extensometers a minimum of 30 days prior to a tunnel heading advancing to within 50 feet of the installation site.

3.03 INSTALLATION OF INSTRUMENTS

- A. Surface Settlement Points (SSP)

1. Surface settlement points shall be installed at locations as directed by the Owner and as shown on the Drawings.
- B. Surface Monitoring Markers (SMM)
1. SMM on Horizontal Surfaces: SMM will be located as shown on the Contract Drawings. After completion of installation, the As-Built location in horizontal position and elevation shall be within specified tolerances.
- C. Inclinerometers (IS)
1. Inclinerometers shall be installed at the locations and depths directed by the Owner and as shown on the Drawings.
 2. Install IS in accordance with the manufacturer's recommendations and per the Contract Drawings.
 3. Install surface protection as specified herein.
 4. A separate cap shall be installed on the IS casing below the protective housing or locking cap to prevent the entry of debris when not in use.
 5. A post-installation acceptance test overseen by the Professional Engineer responsible for the instrument installation shall be performed within 48 hours after installation to verify that there is no grout within the IS casing, that groove orientation and vertical tolerances are correct, and that the inclinometer probe tracks correctly in all four orientations. This information shall be submitted with the instrument installation record.
 6. After completion of installation, the as-built location in horizontal position shall be determined to an accuracy of ± 0.1 foot, and the elevation of the top of the inclinometer casing to an accuracy of ± 0.01 foot. The point selected to determine horizontal position shall be indicated on the installation record sheet.
- D. Groundwater Monitoring Points (GWMP)
1. Observation Wells Piezometers (OWPZ):
 - a. OWPZs shall be installed at the locations and depths required by the Contractor's groundwater control plan and as shown on the Drawings.
 - b. Each OWPZ shall be installed in a borehole that is drilled and logged in accordance with ASTM D1586.
 2. Bentonite drilling mud shall not be used in boreholes intended for piezometer installations.
 - a. A standard split spoon sample shall be taken at the top and bottom of the piezometer screened zone and submitted with its accompanying boring log to the Owner within 24 hours.
 - b. OWPZ screens shall be centered in the borehole and fully encased in sand.
 3. Depth to the top of each increment of granular bentonite shall be checked using a cylindrical sounding hammer. The granular bentonite shall not be tamped.
 - a. After completion of installation, a post-installation acceptance test shall be performed by conducting a falling head permeability test to verify seal integrity.
 4. Vibrating Wire Piezometers (VWPZ):
 5. VWPZs shall be installed at the locations and depths as shown on the Drawings and as approved by the Owner.
 - a. Each VWPZ shall be installed in a Borehole that is drilled and logged in accordance with ASTM D1586.
 - b. Bentonite drilling mud shall not be used in boreholes intended for piezometer installation

- c. VWPZs shall be installed within a fully grouted profile as required by the approved manufacturer and as shown on the Drawings.
 - d. VWPZ sensors shall be centered in the borehole and be fully encased in grout.
 - e. A standard split spoon sample shall be taken at the top and bottom of the piezometer sensing zone and submitted with its accompanying boring log to the Owner within 24 hours.
 - f. After completion of VWPZ installations within the vicinity of a secant pile shaft, a post-installation pumping test from within the shaft is required as specified elsewhere prior to shaft excavation. VWPZs shall be monitored continuously starting one (1) hour before and concluding twelve (12) hours after this test is performed.
 - g. The surface end of the wire lead from each VWPZ installed shall be clearly labeled with the instrument number and installation depth of the VWPZ it is connected to. These labels shall be durable and waterproof.
- E. Displacement Monitoring Points (DMP)
- 1. DMPs shall be installed at locations necessary to monitor for damage to structures, as directed by the Owner and as shown on the Drawings.
 - 2. DMPs shall be installed using a non-destructive, removable adhesive, per the manufacturer's requirements.
- F. Utility monitoring Points (UMP)
- 1. Utility monitoring points shall be installed at the locations directed by the Owner and as shown on the Drawings.
- G. Field locate utility identified for monitoring in the geotechnical instrumentation plans. Vacuum excavate or hand dig the UMP borehole to avoid damaging utilities. Contractor shall be responsible for any damage to the utility during installation.
- 1. Drill casing may be used during the installation. The rod with centralizers shall be installed into the borehole/excavation and placed in contact with the utility to be monitored before the PVC casing is installed into the borehole/excavation.
 - 2. The annular space between the PVC casing and the surrounding ground shall be backfilled with sand or bentonite chips/pellets.
 - 3. Centralizers shall be used between the PVC casing and the inner rod and shall be installed at the third points of the pipe length or every 5 feet, whichever is less.
 - 4. Bentonite slurry may be used to backfill the space between the PVC casing and inner rod to prevent debris from interfering with the free vertical movement of the inner rod.
 - 5. After completion of installation, the as-built location in horizontal position will be determined to an accuracy of ± 0.1 -foot and the elevation of the top of the utility to an accuracy of ± 0.01 -foot.
- H. Install protective housing consisting of flush-mounted roadway box so as not to obstruct vehicle or foot traffic and to permit a minimum 2 inches of clearance between the inner rod and the bottom of the cover.
- I. Borehole Extensometers (BX):
- 1. Shall be installed at the locations and elevations indicated within the Contract Drawings.
 - 2. Shall be installed per the manufacturer's recommendations and as detailed within the Contract Drawings.
 - 3. Initial measurements of each anchor and sensor in the installation shall be conducted within 48 hours of installation.
- J. Optical Survey Target (OST):

1. OSTs shall be installed at locations necessary to monitor for damage to structures, as directed by the Owner and as shown on the Drawings.
2. OSTs shall be installed using a non-destructive, removable adhesive per the OST manufacturer's requirement

3.04 BASELINE READINGS

- A. Baseline readings for all geotechnical instrumentation requiring surveying shall be taken by a registered Professional Surveyor licensed in the State of Michigan. Baseline readings shall be submitted to the Owner for review and acceptance by the Owner prior to the start of construction operations or continuation of construction, as applicable.
- B. Baseline readings for settlement monitoring markers, surface settlement points, optical survey targets, and displacement monitoring points consist of two consistent sets of readings made on separate days, within 10 days of installation. Readings are considered consistent when they are within applicable survey tolerances.
- C. Baseline readings for utility monitoring points consist of the average of three (3) readings with 24 hours minimum between readings, within 10 days of installation.
- D. Baseline readings for GWMPs consist of readings taken for at least 30 days prior to dewatering and excavation activities. Baseline readings shall also be taken for existing piezometers at each construction site.
 1. OWPZs: After the complete installation and development of all OWPZs, record the groundwater levels at each well at least once a day, or as required by the Owner. The average reading of each well shall be derived from the readings taken during the period before dewatering and excavation activities. The average groundwater elevation at each well, excluding readings during heavy rain events, shall be considered the well's "Baseline Groundwater Level."
 2. VWPZs: After the complete installation of all VWPZs take and record the groundwater levels at each well continuously, or as required by the Owner. The average reading of each well shall be derived from the readings taken during the minimum 45 day period before dewatering and excavation activities. The average groundwater elevation at each well, excluding readings during heavy rain events, shall be considered the well's "Baseline Groundwater Level."
- E. Baseline readings for inclinometers shall consist of a minimum of three readings taken within a two-week period on three separate days, up to 30 days after installation, but before shaft development, within a maximum deviation of 20% from their numerical average.
- F. Any construction activities that have affected the performance of monitoring devices prior to the start of excavations shall be immediately reported to the Owner. Replacement and/or base-lining shall be conducted at the direction and to the satisfaction of the Owner.

3.05 MONITORING FREQUENCY

- A. Minimum monitoring frequencies for the specified monitoring points shall follow the requirements herein and are in addition to the base-lining requirements of this Section.
- B. For SMMs, SSPs, UMPs, OSTs, and DMPs monitor as follows:
 1. After instrument baselining, read instruments monthly until one month prior to commencement of subsurface work within 100-feet of the instrument.
 2. One month prior to the commencement of dewatering, excavation, begin reading instruments weekly.
 3. Daily for one week prior to dewatering and excavation activities taking place within 100-feet of instruments.
 4. Once per shift when dewatering and excavation activities are within 100-feet of instruments.

5. At least weekly until final structure is completed and excavation is backfilled.
 6. Re-read any instrument showing anomalous or inconsistent readings within 24 hours.
 7. Increase reading frequency at Owner's direction on any instrument showing movement trends approaching review and alert levels at no additional cost to the Owner.
- C. For GWMPs, monitor as follows:
1. OWPZs
 - a. Daily for one week prior to start of dewatering and excavation activities at any site.
 - b. Daily when groundwater control system is in operation at any site.
 - c. Daily during excavation activities at any site.
 - d. Monitor more frequently when directed by the Owner.
 - e. Monitor existing piezometers in addition to Contractor installed piezometers.
 2. VWPZs
 - a. Continuous recording and daily data reporting from one week prior to start of dewatering and excavation activities at any site.
 - b. Continuous recording and daily data reporting through completion of de-watering and backfilling of excavations.
 - c. Monitor during shaft pumping test as previously specified in this Section.
 - d. Monitor more frequently when directed by the Owner.
 - e. Monitor existing piezometers in addition to Contractor installed piezometers.
- D. For inclinometers (IS), monitor as follows:
1. Daily starting one week in advance of the start of any excavation.
 2. Daily upon start excavation activities and extending until the end of each excavation.
 3. Re-read any instrument showing anomalous or inconsistent readings within 24 hours.
 4. Weekly until the final structures are completed and backfilled or until directed by the Owner to end monitoring.
- E. For Borehole Extensometers (BX), monitor as follows:
1. For tunnel excavations, measure anchor displacements and piezometers hourly starting at least 1 month prior to the tunnel face reaching the instrument
 2. Read the instrument every 6 minutes when the tunnel excavation face is between 250 feet of the instrument. If the instrument is located within 250 feet of a shaft, commence continuous readings 4 hours prior to MTBM launch.
 3. Once the distance between the instrument and the active tunnel excavation face is greater than 250 feet, commence readings hourly minutes for at least 2 months after the end of the TBM shield has passed the instrument.
 4. Read instruments daily thereafter until completion of the Work or as directed by the Owner.
 5. Measure surface monitoring point associated with extensometer as described herein.

3.06 REVIEW AND ALERT LEVELS

- A. Review and Alert Levels on this Project are defined by a two-tier process for each monitoring point and are established as an initial basis for eliminating or minimizing potential disturbances or damages to adjacent structures, buildings, utilities, roadways, and other facilities.

- B. Review and Alert levels specified herein can be adjusted at the request of the Contractor but subject to the written approval of the Owner as construction progress, actual field conditions and observed data trends warrant.
- C. Regardless of the specified instrumentation and the measured quantities in reference to the established Review and Alert Levels, the Contractor shall take immediate actions should observed ground or structural deformation of any kind in reaction to the related construction activities, regardless of its magnitude, be deemed by the Contractor or the Owner to cause an unsafe condition.
- D. Review Level and Alert Level
 - 1. Review Level – When the monitoring data at any monitoring point indicate that the differential readings (from the baseline) are closely approaching or equal to the Review Levels specified herein, the Review Level is said to have been reached. At this time, the Contractor shall review the construction operations and keep a more active review of the trend of the monitored movement and increase the frequency of monitoring as deemed necessary or as directed by the Owner. Contractor shall provide measures to improve the construction operations to limit further increases in the differential readings and provide justification for any operational deviations from the approved submittals.
 - 2. Alert Level – When the monitoring data at any monitoring point indicate that the differential readings (from the baseline) are closely approaching or equal to 100% of the Alert Levels specified herein, the Alert Level is said to have been reached. At this time, the Contractor shall issue a stop work order to cease all related construction activities and protect all structures against potential damages. Contractor shall investigate and correct the excessive movement before work can be resumed. Contractor shall submit in writing results of the investigation and what additional mitigation measures are to be implemented. Contractor shall install and monitor additional monitoring points as deemed necessary or as directed by the Owner.
- E. Immediately inform the Owner when the following Review and Alert Levels are reached:
 - 1. SMMs and SSPs:
 - a. Review Level: 0.50 in. (vertical)
 - b. Alert Level: 1.00 in. (vertical)
 - 2. OSTs and DMPs:
 - a. Horizontal (in- and out-of-plane) and Vertical:
 - 1) Review Level: 0.125 in.
 - 2) Alert Level: 0.250 in.
 - b. Angular Distortion:
 - 1) Review Level: 0.0012
 - 2) Alert Level: 0.0020
 - 3. GWMPs (OWPZs, VWPZs):
 - a. Review Level: Water level less than 24 inches below base of excavation. Water level six (6) inches above top of impermeable layer.
 - b. Alert Level: Water level less than 12 inches below base of excavation. Water level more than 12 inches above top of impermeable layer.
 - 4. UMPs:
 - a. Review Level: 0.50 in. (vertical)
 - b. Alert Level: 0.75 in. (vertical).
 - 5. Inclinometers (IS):

- a. Horizontal and Vertical:
 - 1) Review Level: 1.00 in.
 - 2) Alert Level: 2.00 in.
- b. Vertical:
 - 1) Review Level: 0.30 in.
 - 2) Alert Level: 0.50 in.
- c. Angular Distortion:
 - 1) Review Level: 0.0012
 - 2) Alert Level: 0.0020
- 6. Borehole Extensometers (BX):
 - a. Review Level: 0.50 in
 - b. Alert Level: 0.75 in
- 7. At the E-13A project site, immediately inform both the Owner and CEI when any of the above Review and Alert Levels are reached.
- F. Response to Public Comments and Observations
 - 1. Upon receiving comments or observations from the public to the Owner, in any format regarding defects or other impact related to construction induced ground movement, groundwater levels, vibrations or structural damages, the Contractor shall provide a report immediately to the Owner.
 - 2. Contractor shall proceed immediately to measure, quantify, monitor, or correct the observed defects reported by the public, as deemed necessary, or at the direction of the , Owner to protect the public.
 - 3. Contractor shall not respond directly to public concerns regarding the work and shall forward all public concerns/comments to the Owner for response.

3.07 REPORTING FREQUENCY AND FORMAT

- A. Submit three (3) copies of the instrument monitoring reading data to the Owner, on forms approved by the Owner within 24 hours after the observation readings are made.
- B. Submit reduced data and updated data plots of reading results within two (2) working days after observation readings are made. Data is to be submitted in an electronic format that can be manipulated acceptable to the Owner.
- C. The monitoring records shall be presented in both data table format and cumulative time history trend plots. The records shall be submitted in an electronic format acceptable to the Owner. Sample data presentation formats for each monitoring device shall be submitted to the Owner for review. The monitoring record in both data table and graphs form shall clearly report the following:
 - 1. Locations and identification of the monitoring devices.
 - 2. Labor and equipment used to take readings.
 - 3. Data and time readings and personnel who conducted the monitoring.
 - 4. Conditions under which the readings are taken including progress of construction activities, weather conditions including temperature and rainfall, and note any potential factors that may have affected the readings.
 - 5. Instrument readings, both absolute and differential values from the corresponding baseline readings, and the Review and Alert Levels specified herein. Plots shall be differentiated using a combination of varying line types, data point symbols, or colored

lines.

- D. Contractor's registered Professional Engineer in charge of geotechnical instrumentation and monitoring shall make his/her own interpretation of the monitoring data. Contractor shall inform the Owner immediately if the Review and Alert Levels specified herein are being closely approached or have been reached or exceeded. Data or interpretations shall not be published or disclosed to parties other than the Owner without prior written permission of the Owner.

3.08 INSTRUMENT PROTECTION, MAINTENANCE, AND REPAIR

- A. Protect the instruments from damage. Damaged instruments shall be replaced or repaired, and rebaselined prior to continuing work, or as required by the Owner at no additional cost to Owner. Reinstalled instruments shall be assigned movement associated with previous instrument and shall not be zeroed out.
- B. Maintain the instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed at all times.

3.09 DISPOSITION OF INSTRUMENTS

- A. Settlement Monitoring Markers, Surface Settlement Points, Displacement Monitoring Points, and Utility Monitoring Points:
 - 1. All settlement and displacement monitoring instruments on public property shall remain in-place at the completion of the Contract.
 - 2. Remove all settlement and displacement monitoring instruments on private property during the cleanup and restoration Work, or as required by the Owner. Fill open holes with cement grout and provide notice of completion to the Owner.
 - 3. Conform to the requirements for Well and Installation Abandonment established elsewhere in the Contract Documents for grouting.
 - 4. Restore pavement, sidewalks, and landscaped areas in kind or better than existing adjacent conditions.
- B. Inclined meters and borehole extensometers:
 - 1. Casings and associated protective vaults, sensors, and wires shall be removed within two feet below ground surface at the completion of the Contract. Fill open holes with cement grout using a tremie method.
 - 2. Conform to the requirements for Well and Installation Abandonment established elsewhere in the Contract Documents for grouting.
 - 3. Restore pavement, sidewalks, and landscaped areas in kind or better than existing adjacent conditions.
- C. Piezometers
 - 1. OWPZs and associated protective vaults shall be removed within two feet below ground surface at the completion of the Contract. Fill open holes with cement grout.
 - 2. Conform to the requirements for Well and Installation Abandonment established elsewhere in the Contract Documents for grouting.
 - 3. Restore pavement, sidewalks, and landscaped areas in kind or better than existing adjacent conditions.

END OF SECTION 31 09 13

SECTION 31 10 00 SITE PREPARATION

GENERAL

1.01 SCOPE OF WORK

- A. Section includes:
 - 1. Protection of existing fences, infrastructure, and associated improvements, streets and utilities within and near construction areas from damage due to boulders, trees, or other objects dislodged during the construction process.
 - 2. Labor, equipment, and materials necessary for existing tree relocation, protection and trimming.
 - 3. Providing temporary stabilized crushed rock for staging/laydown in accordance with the Contract Documents.
 - 4. All clearing and grubbing work indicated on the Drawings and as required, complete with cutting and removal of trees, shrubs, vegetation, stumps, logs, brush, roots and undergrowth, and disposal of materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 32 13 - Construction and Schedule Constraints
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 57 13 - Temporary Erosion and Sediment Control

1.03 REFERENCE STANDARDS

- A. Except as specifically modified in this specification, paving and surfacing operations and materials shall comply with City of Cleveland standards, and applicable sections of the 2013 Ohio Department of Transportation (ODOT) Construction and Material Specifications, including current revisions thereto.
 - 1. Item 203 - Roadway Excavation and Embankment
 - 2. Item 304 - Aggregate Base
- B. Code of Standards of the American Association of Nurserymen and the American Standard for Nursery Stock and Tree Care Association Standards for Pruning and Guying of Shade Trees.

1.04 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials

1.05 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Name and location of plant providing aggregate.
- C. Type and composition of proposed materials, including aggregate gradation.
- D. Certificates of Compliance certifying compliance with the referenced specifications and standards.
- E. Submit documentation, if applicable, of permission from property owners, of any timber removal or salvaged timber with work occurring outside of property or right-of-way limits.
- F. Chain Link Protection Fencing: Submit proposed methods and sequence of site preparation to the Owner for review prior to start of Work.
- G. Copy of Arborist's certification.

PRODUCTS

2.01 MATERIALS

- A. Aggregate for Stabilized Staging/Laydown:
 - 1. Aggregate stabilized staging/laydown area base shall be in conformance with Item 304 of the referenced ODOT specifications and AASHTO No. 1, 2, and 57 stone/rock as referenced on the Drawings.

EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Contractor is responsible to provide equipment, workmanship, and materials required to achieve a finished product which meets these specifications for the stabilized staging/laydown area.
 - 2. Do not place aggregates on frozen subgrade or when air temperature is below 35°F.
 - 3. Do not place aggregate materials when natural light is not sufficient to properly observe work on operations.
 - 4. Do not place paving and surfacing material before subgrade is reviewed and accepted by the Owner. Do not place paving and surfacing materials on a frozen or muddy subgrade.
 - 5. Provide adequate drainage at all times to prevent water from standing on subgrade.
- B. Cleaning:
- C. Clean Site of rubbish, excess material, structures, and equipment. Restore damaged property.
- D. Overexcavation, Regrading, and Backfill Under Fill Areas:
 - 1. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level of 1-foot below the existing ground contours shall be backfilled.
- E. Soil Erosion and Sedimentation Control:
 - 1. 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 Drawings or as determined by Owner.
 - 2. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in waterways downstream of the Work.
 - 3. The measures should include provisions to reduce erosion by the wind of all areas stripped of vegetation, including material stockpiles.
 - 4. Comply with requirements of Section 01 57 13 - Temporary Erosion and Sediment Control.
- F. Seasonal Constraints:
 - 1. No tree or shrub removal can take place between the dates listed in Section 01 32 13 - Construction and Schedule Constraints, unless coordination and approval is given through by the Owner.
- G. Clearing:
 - 1. Trees, stumps, brush, hedges, and other vegetation occurring within the Contract limits, as defined on the Drawings or as directed by Owner, shall be cut off flush with the ground

and shall be completely removed.

2. Use every precaution to prevent damage to and provide protection as necessary of existing plant material. Repair or replace to original condition, as acceptable to the Owner and at no additional cost to the Owner, any material or Work damaged or destroyed while performing Work.
3. Vegetation protection fencing shown on Drawings are minimum required for Work. Contractor shall be responsible for providing additional temporary fencing during the Work as necessary to protect vegetation.
4. Flagging of Existing Trees: Flag trees to remain and to be removed with a bright and different colored ribbon. Notify the Owner at least 48 hours prior to commencing of Work to verify all trees that are flagged.
5. Do not park any vehicles or equipment, nor store any materials or stockpiled soil, nor dispose of building materials, chemicals, petroleum products or other detrimental substances within drip line of tree. Protect trees from flame, smoke and heat. Construction access to Site shall not occur beneath drip line of trees.

H. Clearing and Grubbing:

1. Trees, stumps, brush, shrubs, hedges, roots, corduroy, logs, matted roots, other vegetation and debris occurring within the Contract limits as defined on the Drawings or as directed by Owner, shall be completely removed. Depth of removal shall be in accordance with paragraphs 3.01.H thru 3.01.L of this Section.

I. Selective Clearing:

1. Selective clearing shall consist of removing and disposing of dead, diseased, poorly formed, or otherwise undesirable trees, undergrowth, stumps, uprooted trees and debris. The trees to be removed will be marked and the area where the undergrowth is to be removed will be indicated on the Drawings or designated by Owner.
2. Selective Clearing, Type I:
 - a. Trees and stumps shall be cut off at an elevation not more than four (4) inches (100 mm) above the existing ground level.
3. Selective Clearing, Type II:
 - a. Trees and stumps shall be chipped or ground down to an elevation approximately four (4) inches (100 mm) below proposed ground level.

J. Depth of Removal in Excavation Area:

1. For excavation areas within roadways, parking lots, and other paved areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the subgrade elevation.
2. In all other excavation areas, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the finish surface elevation, or as indicated on the Drawings or as designated by Owner.

K. Depth of Removal in Embankment Areas:

1. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is five (5) feet (1.5 m) or less in height above the existing ground, the trees, stumps, and roots shall be removed to a depth of not less than 12 inches (300 mm) below the existing ground.
2. Within embankment areas for roadways, parking lots, and other paved areas where the top of road material is more than five (5) feet (1.5 m) in height above existing ground, the trees and stumps shall be cut off flush with the existing ground surface.

3. For embankment areas other than roadways, parking lots, and other paved areas, the trees and stumps shall be cut off flush with the existing ground surface, or as indicated on the Drawings or as designated by Owner.
- L. Removal of Trees, Stumps, and Other Vegetation:
1. Where trees cannot be felled without danger to traffic or injury to other trees, structures or property, they shall be cut down in sections.
 2. Removal of stumps and roots may be accomplished by the use of a shredding machine meeting the approval of Owner.
- M. Removing Corduroy:
1. Logs, stumps, poles, brush, and other unsatisfactory material occurring in the Contract limits at or below the surface of the ground and within the depth of four (4) feet (1.2 m) below the proposed plan grade shall be removed and shall be disposed of by Contractor.
 2. Burial of trees, stumps and other vegetation, will not be permitted, except at disposal areas indicated on the Drawings or as determined by Owner. Trees and stumps buried in these areas shall have a minimum cover of two (2) feet (0.6 m).
- N. Holes and Trenches:
- O. 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.
- a. The 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 Owner.
 - b. 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.
- P. Salvaging Timber:
1. Trees required to be removed and having a diameter of four (4) inches (100 mm), or more, are classed as merchantable timber. On right of way, fee simple, merchantable timber shall become the property of Contractor, unless otherwise specified in the Contract Documents. When such material is placed outside of the right of way, Contractor shall obtain and provide Owner with written permission from Owner of the property on which the timber is to be placed.
 2. Merchantable timber to be removed from areas outside of right-of-way, fee simple, shall be cut and piled for the use of property owner, except where Contractor provides Owner with a written agreement from property owner that he does not desire the salvaged timber. Where property owner has signed such an agreement, the salvaged timber will become the property of Contractor.
 3. When such material is placed outside the Work limits, Contractor shall obtain and provide Owner with written permission from the of the property on which the timber is to be placed. Timber from 4 to 12 inches (100 to 300 mm) in diameter may be left in full tree lengths or cut to commercial lengths, at the option of the Contractor. Timber 12 inches (300 mm), or more, in diameter shall be cut into commercial lengths and piled separately from other timber.
- Q. Existing Trees to Remain:
1. General:
 - a. Protect root systems from smothering and restrict foot traffic to prevent excessive compaction of soil over root systems.
 - b. Individual trees and areas shown to remain shall be protected by six (6) foot high chain link fence. Install fencing before site preparation, grading, and clearing and

grubbing operations.

- c. Under no circumstances shall the Contractor remove existing trees designated to remain for his/her convenience or ease of construction.
- d. Trees which are not to be removed and become damaged or die shall be replaced with trees of the same species and equal size.
- e. Prior to installation, stake the location of protection fencing for approval by the Owner. Location stakes or marking shall be placed not greater than ten (10) feet on center.

2. Excavation Around Trees:

- a. Protect root systems from smothering and restrict foot traffic to prevent excessive compaction of soil over root systems. Excavate within drip line of trees only where shown on the Drawings.
- b. Where trenching for utilities is required within drip line, tunnel under or around roots by hand digging. Do not cut main lateral roots or tap roots. Contractor shall notify the Owner prior to cutting roots over 6 inches in diameter. Roots up to and including 3/4-inch diameter shall be cut by hand saws. Do not leave roots exposed to sun or drying for more than 24 hours. Protect all exposed roots with moist organic mulch or burlap and backfill as soon as possible.
- c. Where excavating for new construction is required within drip line of tree, excavate by hand to minimize damage to roots and perform as follows:
 - 1) Use narrow tine spading forks and comb soil to expose roots.
 - 2) If main lateral roots are immediately adjacent to location of new construction, cut roots three (3) inches from new construction.
 - 3) Do not allow exposed roots to dry out before permanent backfill is placed.
 - 4) Provide temporary earth cover, or pack with peat moss and wrap with burlap.
 - 5) Water and maintain in moist conditions until covered with backfill.

R. Trimming of Existing Trees:

1. General:

- a. Tree pruning, tree repair, and tree removal shall be performed by competent workers, under the supervision of an arborist holding certification from the International Society of Arboriculture (ISA) or equivalent education and experience. No pruning shall be performed, unless approved by the Owner.
- b. Coordinate with City of Cleveland Arborist when trimming or removing within public right of way to obtain approval.

2. Pruning:

- a. Cut branches with sharp pruning instruments and do not break or chop.
- b. Prune flush with trunk surface.

3. Trimming:

- a. Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch.
- b. Spikes shall not be used for climbing live trees.
- c. Cuts over 1-1/2-inches in diameter shall be coated with an asphaltic emulsion material.

END OF SECTION 31 10 00

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 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 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. 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 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. Sites shall be graded as specified on the Plans or as determined by the Engineer. Contractor shall carry out the grading operation to prevent standing water and soil saturation detrimental to structures and improvements.

- B. Provisions shall be made to preserve and protect trees and other vegetation specified on the Plans or determined by the Engineer as not to be removed.

3.02 REMOVING AND SALVAGING TOPSOIL

- A. Topsoil encountered along the route of the construction shall be pushed back and preserved for use in restoration following completion of the construction. The topsoil must remain on each given parcel and lot throughout the Project including the existing road right-of-way adjoining the parcel or lot where it existed.
- 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. If there is insufficient working area, the topsoil may be removed, stockpiled and later replaced on the original lot or parcel. Contractor shall furnish the Engineer with written permission obtained from the property owner of the property on which the topsoil is to be stockpiled, prior to commencing the stockpiling operation.
- D. Topsoil shall be salvaged in an amount equivalent to the quantity required by the Plans. Topsoil salvaged in excess of that required by the Plans or as required by the Engineer will be disposed of by the Contractor at Contractor's expense.
- E. Before removing topsoil, vegetation shall be reduced to a height of approximately 4 inches and all such vegetation and all brush, stones, rocks, and any other objectionable litter or foreign material shall be removed and disposed of before the ground is broken for topsoil removal.
- F. Equipment and methods of operations shall be such as to avoid the lifting of the subsoil. If soil or weather conditions are unsuitable, the Contractor shall cease stripping until stripping can resumed in a suitable manner.
- G. Topsoil shall be removed within the grading limits for cuts and shall be removed to a width and depth specified on the Plans or as determined by the Engineer.
- H. Topsoil shall be stockpiled within the limits of construction in areas designated on the Plans, or in areas out of the way of construction as determined by the Contractor.
- I. Stockpiles shall be located and shaped so as to avoid diversion of storm water runoff, either in or out of the limits of construction, towards buildings, creation of standing water or interference of controlled irrigation.
- J. Contractor shall not place topsoil around trunks and root areas of trees to be preserved.
- K. Topsoil shall be kept separate from other excavated materials that are to be used for embankment and shall be completely removed from any designated area prior to the beginning of regular excavation or placing embankment in the area.
- L. Topsoil stockpiles shall be located as near the original location as possible and no payment will be made for overhaul.
- M. After the completion of construction, the topsoil shall be screened through a 5/8 inch maximum size mesh screen, spread, graded, raked and prepared for seeding or sodding.

3.03 EXISTING SAND ON-SITE

- A. In those instances where the construction takes place within private easements, the sand shall not be removed from each parcel or lot. Sand encountered in existing road right-of-way may be used for construction purposes throughout the Project providing it meets the requirements for the material it is intended to be used for.
- B. Removal of sand from the Project will not be allowed, except for the volume displaced by the new construction.
- C. If there is insufficient working area, the sand may be removed, stockpiled and replaced on the original lot or parcel. Contractor shall furnish the Engineer with written permission obtained from the property owner of the property on which the sand is to be stockpiled, prior to commencing

the stockpiling operations.

3.04 ROUGH GRADING

- A. The site shall be graded as necessary to comply with the Plans or as determined by the Engineer. The subgrade shall be roughly established by cut or fill, approximately parallel to proposed finished grades and to elevations which allow for thickness of topsoil and installation of site or roadway improvements.
- B. In fill areas all debris shall be removed from the area to be filled. Material detrimental to site improvement shall be removed from the site and acceptably disposed of as specified in Section 01 89 00.
- C. Original ground shall be scarified and benched or otherwise treated to provide adequate bond and to prevent slippage of fill.
- D. Fill material shall be free of debris or other detrimental material and shall have a moisture content within 2% optimum moisture when placed. Fill shall be compacted to a density not less than 95% of the maximum unit weight and placed in layers no less than 9 inches and no greater than 15 inches. The maximum unit weight shall be determined by ASTM D698, Method B.
- E. If possible fills or embankments shall be constructed when the ground is frost-free and there is favorable weather. However if winter grading is necessary, all ice and snow shall be removed from the surface of the ground before the fill or embankment is placed.
- F. No frozen material will be allowed in the fill area or in the embankment being constructed.
 - 1. Frozen material on a partially completed fill shall be removed before placing any additional fill. Frozen material shall be stockpiled outside the 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. Subgrade shall be smoothed parallel to proposed finished grades and elevations specified on the Plans. Subgrade shall be scarified to assure bond with the topsoil prior to spreading of the topsoil.
- B. Topsoil shall be spread uniformly to provide a smooth, even surface at a finish grade specified on the Plans or acceptable to the Engineer. After spreading, the topsoil shall be compacted lightly as necessary to minimize settlement. Final grades shall not vary more than 0.1 foot from the elevations indicated on the Plans.
- C. Finished grading shall be done when the ground is frost-free and weather is favorable.

3.06 ADJUST STRUCTURES

- A. Structures to be adjusted shall be as called for on the Plans or as indicated by the Engineer. Adjustment of structures shall apply where the elevation of the casting is either raised 12 inches or less, or lowered 6 inches or less.
- B. For Rehabilitation/Resurfacing Projects
 - 1. For structures in existing pavement, the pavement shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.
 - a. For structures in concrete pavement, the structure shall be adjusted, backfilled and compacted as noted below. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed concrete pavement.
 - 1) In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.

- 2) For resurfacing projects, expansion or epoxy anchored hook bolts shall be placed 18 inches on center around the edges of the existing concrete pavement, unless otherwise shown on the plans. The concrete pavement, minimum 8 inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.
- b. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed. The structure shall be adjusted, backfilled and compacted as noted below.
 - 1) Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement. A minimum of 8 inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base or leveling courses.
 - 2) Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.
- C. For Bituminous Reconstruction or New Construction Projects
 1. The frame and cover on new and existing structures shall be removed and the structure plated prior to placing the bituminous base or leveling courses.
 2. Bituminous base and leveling courses shall be placed over the plated structures.
 3. Prior to placing the bituminous wearing course, the bituminous base and leveling courses shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the Plans. The structure shall be adjusted, backfilled and compacted as noted below.
 4. Six inches of aggregate base course, unless otherwise noted on the Plans, shall be placed below the proposed pavement. A minimum of 8 inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base course.
 5. Bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the project.
- D. Sawcutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the adjusting the structure unless otherwise noted in the Contract Documents.
- E. Existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure, unless a new frame and cover are called for on the Plans.
- F. Brick courses or concrete adjustment rings shall be removed or installed as necessary to adjust the structure's frame and cover to the proper elevation.
- G. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by the Engineer.
- H. The outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 inch thick.
- I. The structure shall be properly backfilled with Granular Material compacted in place, and meeting the approval of the Engineer.
- J. The flow in the entire system shall be maintained, at the Contractor's expense, while performing any part of the Work. Also, the structure shall be cleaned and all unsuitable material shall be disposed of at the Contractor's expense.

3.07 RECONSTRUCT STRUCTURES

- A. Structures to be reconstructed shall be as called for on the Plans or as determined by the Engineer. Reconstruction of structures shall apply where the elevation of the casting must be raised in excess of 12 inches, lowered in excess of 6 inches, or to rebuild portions of the existing structure which are deteriorated.

- B. For Rehabilitation/Resurfacing Projects:
1. For structures in existing pavement, the pavement shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the plans.
 - a. For structures in concrete pavement, the structure shall be reconstructed, backfilled and compacted as noted below. Six inches of aggregate base course, unless otherwise noted on the Plans, shall be placed below the proposed concrete pavement.
 - 1) In areas of new concrete pavement, the concrete pavement around the structure shall be poured integral with the rest of the pavement.
 - 2) For resurfacing projects, expansion or epoxy anchored hook bolts shall be placed 18 inches on center around the edges of the existing concrete pavement, unless otherwise shown on the plans. The concrete pavement, minimum 8 inches thick, shall be replaced around the structure to the grade of the adjoining concrete pavement.
 - b. For structures in bituminous pavement, the pavement shall not be sawcut until after the bituminous base or leveling courses have been completed.
 - 1) The structure shall be reconstructed, backfilled and compacted as noted below.
 - 2) Six inches of aggregate base course, unless otherwise noted on the Plans, shall be placed below the proposed pavement. A minimum of 8 inches of concrete pavement, unless otherwise noted on the Plans, shall be placed to the elevation of the adjoining bituminous base or leveling courses.
 - 3) The bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the Project.
- C. For Bituminous Reconstruction or New Construction Projects:
1. Frame and cover on all new and existing structures shall be removed and the structure plated prior to placing the bituminous base or leveling courses.
 2. Bituminous base and leveling courses shall be placed over the plated structures.
 3. Prior to placing the bituminous wearing course, the bituminous base and leveling courses shall be sawcut a minimum of 5-foot by 5-foot unless otherwise shown on the Plans. The structure shall be reconstructed, backfilled and compacted as noted below. Six inches of aggregate base course, unless otherwise noted on the plans, shall be placed below the proposed pavement.
 4. A minimum of 8 inches of concrete pavement, unless otherwise noted on the plans, shall be placed to the elevation of the adjoining bituminous base course.
 5. The bituminous wearing course around the structure shall be placed integral with the wearing course on the remainder of the Project.
- D. Sawcutting, removal and replacement of concrete and bituminous pavement, and aggregate base course, shall be incidental to the reconstructing the structure unless otherwise noted in the Plans.
- E. The existing frame and cover shall be carefully removed and stored, and shall be reinstalled on the same structure unless a new frame and cover are called for on the Plans.
- F. Existing corbel entrance sections or precast concrete chimney type entrance shall be removed along with any additional brick courses or precast concrete sections necessary to achieve the amount of reconstruction called for on the Plans or as determined by the Engineer.
- G. The necessary brick work and precast concrete sections shall be installed to meet the design grade.

- H. Manhole steps shall be furnished and shall be installed, as necessary, so that maximum spacing is 24 inches. Brick or concrete adjustment rings shall be set in mortar or installed as shown on the Plans and as determined by the Engineer.
- I. The outside surface of the new brick or block structures shall receive a masonry plaster coat, a minimum of 1/2 inch thick. The structure shall be properly backfilled with granular material, compacted in place, and meeting the approval of the Engineer.
- J. The flow in the entire system shall be maintained, at the Contractor's expense, while performing any part of the Work. The structure shall be cleaned and unsuitable material shall be disposed of at the Contractor's expense.

END OF SECTION 31 22 00

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. Owner shall be notified 24 hours before vibration and impulsive noise producing operations occur at any specific location. Contractor shall provide the Owner with a schedule for all such operations and shall notify the Owner if any operations is delayed for more than one hour.
 - 2. Contractor shall furnish the Owner with a list of those parties notified in accordance herewith prior to the start of such operations. The list shall include names, addresses and telephone numbers.

1.05 COORDINATION DOCUMENTATION

- A. For all work sites, prior to starting vibration and impulsive noise producing operation, the Contractor shall notify the appropriate local municipal officials, above- and below-ground utility owners and the general public expected to be potentially affected, the Contractor's intent to conduct controlled operations. Notice shall be given to all operators of all buried pipes, cables, conduits and overhead utility lines and poles located within a 100-foot radial distance of the operation area. Public notice should be given to any occupants and property owners of all

buildings located within 250-foot of where operation occurs in excavations and within 250 feet of all surface operation locations.

- B. Notification to appropriate local municipal officials and utility owners or operators shall be done in writing, at least 48 hours prior to the start of vibration and impulsive noise producing construction operations at a particular site or sooner if so required by any applicable local law or regulation, and shall indicate the expected hours that construction operations might occur and the expected date that operation will be completed. Upon completion of construction operations at the particular site, utility owners or operators shall be notified that construction operations have ceased in the area for the duration of the project.

PRODUCTS – NOT USED

EXECUTION

3.01 GENERAL

- A. Contractor shall erect and maintain signboards of adequate size at locations agreed with the Owner stating that operations are taking place in the area, and such signs shall be 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. Contractor shall conduct all work without causing damage to existing structures from ground vibrations caused by construction operations.
- C. Contractor shall monitor and record ground vibration and noise for all vibration producing operations, unless approved otherwise by the Owner. Work shall be designed to ensure allowable levels are not exceeded.
- D. Contractor shall monitor each activity expected to cause excessive noise or vibration in excess of the limits set forth herein and the local noise ordinances. Contractor shall adjust construction procedures accordingly to ensure allowable levels are not exceeded.
- E. Vibration and Noise Limits and Control Criteria:
 - 1. Operation shall be designed to conform to the vibration limits shown in 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. The noise level resulting from construction shall be within the limits specified in OSHA regulations and all local ordinances.
- F. Monitoring Requirements:
 - 1. Monitoring and recording of vibration and impulsive noise shall be performed by the Contractor for construction operations that generate noticeable ground vibration and impulsive noise, if required by the Owner.

3.03 SUSPENSION OF OPERATION

- A. Vibration and noise producing operations shall be suspended by 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. Vibration and noise producing operations shall not resume until the Owner has reviewed and approved the Contractor's revised operation plan with modifications correcting the conditions causing the suspension.

3.04 DAMAGE

- A. Contractor shall restore or replace; utilities, equipment, and structures damaged by vibrations at no additional cost to the Owner.

END OF SECTION 31 23 10

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 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 22 00 - Grading
- F. Section 31 23 19 - Dewatering
- G. Section 32 31 00 - Fences and Gates
- H. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM 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. Finish subgrade surface shall be shaped 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 shall provide the Engineer with two (2) certified copies of the sieve analysis of the backfill material.

2. Testing of the material and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.
3. Testing lab shall provide the Engineer with two (2) certified copies of the compaction and moisture tests of the backfill and subgrade materials.
4. Testing of the materials and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

B. Samples:

1. Submit sample of the proposed subgrade stabilization fabric measuring not less than 1 syd in area, and the manufacturer's certification that the proposed fabric meets or exceeds therequirements listed in Part 2 of this Section.
2. Submissions shall be made not later than 10 working days prior to any installation.

1.06 PRODUCT DELIVERY STORAGE AND HANDLING

- A. Geotextile fabric shall be furnished and stored in a wrap that will protect the geotextile from ultraviolet radiation and abrasion. Geotextile shall be covered with the aggregate base as per plan within two (2) weeks of its placement.

1.07 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.
- B. Measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.
- C. Measures should include provisions to reduce erosions by the wind of areas stripped of vegetation, including material stockpiles.
- D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS

- A. Granular Material shall conform to the requirements for Class II granular material as specified in MDOT Section 902.

2.02 AGGREGATE MATERIALS

- A. Aggregate materials, used for undercut backfill shall be crushed limestone, natural aggregate, blast furnace slag, or crushed concrete, meeting the requirements of 21AA, 21A, or 22A as specified in MDOT Section 902. Crushed concrete shall be free of all steel and other deleterious materials.

2.03 SUBGRADE STABILIZATION FABRIC

- A. Subgrade stabilization fabric shall be composed of synthetic fibers formed into a woven fabric. The fibers shall be composed of 85% propylene or ester polymers. The geotextile shall conform to the following requirements listed below:

Property	Test Procedure	Test Result
Grab Tensile	ASTM D4632/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. Structures and sewers to be removed shall be called for on the Plans or as determined by the Engineer. Removal or abandonment of structures shall be in accordance with Section 01 89 00.

3.02 HOLES

- A. Earth removed during any phase of the excavation or removal operations, resulting in a hole or void, shall be replaced by backfilling to the proposed subgrade with a suitable Granular Material approved by the Engineer.
- B. Material shall be compacted to 95% of its maximum unit weight.
- C. The furnishing, placing and compacting of the backfill material shall be at the Contractor's expense.

3.03 SALVAGING AND STOCKPILING TOPSOIL

- A. Topsoil, within the grading limits for cuts, and where the fill is less than 5 feet in height to the top of proposed road, shall be removed to a depth and width specified on the Plans.
- B. Topsoil from peat and muck areas shall not be removed.
- C. Topsoil salvaged in excess of that required by the Plans will be disposed of by the Contractor at Contractor's expense.
- D. Removing and salvaging topsoil shall be in accordance with Section 31 22 00.

3.04 PREPARING ROADWAY SUBGRADE

- A. Muck, peat and other unsuitable material within the roadway shall be removed, displaced or otherwise treated, as shown on the Plans or as directed by the Engineer.

- B. Deposits of frost heave material within lines 2 feet outside the proposed roadbed shall be removed 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. Ice and snow shall be removed from the surface of the ground before the embankment is placed.
- D. Muck, peat, frost heave material and other unsuitable material shall be disposed of outside the highway limits or shall be spread uniformly in low places beyond the roadway limits when so approved by the Engineer.
- E. Old road surfacing or gravel, crushed stone, or other nonrigid type surfacing, occurring within the area of the roadbed and underlying proposed embankment less than 1 foot in depth, and which is not to be salvaged and incorporated in the new Work, shall be plowed or scarified full depth, spread and compacted to form a uniform foundation, before any new embankment is placed.
- F. Old pavement and other rigid structures, occurring within the area of the roadbed and underlying the proposed embankment less than 1 foot in depth and which are not to be incorporated into the new Work, shall be broken up, removed and disposed.

3.05 SUBGRADE

- A. Area to be paved shall be excavated and smoothed to the line, grade and cross section as indicated on the Plans.
- B. Subgrade between the lines 2 feet on either side of the proposed edge of pavement or curb shall be compacted to 95% of the maximum unit weight for a depth of 7 inches, by rolling with a roller weighing not less than 10 tons.
- C. Subgrade shall be completed ahead of placing forms or paving a distance equal to the distance of one day's average paving operation. Prior to the paving operation, the subgrade shall be shaped and compacted to the Plan cross section by approved mechanical means.

3.06 PAVEMENT EXCAVATION

- A. Pavement excavation shall consist of Work required to construct the earth grade and its appurtenances true to the lines, grades, and cross sections called for on the Plans and in accordance with these Specifications.
- B. Excavation shall consist of the following items, any of which or all of which may be included or incidental to it; removing trees, stumps, hedges, roots, culverts, sewers, miscellaneous structures, roadway excavation, removing of asphalt or concrete pavements, curbs, curb and gutters, sidewalks, end headers, removing aggregate surfaces, salvaging and stockpiling topsoil, subgrade undercut, excavation for structures, trimming and finishing earth grade, fine grading, right-of-way ditching and restoration, and the disposal of unsuitable material.
- C. 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 shall be completely removed and properly disposed of as specified in Section 31 11 00.
- D. Earth and other existing materials shall be excavated for the full depth and width of the cross section as shown on the Plans. Material shall be excavated sufficiently for setting of forms or slip-form equipment. Excavation shall be limited to 3,000 linear feet of right-of-way unless additional lengths are requested in writing and approved by the Engineer.
- E. Excess excavated material shall be removed from the project by the Contractor along approved routes to disposal sites approved by the Owner. Disposal of excess excavation and maintenance of the dump sites shall be considered incidental to the price paid for excavation and shall be as specified in Section 01 89 00.

3.07 BORROW EXCAVATION

- A. Materials which are secured from locations outside of the project limits for the purpose of completing embankments and other items, will be considered as borrow excavation. Borrow

pits and the materials to be removed therefrom shall be subject to the inspection of the Engineer and shall be secured by the Contractor, unless otherwise provided.

- B. Borrow excavation will be measured by volume in cubic yards compacted in place, based on the neat lines called for on the Plans or as authorized by the Engineer. To facilitate the accurate measurement of borrow quantities, unless otherwise specified in the Contract Documents, the Contractor shall perform all the regular excavation and grading with existing materials for any designated area and the Engineer will cross section these areas prior to the Contractor furnishing and placing the required borrow material. Engineer will then resection the completed area and compute the volume of borrow material in its compacted-in-place state. Borrow material placed beyond the neat lines called for on the Plans or which is not authorized by the Engineer in writing will not be measured and computed as borrow excavations. Measurement of borrow material by truck count will not be acceptable.
- C. Public and private roads used by the Contractor between the source of borrow and the Project shall be maintained by the Contractor, at Contractor's expense, including repairs of any damage caused by Contractor's operations. Also included is the application of a dust palliative when necessary, as determined by the Engineer.

3.08 EMBANKMENTS

- A. Embankments shall be constructed with sound earth. The materials shall be deposited and compacted by either the Twelve Inch Layer Method, or the Controlled Density Method. The Controlled Density Method will be required unless the Twelve Inch Layer Method or some other method is specifically called for on the Plans.
- B. The topsoil shall be stripped from the entire fill area. The depth of the topsoil to be removed shall be as shown on the Plans or as determined by the Engineer. After the topsoil is removed, the entire area upon which the embankment is to be constructed shall be compacted to not less than 90% of the maximum unit weight, to a depth of 9 inches.
- C. Where stones are prevalent, the material shall be carefully placed so that all large stones will be well distributed and the crevices completely filled with smaller stones, earth, sand or gravel so as to form a solid embankment. Rock or fragmental material of such size as would prohibit it from being placed in layers of the specified depth shall not be placed in the embankment. In no case shall stones over 3 inches in diameter be placed within 12 inches of the surface of the earth grade within the areas between lines 2 feet outside of the edges of proposed roadbed.
- D. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.
- E. Construction requirements for the two (2) methods of placing and compacting embankments are as follows:
 - 1. Twelve-Inch Layer Method:
 - a. The material shall be deposited and spread in layers not more than 12 inches depth, loose measure, parallel to the finished grade and extending to the full width of the embankment. The material shall be deposited by operating the conveying equipment over the layer being placed, insofar as feasible.
 - b. Each layer shall be compacted to not less than 95% of the maximum unit weight as determined at the existing moisture content. The operation of compacting shall be continued until each layer is compacted to the required density for its full width.
 - 2. Controlled Density Method:
 - a. The material for the embankment shall be deposited and spread in layers not more than 9 inches in depth, loose measure, and extending to the full width of the embankment, except that granular material may be spread and compacted in layers not more than 15 inches in thickness if the specified density is obtained.
 - b. The material for embankments of 5 feet or less and the bottom 4 feet of embankments of more than four 4 feet above the surface of the ground upon which

the embankment is to be constructed shall have not more than the optimum moisture content at the time of compaction.

- c. The material for that part of the embankment more than 5 feet above the surface of the ground upon which the embankment is to be constructed shall have a moisture content of not greater than 3% above optimum at the time of compaction, except that the moisture content of the top 3 feet of the embankment shall not exceed optimum.
- F. If granular material is used to construct the embankment, it shall be at a moisture content below saturation.
- G. If the material contains an excess of moisture, it shall be dried to the required moisture content before being compacted.
- H. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of its maximum unit weight, unless otherwise specified, before the succeeding layer is started.
- I. When the original ground upon which the embankment is being placed, or any section of compacted embankment, or the soil in cut sections becomes rutted or distorted by the Contractor's equipment, the method of operation shall be changed to eliminate this condition. Contractor shall reshape and recompact any areas so rutted or distorted at his own expense. This shall be done before any succeeding layers are placed.

3.09 ROUGH GRADING

- A. Contractor shall rough grade as close as possible to finished subgrade leaving a minimum to be removed in fine grading.
- B. Any excavated material removed during grading and stored along the line of Work between curb and sidewalk on improved lawns shall not be left longer than 48 hours. Lawns or otherwise improved areas shall be left in a neat and clean state within the specified 48 hours.
- C. During the excavation operation, including the placing of the subbase, the Work area shall be kept free of water. A dewatering system shall be provided and maintained by the Contractor at Contractor's expense. The dewatering system shall remain in operation until the paving is completed.

3.10 PROOF ROLLING

- A. After removal of topsoil or other overburden and after construction of embankments, proof roll the existing subgrade with six passes of a minimum 15 ton pneumatic-tired roller. Operate the roller in a systematic manner to assure the number of passes over all areas, and at speeds between 2.5 and 3.5 miles per hour.
- B. When proof rolling under structures, one-half of the passes made with the roller shall be in a direction perpendicular to the other passes.
- C. Proof rolling shall be done in the presence of the Engineer. Rutting or pumping shall indicate unsatisfactory material and that material shall be undercut as determined by the Engineer, and replaced with the appropriate fill material.
- D. Perform proof rolling only when weather conditions permit. Do not proof roll wet or saturated subgrades. Materials degraded by proof rolling a wet or saturated subgrade shall be replaced by the Contractor 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 shall 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. The areas excavated of unsuitable material, unless otherwise specified in the Contract Documents, shall be backfilled with non-frost heaving material similar to the adjacent soil. However, in areas as determined by the Engineer where free water due to seepage is present, the excavation shall be backfilled with MDOT Granular Material, Class II and drainage shall be provided. The backfill shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified.

3.12 SUBGRADE STABILIZATION FABRIC

- A. Place Subgrade Stabilization Fabric on prepared subgrade or subbase in the manner and at the location as called for on the plans. The fabric shall be laid smooth and free of tension stress, wrinkles or creases.
- B. Fabric strips shall be placed to provide a minimum overlap of 24 inches for each joint. Fabric shall be placed so that the upper strip will overlap the next lower strip.
- C. Should the geotextile be damaged during construction, the torn or punctured section shall be repaired by placing a piece of fabric that is sufficiently large to cover the damaged area plus 24 inches 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 the earth grade has been constructed to the required grade, all stones and rocks more than 3 inches in diameter, appearing on the surface of the subgrade shall be removed.
- B. Earth grade and the subgrade shall be trimmed to the grade called for on the Plans. Subgrade, where a subbase or base course is required, shall be trimmed to the established grade within ± 0.1 foot. Where a subbase or base course is not required, the subgrade shall be trimmed to the established grade within $\pm 3/4$ inch.
- C. The earth grade outside the subgrade shall be trimmed, all irregularities made smooth and the entire site or roadway completed to the required lines, grades, and cross sections. Backslopes and fill slopes shall be finished as either Class A or Class B slopes. Class A slopes shall be required unless otherwise specified in the Contract Documents.

1. Class A Slopes:
 - a. Class A slopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.1 foot above or below the established grade measured at right angles to the slopes.
 2. Class B Slopes:
 - a. Class B backslopes shall be finished to the average slopes shown on the Plans with no variations at any point more than 0.5 foot above or below the established grade measured at right angles to the slope.
 - b. Class B fill slopes shall be finished 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. The remainder of the completed fill slope shall conform to the requirements for Class B backslopes.
 3. The degree of finish of the slopes shall be that obtainable from machine operations. The smoothness of surface finish ordinarily associated with template or string line and hand operations will not be required, but abrupt variations will not be permitted.
 4. Debris except sod, leaf mold and rotted forest litter shall be removed and loose clods of earth extending beyond the slope tolerance specified shall be broken or removed.
 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. Where trees or other restrictions do not interfere, the tops of backslopes, bottoms of fill slopes and all other angles in the lines of the cross section shall be rounded to form vertical curves as shown on the Plans or as determined by the Engineer. Transitions in length of vertical curves shall be gradual and shall present a uniform and attractive appearance. When ditches are constructed in peat, vertical curves may be omitted.

3.15 SUBBASE

- A. Granular material for subbase shall be evenly spread and compacted as specified in MDOT Section 301.
- B. The thickness of each layer placed shall be determined by the required density obtained but shall not exceed 15 inches in depth, loose measure.
- C. The subbase shall be constructed to the alignment, grade and cross section shown on the Plans. Should the subgrade at any time prior to or during the placing of the subbase become soft or unstable such that rutting occurs in the subgrade, or if the subgrade material is forced up into the subbase material, the operation shall immediately cease and the mixed material shall be removed and disposed of. The subgrade shall be corrected and new subbase material placed and compacted. This Work shall be considered incidental to the construction of the Project.

3.16 SCARIFY, RE-GRADE AND COMPACT EXISTING SUBGRADE

- A. The existing subgrade (base) shall be scarified to a depth of 9 inches within the limits as shown on the plans. The subgrade shall then be re-shaped to the cross section as shown on the plans and compacted to 95% of its maximum unit weight by rolling with a roller weighing not less than 10 tons.

3.17 ROADWAY DITCHING

- A. Ditching shall be constructed at the locations called for on the Plans or as determined by the Engineer. The ditch 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.
- B. The excess material from the ditch construction shall be disposed of by the Contractor at Contractor's expense.

- C. The ditch section shall be graded to receive topsoil and seed.
 - 1. Topsoil, seed, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19.
- D. Contractor, at Contractor's expense, shall furnish, place and compact any additional material needed to construct the ditch at the location and cross sections called for on the Plans.

3.18 RIGHT-OF-WAY RESTORATION

- A. The right-of-way shall be restored in accordance with the type and location specified on the Plans. The right-of-way 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.
- B. Excess material from the right-of-way restoration operation shall be disposed of by the Contractor at Contractor's expense, as specified in Section 01 89 00.
- C. The right-of-way shall be graded to receive topsoil and seed.
 - 1. Topsoil, seed, fertilizer and mulch shall conform to the requirements specified on the Plans and in Section 32 92 19.
- D. Contractor, at Contractor's expense, shall furnish, place, and compact any additional fill, meeting the approval of the Engineer, needed to construct the right-of-way to the cross sections called for on the Plans.

3.19 MACHINE GRADING

- A. The Work of machine grading shall consist of light grading of such character that, in general, the excavation from ditches and roadbed will be utilized in shaping shoulders and adjacent shallow fills and the work can be performed by a blade grader or similar equipment. Machine grading shall apply on the sections shown on Plans or specified in the Contract Documents.
- B. Work shall include all necessary scarifying, plowing, discing, moving and shaping the earth to develop the cross section shown on Plans.
- C. Ditches shall be in reasonably close conformity with the line and grade as shown on the Plans or as directed and must drain runoff waters to outlets shown on the Plans or designated by the Engineer.
- D. The roadbed shall be finished to grade with a blade grader or equivalent equipment.
- E. Intersections, approaches, entrances, and driveways shall be graded as shown or as directed, except that loading and hauling of earth will not be required as part of this Work.

3.20 MAINTENANCE AGGREGATE

- A. Contractor shall furnish and install MDOT 21A, 21AA or 22A maintenance aggregate to maintain pedestrian and traffic access. Aggregate shall be placed and compacted to maintain access in areas as determined by 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. Taking of samples and the testing required shall be performed by a testing laboratory suitable to the Owner and approved by the Engineer.
- C. Engineer shall determine the location and number of samples to be made. The testing laboratory shall furnish the Engineer with two (2) certified copies of the results of all tests.
- D. Testing procedures shall conform to current MDOT Standards for Construction .

- E. Maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method D, modified to include all the material passing the 1 inch sieve.

3.22 DEFECTIVE WORK

- A. Any portion of the backfill, subbase or subgrade which is deficient in the specified density shall be corrected by methods meeting the approval of the Engineer.
- B. Any extra testing or sampling required by the Engineer, because of deficiencies, shall be at the Contractor's expense.

END OF SECTION 31 23 13

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 22 00 - Grading
- E. Section 31 23 19 - Dewatering
- F. Section 32 92 19 - Seeding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM 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. The testing laboratory shall provide the Engineer with two (2) certified copies of the test results of the compaction of the backfill. The testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.05 SOIL EROSION AND SEDIMENTATION CONTROL

- A. Contractor shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by 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 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. Granular material shall conform to the requirements for Class II, as specified in MDOT Section 902. Granular Material shall be natural bank run sand.

2.02 COARSE AGGREGATE

- A. Coarse aggregate shall conform to the requirements for 6A, as specified in MDOT Section 902.

PART 3 EXECUTION

3.01 DEWATERING

- A. The area within the vicinity of the new Work shall be dewatered in accordance with Section 31 23 19 prior to the excavation operation.
- B. Depth of the dewatering shall be sufficient to allow the excavation to remain in a dry condition during the construction of the structure, including the excavating, backfilling and compacting operations.

3.02 SHEETING, SHORING, AND BRACING

- A. Contractor shall furnish, place and maintain at all times such sheeting, shoring, and bracing of the excavated area as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipelines and conduits next to, or crossing the excavated area, and for the protection and safety of pedestrian and vehicular traffic.
- B. Contractor shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions, shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation, and shall effectively restrain movement of the adjacent soil.
- C. Prior to installing the sheeting, shoring or bracing, the Contractor shall submit Plans for this Work to the Engineer for informational purposes only.
- D. Sheeting, shoring, and bracing, and excavation shall conform to current federal or state regulations for safety.
- E. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No extra compensation shall be paid to the Contractor for sheeting, shoring or bracing left in place unless otherwise indicated in the Proposal.
- F. Supports for pipes, conduits, etc., crossing the excavated area shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.
- G. Furnishing, placing, maintaining and removing of sheeting, shoring, and bracing materials shall be at the Contractor's expense unless otherwise indicated in the Proposal.
- H. Contractor shall not remove the sheeting, shoring or bracing until the structure has obtained sufficient strength to support the external loads.
- I. Sheeting, shoring and bracing material shall not come in contact with the structure, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the structure.

3.03 COFFERDAMS

- A. A cofferdam shall consist of the maintenance, installation and removal of a substantially watertight enclosure or a well-point system or similar system, which will permit construction of the substructure, above seal or subfooting, in the dry and without damage to the Work.
- 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. Interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms.
- E. Cofferdams, caissons or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.

- F. Cofferdams shall not be braced to substructure forms. They shall be constructed so as to protect the Work in place against damage from high water and to prevent injury to the foundation by erosion.
- G. No timber bracing shall extend into or remain in the finished concrete.
- H. Cofferdams shall be removed in such a manner as not to disturb or mar the finished concrete. When called for on the Plans or where necessary in the Work, cofferdam sheeting shall be left in place.
- I. Furnishing, construction, maintenance and removal of the cofferdams including pumping shall be at the Contractor 's expense.
- J. If the Contractor elects to use a well-point system or similar system, he shall be responsible for any claims for damages resulting therefrom.

3.04 EXCAVATION

- A. Excavation shall include the site clearing and grubbing, the excavating and disposing of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.
- B. Excavation shall also include the removal of existing structures, as shown on the Plans or as determined by the Engineer.
- C. Rock excavation, if applicable, shall be performed as a part of the excavation in accordance with specifications contained elsewhere.
- D. Contractor shall keep the limits of excavation operations within a reasonable close conformity with the location and grade, of each structure.
- E. Excavated materials shall be temporarily stored in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property or traffic. Excavated materials shall not be placed at such locations that will endanger the banks of the excavation by imposing loads thereon.
- F. The excavation shall be of sufficient size to allow for the construction of the new Work, the placing and compacting of the backfill and for the dewatering operation.
- G. When concrete is to bear on or against an excavated surface other than rock, special care shall be taken not to disturb the surface. The final removal of the foundation material to grade shall not be made until just prior to the placing of the concrete.
- H. Concrete shall not be placed until the depth of the excavation has been checked and the suitability of foundation material has been reviewed by the Engineer.
- I. Excavated material, determined by the Engineer as suitable for backfill may be used.
- J. Excess materials shall be disposed by the Contractor, at Contractor's expense, as specified in Section 01 89 00.
- K. The elevations for the bottom of footings shall be subject to such changes as are necessary to insure a satisfactory foundation. Any changes required shall be reviewed by the Engineer prior to making the change.
- L. The surface of all rock or other hard material upon which concrete is to be placed shall be free of all loose fragments, cleaned and cut to a firm surface. The surface shall be level, stepped or serrated, as shown on the Plans.
- M. Unsound material underlying proposed structures shall be removed and replaced with granular material approved by the Engineer, in layers not exceeding 6 inches in depth. Each layer shall be compacted to 95% of maximum unit weight unless indicated otherwise on the Plans, or within these specifications.

3.05 BACKFILL

- A. Backfill material shall be placed only after the new Work and backfill material have been inspected by the Engineer.
- B. Backfill shall not be placed against any portion of the new Work until the required curing, surface finishing and waterproofing of such portions have been completed. Backfill which will place an unequalized horizontal loading on the new Work shall not be placed until the concrete has attained at least 70% of its design strength. To equalize horizontal loadings, the required backfill around the new Work shall be placed on opposite sides at the same time.
- C. Granular material shall be used for backfilling within 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. Spaces excavated and not occupied by the new Work or by the specified backfill material, shall be backfilled with suitable material from the excavation.
- E. After the backfill has been placed and compacted to the flow line elevation of any weep holes indicated on the Plans, the back end of each weep hole shall be covered with not less than 2 cubic feet of coarse aggregate.
- F. Large stones, boulders, broken rocks, concrete, and masonry shall not be used in the backfill.
- G. Backfill shall be carried up to the surface of the adjacent ground or to the elevation of the proposed earth grade, and its top surface shall be neatly graded. Fills around all new Work shall be trimmed to the lines shown on the Plans or as directed by the Engineer.

3.06 COMPACTING BACKFILL

- A. All backfill behind and around the new Work shall be placed in layers, not more than 9 inches in depth, and shall be compacted to not less than 95% of the maximum unit weight.
- B. Areas where the density does not affect the construction, as determined by the Engineer, shall be compacted to not less than 90% of maximum unit weight.
- C. Backfill material shall be placed as specified in MDOT Section 206.03.B, except for the following modifications. The backfill material shall have a moisture content not greater than 3% above optimum, at the time of compaction. If the material contains an excess of moisture, it shall be dried to the required moisture content before being installed.
- D. Each layer of material containing the required amount of moisture shall be compacted to not less than 95% of the maximum unit weight, unless otherwise specified on the Plans or authorized by the Engineer, before the succeeding layer is started.
- E. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 CLEANUP

- A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by the Contractor, at Contractor's expense, as specified in Section 01 89 00.
- B. The construction area shall be graded and left in a neat, workmanlike condition.
- C. At a seasonally correct time, the disturbed area shall be raked, having topsoil placed thereon, fertilized and restored per the requirements of Section 32 9219.

3.08 TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing laboratory approved by the Engineer.

1. The cost for testing and sampling shall be at the expense of the Owner.
- B. The testing laboratory shall furnish the Engineer with two (2) certified copies of the results of all tests. Testing procedures shall conform to current MDOT's Standard Specifications for Construction.
- C. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method A, for Granular Materials, and Method C for all other soils.

3.09 DEFECTIVE WORK

- A. Any portion of the backfill which is deficient in the specified density shall be corrected by the methods meeting the approval of the Engineer. Any extra testing or sampling required because of apparent deficiencies shall be at the Contractor's expense.

END OF SECTION 31 23 16

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 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 03 30 00 - Cast-in-Place Concrete
- E. Section 31 23 16 - Structural Excavation and Backfill
- F. 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 (exhibits to the supplemental conditions). 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. Contractor shall be responsible for the complete design of all structures and methods proposed for dewatering the project site, including the implementation of materials, tools and equipment proposed for use in the Work.
- C. Temporary wiring associated with the dewatering shall 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. Dewatering systems design and construction shall conform to the provisions of 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. Where applicable, the Contractor shall obtain and pay for all permits and inspections for dewatering construction in accordance with the provisions of PA 451, State of Michigan, 1994, and all local government agencies having jurisdiction. No additional claim for compensation shall be allowed because of the Contractor's failure to obtain or pay for such permits and inspections.
- B. 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. The measures shall prevent surface runoff from carrying excavated materials into the waterways, to reduce erosion of the slopes, and to prevent silting in of waterways downstream of the Work. Measures should include provisions to reduce erosion by the wind of areas stripped of vegetation, including material stockpiles.

1.05 FEDERAL, STATE, AND LOCAL REGULATIONS

- A. Dewatering operations shall conform to the requirements of all federal, state, and local agencies having jurisdiction.
- B. Dewatering water shall be discharged to local City of St. Joseph sanitary sewers only and may require permits from federal, state or local agencies having jurisdiction. Contractor shall comply

with all water quality requirements required by the Benton Harbor- St. Joseph Wastewater Treatment Plant and the City of St. Joseph prior to discharging dewatering water. Please see attached letter from the Benton Harbor-St. Joseph Joint Wastewater Treatment Plant.

1.06 PROTECTION

- A. Take steps necessary, during the Work of this Section, to protect surrounding property and adjacent buildings, private water supplies, roads, drains, sewers, structures and appurtenances. Adequate measures shall be taken to protect such property and construction from the effects of the dewatering operations.

1.07 SUBMITTALS

- A. Submit detailed plans indicating proposed type and location of dewatering wells, type and location of collection/conveyance piping, and point of disposal of pumped water. Do not begin any dewatering work until submittals and supporting data have been reviewed by Engineer.
- B. Dewatering system shall be designed by a professional with a minimum of seven years documented experience in the installation and design of dewatering systems. Submittal shall be signed and sealed by a registered Professional Engineer in the state of Michigan, stating that the proposed dewatering method is adequate to perform the required tasks.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Provide electrical power from local utility. Provide stand-by power and other required auxiliary dewatering equipment to ensure continuous dewatering capability. Dewatering, where required, shall be continuous. Dewatering will not be stopped during work stoppage without approval of the Engineer. Coordinate construction operations to minimize duration and extent of dewatering required.
- B. Dewatering wells are to use properly designed filters to prevent the migration of soil fines into the well.

3.02 MONITORING AND CONTROL

- A. During dewatering operations, monitor ground water level with piezometers to ensure the design or specified groundwater elevation is maintained. Install monitoring wells with screens below the excavation level as required. Install wells at 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. Prior to beginning Work, verify in the field the location, type and capacity of existing drainage facilities and conditions which will affect the Work of this Section. No allowances shall be made for conditions found during the progress of the dewatering operations because of the Contractor's failure to verify such conditions.

3.04 EXISTING STRUCTURES AND UTILITIES

- A. Contractor shall make field verification of existing structures and utilities at the site of the Work which are scheduled to remain and which may be affected by the Work of this Section. Contractor shall be responsible for damage to existing structures and/or utilities caused because of his Work and shall repair such damage at Contractor's expense to the satisfaction of the Engineer or utility owner.

3.05 DRAINAGE OF EXCAVATIONS

- A. Contractor shall maintain finished excavation Work free of water during the preparation of the subgrade and until the completion of the Work. No unit of Work shall be constructed under water except as 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 parts of the Work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until construction is complete.
- C. Excavations which extend down to or below the static groundwater elevation shall be dewatered by lowering and maintaining the groundwater level beneath such excavations a distance of not less than 12 inches below the bottom of the excavation. Drainage system methods shall not cause damage to wells or adjacent property.
- D. Outlet drainage piping and conduit shall be kept clean and free from sediment. Contractor shall be held responsible for the condition of existing pipes, conduits and structures which Contractor may use for drainage.

3.06 DEWATERING SUMPS AND PUMP WELLS

- A. Sumps and pump wells used as a part of the dewatering system shall be strongly sheathed and braced to protect the construction while in use. Tops of well casings must be covered to prevent animals and debris from entering and shall be 2 to 3 feet above ground. Sumps and wells, when abandoned, shall be backfilled and compacted to the satisfaction of the Engineer.

3.07 DRILLING

- A. Methods used in drilling wells associated with dewatering systems shall be the responsibility of the Contractor and shall be acceptable to the Engineer.
- B. Drilling methods shall ensure proper placement of well materials and shall not involve displacement of earth formations.
- C. Drilling shall be done with equipment of proper type, in good condition, and acceptable to the Engineer.

3.08 PUMPING

- A. Equipment for pumping and pumping methods associated with dewatering systems shall be the responsibility of the Contractor and shall be acceptable to the Engineer. Contractor shall construct or furnish adequate discharge piping to conduct and dispose of the water so as to prevent damage to existing structures or property.
- B. Pumping equipment shall be of proper type and size for the Work, in good condition, and acceptable to the Engineer. Provide anchors and supports necessary for pumping equipment.
- C. Contractor shall provide pump run times and pump discharge rates to the city and Engineer for all dewatering activities.

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. Earth fills shall be compacted to a density equal to that of the surrounding undisturbed earth.

END OF SECTION 31 23 19

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 33 11 00 - Water Utility Distribution Piping
- I. Section 33 41 00 - Storm Utility Drainage Piping

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM 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 shall provide the Engineer with two (2) certified copies of the test results of the compaction of the backfill.
- B. Testing for compaction and the certification of the test results shall be performed by a testing laboratory approved by 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. 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 drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work.
- C. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.
- D. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 GRANULAR MATERIALS CLASS II

- A. Granular Material Class II shall conform to the requirements for granular material Class II, as specified in MDOT Section 902 except as follows. The granular material shall 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. Concrete shall 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. Fly Ash shall have a maximum loss on ignition of 12% and meet the other requirements of ASTM C618 (Class F).
 - 2. Water shall meet 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. The temperature of the flowable fill mix as manufactured and delivered shall be at least 50 degrees Fahrenheit.
- 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. The area within the vicinity of the trenching operation shall be dewatered in accordance with Section 31 23 19 prior to the trenching operation.
- B. Depth of the dewatering shall be sufficient to allow the trench excavating operation including backfilling and compacting to proceed in a dry condition.

3.02 TRENCH EXCAVATION

- A. Open cut trench excavation shall include the site clearing and grubbing, the excavating of all materials encountered, the supporting and protecting of all structures and/or utilities encountered above and below the ground surface, and the removal of water from the construction site.
- B. The trenching operation shall commence at the downstream or outlet end of the new Work and proceed upstream, unless otherwise specified on the Plans or directed by the Engineer.
- C. The trench shall be excavated in reasonably close conformity with the lines and grades specified on the Plans or as established by the Engineer.
- D. The excavated materials shall be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, improvements, utilities, private property, public property or traffic. The excavated materials shall not be placed at such locations that will endanger the trench banks by imposing loads thereon.
- E. For rigid pipe, the trench shall be of sufficient width to provide adequate working space to permit the installation of the pipe and the compaction of the bedding material under and around the pipe. However, for rigid pipe, the width of the trench from below the pipe bedding to 12 inches above the top of the pipe shall 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. To support the additional load of the backfill when the maximum trench width as specified for rigid pipe is exceeded, the Contractor shall install, at Contractor's expense, concrete encasement which shall completely surround the pipe and shall have a minimum thickness at any point of 1/4 of the outside diameter of the pipe or 4 inches whichever is greater; or at Contractor's expense, install another type bedding, approved by the Engineer. The concrete encasement shall consist of 3,000 psi strength concrete.
- F. For flexible pipe, the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25, plus 12 inches. The maximum trench width for flexible pipe shall not exceed the minimum width by more than 6 inches.
 - 1. To support the additional load of the backfill when the maximum trench width as specified for flexible or semi-rigid pipe is exceeded, the Contractor shall 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.
- G. When, through the Contractor's construction procedure or because of unsuitable existing ground conditions, it becomes impossible to maintain alignment and grade properly, the Contractor, at Contractor's expense, shall excavate below the normal trench bottom grade and shall fill the void with a large size aggregate or 3,000 psi (21 MPa) concrete as approved by the Engineer to ensure that the pipe when laid in the proper bedding will maintain correct alignment and proper grade.
- H. Trench excavations, including those for shafts and structures, shall be adequately braced and/or sheeted where necessary to prevent caving or squeezing of the soil.

3.03 SHEETING, SHORING, AND BRACING

- A. Contractor shall furnish, place and maintain sheeting, shoring, and bracing of the trench and/or shaft as may be required for safety of the workmen and for protection of the new Work or adjacent structures, including pavement, curbs, sidewalks, pipe lines, and conduits next to or crossing the trench; and for the protection and safety of pedestrian and vehicular traffic.

- B. Contractor shall be responsible for the complete design of all sheeting, shoring and bracing Work. The design shall be appropriate for the soil conditions; and shall be of such strength, quality, dimension and spacing as to prevent caving or loss of ground or squeezing within the neat lines of the excavation; and shall effectively restrain movement of the adjacent soil.
- C. Prior to installing the sheeting, shoring or bracing, the Contractor shall submit plans for this Work to the Engineer for informational purposes only.
- D. Sheeting, shoring, bracing, and excavation shall conform to the current federal or state regulations for safety.
- E. Where indicated on the Plans and where necessary in the Work, install and leave sheeting, shoring, and bracing in place. No additional compensation shall be paid to Contractor for sheeting, shoring or bracing left in place.
- F. Supports for pipes, conduits, etc. crossing the trench shall conform to the requirements of the owners of such facilities and if necessary, shall be left in place.
- G. Furnishing, placing, bracing, maintaining, and removing of sheeting, shoring, and trenching materials shall be at the Contractor's expense.
- H. Contractor shall not remove the trench sheeting, shoring and bracing until the pipe has been properly bedded, and the trench backfilled to sufficiently support the external loads.
- I. Sheeting, shoring, and bracing material shall not come in contact with the pipe, but shall be installed so that no concentrated loads or horizontal thrusts are transmitted to the pipe.

3.04 PIPE BEDDING

- A. Install and compact in 6 inch layers. Particular care shall be taken to assure filling and tamping all spaces under, around, and above the top of the pipe. Work in and around pipe by hand to provide uniform support.
- B. Rigid Pipe Bedding:
 - 1. Rigid pipe bedding shall conform to ASTM C1479, except as noted.
 - 2. Class R-A:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/4 of the outside diameter of the pipe, whichever is greater; and shall extend up the sides of the pipe to the horizontal centerline.
 - b. The top half of the pipe shall be covered 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. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and shall extend up the sides of the pipe to the horizontal centerline.
 - b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be granular material Class II. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.
 - 4. Class R-C:
 - a. Pipe shall be bedded in granular material Class II placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a

level not less than 12 inches above the top of the pipe.

- b. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.

C. Flexible Pipe Bedding:

1. Flexible pipe bedding shall conform to ASTM D2321, except as noted. A continuous and uniform bedding shall be provided in the trench for all buried pipe.
2. Class F-I:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. The bedding shall have a minimum thickness beneath the pipe of 4 inches and shall extend up the sides of the pipe until the top of pipe is covered by a minimum thickness of 12 inches.
 - b. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.
3. Class F-II:
 - a. Pipe shall be bedded in crushed stone bedding material placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater; and shall extend up the sides of the pipe to the horizontal centerline.
 - b. Backfill from pipe horizontal centerline to a level not less than 12 inches above the top of the pipe shall be granular material Class II. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of pipe.
 - c. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.
4. Class F-III:
 - a. Pipe shall be bedded in granular material Class II placed on the trench bottom. Bedding shall have a minimum thickness beneath the pipe of four 4 inches or 1/8 of the outside diameter of the pipe, whichever is greater, and the bedding shall extend to a level not less than 12 inches above the top of the pipe. This material shall be placed in 6 inch layers with each layer thoroughly compacted by mechanical means with the finished compacted material a minimum of 12 inches above the top of the pipe.
 - b. Where allowable trench widths are exceeded, bedding shall be used to the full width between undisturbed trench walls. Concrete cradle bedding shall not be used.

3.05 BACKFILLING TRENCHES

- A. Backfill material shall be placed on sections of bedded pipes only after such pipe bedding and backfill materials have been approved by the Engineer.
- B. The trench backfilling shall follow the pipe laying as closely as possible. However, at no time shall the pipe laying in any trench precede backfilling of that trench by more than 100 feet, unless otherwise directed by the Engineer.
- C. Backfilling shall not be done in freezing weather except by permission of the Engineer. Frozen materials shall not be used in trench backfilling.
- D. The following trench backfill specifications are for use in that portion of the trench beyond the scope of the pipe bedding requirements which normally stops at a point 12 inches above the top of pipe. Backfill material to be placed above pipe bedding shall be free of cinders, ashes, refuse, boulders, roots, stumps, trees, timbers, brush, debris, or other extraneous materials which in the opinion of the Engineer, are unsuitable. Rocks or stones having a dimension larger

than 6 inches shall not be placed within three 3 feet of the top of the pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and arranged so that no interference with backfill settlement will result.

- E. The type and method of backfilling is dependent on its location and function and shall conform to the following requirements:
1. Trench B:
 - a. Trenches under road surfaces, pavement, curb, driveway, sidewalk and where the trench edge is within three 3 feet of the pavement and as noted on the plans shall be backfilled with natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.
 - b. Trenches under pavement to be constructed in the near future, as noted or shown on the Plans, shall be backfilled with natural bank run sand, meeting the requirements of granular material Class II, unless otherwise indicated on the Plans.
 - c. Where a pipe is installed under an existing or proposed utility, the backfill between the two shall be natural bank run sand meeting the requirements of granular material Class II, unless otherwise indicated on the Plans, constructed as herein specified.
 - d. The material shall be placed in uniform layers that can be adequately compacted and tested from the surface of that layer and shall be compacted to 95% of the materials maximum unit weight, unless otherwise specified on the Plans or by the Engineer.
 2. Trench A;
 - a. All other trenches shall be backfilled with suitable excavated material placed in uniform layers that can be adequately compacted and tested from the surface of that layer.
 - b. Each layer shall be thoroughly compacted by approved mechanical methods to a density equivalent to the undisturbed adjacent soil or 90% of its maximum unit weight, whichever is less.
 3. Unless otherwise specified on the Plans or as directed by the Engineer, the trench backfill shall be carried to the adjacent existing ground or proposed grade whichever is higher.
 4. Where any backfill or bedding as shown on the plans or specified is to be flowable fill, care shall be used to avoid displacing any pipes or structures due to fluid pressure. Pipes in backfill areas may need to be secured to avoid the buoyancy effect.

3.06 COMPACTING BACKFILL

- A. Compaction of the backfill will not be paid for separately, but shall be considered incidental to the Work of installation of the pipe and backfilling and shall include all the Work of manipulating the soil to obtain the specified densities. No additional compensation will be allowed for any delay required to obtain the specified moisture content or the specified density.

3.07 CLEANUP

- A. Immediately following the placing and compacting of the backfill, the excess material shall be removed and disposed of by the Contractor, at Contractor's expense, as specified in Section 01 89 00. The construction area shall be leveled and left in a neat workmanlike condition.
- B. At a seasonally correct time, approved by the Engineer, the disturbed area shall be raked, having topsoil placed thereon and restored.
1. Restoration with seed, fertilizer and mulch shall be the requirements of Section 32 92 19 .
 2. Restoration with sod shall be in accordance with Section 32 92 23.

3.08 FIELD TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density of the backfill. The taking of samples and the testing required shall be performed by a testing

laboratory suitable to the Owner and approved by the Engineer.

- B. The maximum unit weight, when used as a measure of compaction or density of soils, shall be understood to mean the maximum unit weight per cubic foot or per cubic meter as determined by ASTM D1557, Method C.

3.09 DEFECTIVE WORK

- A. Any portion of the trench backfill which is deficient in the specified density shall be corrected by methods meeting the approval of the Engineer.
- B. Any extra testing or sampling required because of deficiencies shall be at the Contractor's expense.

END OF SECTION 31 23 33

SECTION 31 35 00 SLOPE PROTECTION

PART 1 GENERAL

1.01 SCOPE

- A. This Section includes plain riprap, grouted riprap, concrete slope paving, precast concrete block slope paving, interlocking precast concrete slope paving, grouted flagstone, crimped straw, hydroseeding with cellulose, wood fiber mulch, wire mesh gabions, precast concrete grid slope pavers, geotextile filter fabric, and concrete bag slope protection.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 04 05 11 - Mortaring and Grouting
- D. Section 32 92 19 - Seeding
- E. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM A90: Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
 - 2. ASTM A239: Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles
 - 3. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 4. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 5. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 6. ASTM D4355/D4355M: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus
 - 7. ASTM D4491/D4491M: Standard Test Methods for Water Permeability of Geotextiles by Permittivity
 - 8. ASTM D4533/D4533M: Standard Test Method for Trapezoid Tearing Strength of Geotextiles
 - 9. ASTM D4632/D4632M: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - 10. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile
 - 11. ASTM D6241: Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile- Related Products Using a 50-mm Probe
 - 12. ASTM G153: Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
 - 13. Michigan Department of Transportation (MDOT), Standard Specifications for Construction, latest edition.

14. U.S. Department of Commerce, National Bureau of Standards.

1.04 SUBMITTALS

A. Manufacturer's Literature:

1. Submit manufacturer's literature describing materials and fabrication methods for the type of geotextile filter fabric, wire mesh gabions, precast concrete slope pavers, preseeded erosion control blankets and precast concrete grid pavers proposed for use in the Work.

B. Samples:

1. Submit samples of the types of geotextile filter fabric proposed for use in the Work to the Engineer.

C. Shop Drawings:

1. Submit shop drawings of wire mesh gabions showing wire sizes, finishes, fabrication, assembly and erection methods for all wire mesh gabions proposed for use in the Work.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Geotextile Filter Fabric:

1. During delivery, storage, and handling, geotextile filter fabric shall be wrapped in a heavy duty covering which will protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140 degrees Fahrenheit, mud, dirt, dust, debris and the elements.

B. Wire Mesh Gabions:

1. When polyvinyl chloride coated wire mesh gabions are used in the Work, these units shall be protected against freezing temperatures during delivery, storage, handling, also damage to PVC coating.

1.06 CONDITIONS

A. Temperature:

1. Comply with the requirements for placing slope protection materials due to outside ambient air temperatures as specified in this Section.

B. Subbase Conditions:

1. Comply with the requirements for placing slope protection materials on prepared subbase because of frost and freezing conditions as specified in this Section.

C. Slope Protection Materials:

1. Comply with the requirements for protection of slope protection materials during curing periods as described in this Section.

1.07 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. The measures shall prevent surface runoff from carrying excavated materials into the drain, to reduce erosion of the slopes, and to prevent silting in of drain downstream of the Work. Measures should include provisions to reduce erosions by the wind of all areas stripped of vegetation, including material stockpiles.

- B. Comply with requirements of Section 01 57 13.

PART 2 PRODUCTS

2.01 FORM WORK

- A. Forms for concrete shall be metal or wood. Forms shall be straight, free from warps and of sufficient strength to resist springing during depositing of the concrete against the form

surfaces.

2.02 CONCRETE

- A. Concrete shall conform to MDOT Section 1004, use 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.

2.03 CONCRETE REINFORCEMENT

- A. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.

2.04 MEMBRANE CURING COMPOUND

- A. Curing compound shall be a transparent membrane type material conforming to ASTM C309, Type I, Class B vehicle. Test for moisture retention, reflectance and drying time, when performed, shall be based on a curing compound application rate of one 1 gal per 200 sft of surface.

2.05 STONE RIPRAP

- A. Stone for riprap shall be sound, tough, durable rock, free from structural defects. Stone shall be a minimum of 8 inch thick measured perpendicular to the slope, with a least surface dimension of 12 - 16 inches measured parallel to the slope. Maximum to minimum ratio shall not exceed 3:1.

2.06 CONCRETE RIPRAP

- A. Sound pieces of broken concrete free of soil, protruding reinforcing steel, bituminous and other similar materials, with a minimum thickness of 8 inch and a least surface dimension of 12 - 16 inches measured parallel to the slope. Maximum to minimum ratio shall not exceed 3:1.

2.07 PRECAST CONCRETE BLOCK

- A. Precast concrete block shall be factory cast concrete units of the sizes indicated on the Plans. Precast concrete block shall attain a minimum compressive strength of 3000 psi in 28 days and have a maximum water absorption rate of ten 10 lbs / cft when tested in accordance with ASTM C140/C140M with the following exceptions:
 - 1. Compressive Strength:
 - a. Compression test specimens having surface dimensions of 4 inch x 4 inch will be sawed from the units. The specimen will be tested with the load applied in the direction of the unit thickness.
 - 2. Absorption:
 - a. Amount of absorption of water shall be determined on half of the same unit from which the compression test specimen was sawed.

2.08 PRECAST CONCRETE GRID SLOPE PAVERS

- A. Precast concrete grid slope pavers shall conform to the minimum physical properties listed below:

Length	23 inches
Width	15 inches
Thickness	4 inches
Area, Gross	345 square inches
Area, Upper Surface	95 square inches
Area, Base Surface	326 square inches
Bearing Capacity	100 lbs / sft
Strength, Compressive	4000 psi

2.09 INTERLOCKING PRECAST CONCRETE SLOPE PAVERS

- A. Interlocking precast concrete slope pavers shall be composed of precast concrete blocks which interlock together either through a mechanical system or through the design of the blocks themselves. The blocks shall be laid on a geotextile fabric.
- B. The precast concrete block units shall have the following minimum properties:

Comprehensive Strength	2500 psi
Weight	25 lbs / sft
Thickness	4 inches

- C. The system when assembled shall have a minimum of 20% open area suitable for sustaining vegetation.
- D. The geotextile fabric shall be either a woven or nonwoven polypropylene with apparent opening size per ASTM D4751 less than 30 US Std Sieve.
- E. The mechanism for interlocking the precast concrete units shall be noncorrosive and suitable for its intended use.

2.10 EROSION CONTROL

- A. Contractor shall stabilize areas using straw crimped into the ground using a mulch anchoring tool (disc with vertical coulters), hydroseeding with a cellulose, or wood fiber mulch per Section 01 57 13 - Temporary Erosion and Sediment Control.

2.11 FLAGSTONE

- A. Flagstone shall be sound, tough, durable limestone or seasoned sandstone slabs, free from structural defects. Flagstone shall be irregular shaped units of the thickness indicated on the Plans. Aggregate sizes of individual flagstone units incorporated in the overall flagstone work shall be as follows:
 - 1. 25% approximately 64 sq inches
 - 2. 50% approximately 144 sq inches
 - 3. 25% approximately 324 sq inches

2.12 STONE FILL FOR GABIONS

- A. Stone fill used in gabion units shall be sound, tough, durable aggregate with a minimum size of 4 inches based on U.S. Standard square mesh sieves. Stone shall be free of cracks, seams, and other defects that would unduly increase deterioration of the material from natural causes or reduce its size.
- B. The inclusion of objectionable quantities of dirt, sand, clay, and rock fines as determined by the Engineer will not be permitted. Sound pieces of broken concrete, without protruding reinforcement, may be used in place of stone where approved by the Engineer.

2.13 WIRE MESH GABIONS

- A. Galvanized Steel Wire Mesh Gabions:
 - 1. Gabion basket units shall be of non-raveling construction and fabricated from a triple twisted hexagonal mesh of hot dipped galvanized steel wire having a minimum diameter of 0.118 inches after galvanization. Steel wire used shall be galvanized prior to fabrication into mesh.
 - 2. Gabion diaphragm and frame wire shall equal or exceed Federal Specification QQ-W-461H , possess medium tensile strength and a Finish 5, Class III zinc coating of not less than 0.8 oz / sft of uncoated wire surface. The test for weight of zinc coating shall be as determined by ASTM A90. The uniformity of coating shall equal or exceed four, 1-minute dips by the Preece Test; ASTM A239.

3. Mesh openings shall be hexagonal in shape, and uniform in size measuring not more than 3-1/4 x 4-1/2 inches.
 4. Selvedge or perimeter basket frame wire shall be of heavier gage than the wire mesh with a minimum diameter after galvanizing of 0.150 inches.
 5. Wire used for lacing or as internal connecting wire within basket cells may be of soft tensile strength and of lighter gage with a minimum diameter after galvanizing of 0.0866 inches.
- B. Polyvinyl Chloride (PVC) Coated Galvanized Steel Wire Mesh Gabions:
1. Polyvinyl chloride coated gabion basket units shall be of unraveling construction, fabricated from a triple twisted hexagonal mesh of hot dipped galvanized steel wire having a minimum diameter of 0.105 inches after galvanizing and additionally coated with a minimum of 0.020 inches of PVC.
 2. The steel core wire used shall be galvanized and PVC coated prior to fabrication into mesh.
 3. The core wire of all gabion diaphragm and frame components shall equal or exceed Federal Specification QQ-W-461H , shall possess medium tensile strength and a Finish 5, Class III zinc coating of not less than 0.8 oz / sft of uncoated wire surface.
 4. Mesh openings shall be hexagonal in shape and uniform in size measuring not more than 3-1/4 x 4-1/2 inches.
 5. Selvedge or perimeter basket frame core wire shall be of heavier gage than that of the wire mesh with a minimum diameter after galvanization of 0.132 inches, and an overall diameter (core wire plus PVC coating) of 0.174 inches.
 6. Coated wire used for lacing or as internal connecting wire within basket cells may be of soft tensile strength and an overall diameter (core wire plus PVC coating) of 0.127 inches.
 7. The PVC coated wire of all gabion components shall be resistant to the destructive effects of immersion in acidic, salt, or polluted water, exposure to ultraviolet light and abrasion, and retain these characteristics after a period of not less than 3,000 hours under test in accordance with ASTM G153.
- C. Fabrication:
1. Gabions shall be fabricated in such a manner that they can be assembled at the construction site into rectangular baskets of the sizes specified and shown on the Plans. Gabions shall be of single unit construction.
 2. Gabion base, lid, ends, and sides shall be either woven into a single unit or one edge of these members connected to the base section of the gabion in such a manner that strength and flexibility at the point of connection is at least equal to that of the mesh.
 3. Where the length of the gabion exceeds 1-1/2 times its horizontal width, the gabion shall be equally divided by diaphragms of the same mesh and gauge as the body of the gabions, into cells whose length does not exceed the horizontal width.
 4. Gabion shall be furnished with the necessary diaphragms secured in proper position on the base in such a manner that, during assembly, no additional tying will be necessary.
 5. Perimeter edges of the mesh forming the gabion shall be securely selvedged so that the joints formed by tying the selvedges have at least the same strength as the body of the mesh.
 6. Lacing wire or connecting wire shall be supplied in sufficient quantity for securely fastening all diaphragms and edges of the gabion.

2.14 GEOTEXTILE FILTER FABRIC

- A. Geotextile filter fabric material shall be a non-woven, needle punched fabric consisting of compositions of at least 85% by weight polyolefins, polyesters, or polyamides. The geotextile filter fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which adversely alter its physical properties.
- B. The fabric shall conform to the following physical strength requirements:

Physical Property	Test Procedure	Acceptable Test Result
Tensile Strength	ASTM D4632/D4632M	120 lbf
CBR Puncture Strength	ASTM D6241	300 lbf
Elongation	ASTM D4632/D4632M	50% min
Trapezoidal Tear	ASTM D4533/D4533M	50 lbf
Permittivity	ASTM D4491/D4491M	1.7 sec ⁻¹ min
Ultraviolet Degradation	ASTM D4355/D4355M	70% of minimum degradation strength retained after weathering for 500 hours
Apparent Opening Size	ASTM D4751	70 US Standard Sieve

- C. The seams of the fabric shall be sewn with thread of a material meeting the chemical and physical requirements listed above or shall be heat or cement bonded. The strength of seams shall be not less than 90% of the required tensile strength of the filter fabric in any principle direction.

2.15 BURLAP BAGS

- A. Bags shall have maximum dimensions of 18 x 24 inches and shall be made of ten (10) ounce burlap.

2.16 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers of turf and soil concrete grids include:
1. Mono Slabs by Fendt Builders Supply, Inc.
 2. Engineer approved equal.
- B. Gabions:
1. Maccaferri Gabions, Inc.
 2. Bekaert Steel Wire Corp.
 3. Engineer approved equal
- C. Interlocking Precast Concrete Slope Pavers: Subject to meeting any requirements as shown on the plans or specified elsewhere.
1. Tri-lock Erosion Control System by American Excelsior Co.
 2. Tri-lock Erosion Control System by American Excelsior Co.
 3. Engineer approved equal

PART 3 EXECUTION

3.01 VERIFICATION OF SUBBASE

- A. Riprap and Slope Paving Materials:
1. Prior to the installation of any riprap or paving materials, examine the subbase to receive such material for the proper grades and lines required to receive the Work. Ascertain that subgrades and bedding are adequate to receive slope protection. Correct defects and deficiencies before proceeding with Work.

B. Geotextile Filter Fabric:

1. Prior to installation of any geotextile filter fabric, verify that the surfaces to receive fabric are prepared to relatively smooth grades, free of obstructions, depressions, debris and soft or low density pockets of material. Correct defects and/or deficiencies prior to installation of fabric so that fabric will not be damaged.

3.02 PREPARATION - GENERAL

- A. Prepare surfaces to receive slope protection materials as indicated on the Plans and as specified herein.

3.03 BEDDING MATERIALS

- A. Install bedding materials of the types indicated on the Plans and as required to receive the slope protection materials.
- B. Remove buried debris protruding through the bedding material that will impede or damage the proper installation or affect the final appearance of the slope protection installations. Fill voids of installed bedding materials and compact as directed by the Engineer.
- C. Fill voids of installed bedding materials and compact as specified herein or as directed by the Engineer.

3.04 EXAMINATION OF MATERIALS

A. Geotextile Filter Fabric:

1. Prior to installation, inspect geotextile filter fabric for defects, rips, holes, contamination or deterioration. Replace defective geotextile filter fabric as directed by the Engineer.

B. Wire Mesh Gabions:

1. Prior to installation, inspect wire mesh gabions for defects or damage due to manufacture, handling or storage which would substantially affect gabion installation and performance. Replace defective or damaged wire mesh gabions as directed by the Engineer.

3.05 INSTALLATION GENERAL

- A. Material for bedding, where required, shall be spread uniformly on the prepared subbase to the slopes, lines, levels and grades indicated on the Plans in a manner satisfactory to the Engineer. Bedding methods shall not cause segregation of bedding material particle sizes or damage to prepared subbase.
- B. Repair defective or damaged work to the satisfaction of the Engineer.
- C. Bedding shall be compacted and finished to present a reasonably even surface, free from mounds or windrows.
- D. Install formwork for concrete headers, cast-in-place concrete slope paving and weep holes for riprap paving where indicated on the Plans. Forms shall be the full depth of the concrete.
1. Forms shall be firmly staked to the required line and grade.
 2. Slab division forms shall be placed so that the slab division joints are straight and continuous.

3.06 CONCRETE SLOPE PAVING

- A. Construct concrete slope paving on the prepared subgrade to the lines and levels and according to the details indicated on the Plans. Prepared subgrade shall be thoroughly wetted and the concrete deposited to the proper depths. Concrete shall be placed in blocks having dimensions indicated on the Plans. Place concrete in alternate blocks. Pour remaining blocks after first blocks are placed.
- B. No concrete shall be placed unless the temperature of the air away from artificial heat is at least 25 degrees Fahrenheit and rising, unless otherwise allowed by the Engineer.

- C. Place no concrete against frost or frozen materials.
- D. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit.
- E. Thoroughly spade concrete along the faces of forms before finishing operations are started. Alternately tamp and strike off concrete with a strike board until voids are removed and the surface reaches the required grade and cross section.
- F. Finish the concrete surfaces with a wood float. Round edges and joints to a radius of 1/4 inch with an approved finishing tool.
- G. The concrete shall be cured for a minimum of four days by being kept continuously wet or by the application of transparent membrane curing compound.
- H. Protect the concrete from freezing until the concrete has attained at least 100 psi flexural strength.
- I. Protect concrete against foot traffic for a minimum of 24 hours.

3.07 CONCRETE HEADERS

- A. Construct cast-in-place concrete toe and side headers of the types, sizes and to the lines and levels indicated on the Plans.
- B. Placing, curing and protection of concrete headers shall be as described herein.

3.08 GEOTEXTILE FILTER FABRIC

- A. Place geotextile filter fabric on the prepared subbase in the manner and at the locations shown on the Plans. Fabric shall be laid smooth and free of tension, stress, folds, wrinkles or creases.
- B. Fabric strips shall be placed to provide a minimum overlap of 24 inches for each joint. Fabric shall be placed so that the upper strip will overlap the next lower strip. Install securing pins with washers through both strips of overlapped fabric along a line through the midpoint of the overlap at center-to-center spacings as recommended by manufacturer unless otherwise indicated on the Plans. Washers shall bear against fabric to secure firmly to subbase.
- C. Additional pins shall be installed as necessary to prevent slippage of the filter fabric. Securing pins shall be steel, 3/16 inch minimum size, pointed at one end, of lengths as recommended by manufacturer unless otherwise indicated on the Plans; but not less than 18 inches long. Washers shall have an outside diameter of not less than 1-1/2 inch.
- D. Schedule the Work so that fabric is covered with slope protection materials specified within seven days after placing fabric. Failure to comply shall require replacement of fabric.
- E. Filter fabric shall be protected from damage by limiting the height of drop of slope protection material or by placing a cushioning layer of sand on top of fabric before placing other material.

3.09 AGGREGATE FILTER DRAINAGE LAYERS

- A. Install aggregate filter drainage layers in the locations and to the lines and levels indicated on the Plans.
- B. Gradation of aggregate for filter drainage layers shall be as detailed.
- C. Spread and compact aggregate as indicated.

3.10 PRECAST CONCRETE SLOPE PAVING

- A. Unless otherwise specified, the precast concrete slope paving shall be laid on a prepared subbase as indicated on the Plans. Units shall be laid beginning at toe of slopes.
- B. Joints shall be as detailed and shall be filled with mortar. Edges of precast units shall be moist when the mortar is placed. Mortar shall be placed from bottom to top and sufficient mortar shall be used to construct solid joints. Mortar shall be worked with suitably approved tools to completely fill the joints between the units. Excess mortar shall be removed from the surface of

the precast concrete units.

- C. Precast concrete slope paving shall be cured and protected as specified herein.

3.11 PLAIN RIPRAP SLOPE PAVING

- A. Stone for riprap shall be placed on the prepared subbase commencing at the toe of the slope and progressing upward; each stone being laid by hand. Stone shall be placed in a manner as to produce a reasonably well graded mass with a minimum practicable percentage of voids.
- B. Riprap along the lower edge of an area shall consist of the largest stones.
- C. Except for small stones used to fill voids between larger stones, no stone shall be used in the exposed face of the riprap which will extend less than 1/2 the riprap thickness, and shall be placed within the tolerances and to the lines and levels shown on the Plans.
- D. Riprap shall be placed to a full course thickness in one operation and in a manner to avoid displacement of subbase.
- E. Larger stones shall conform to the gradation indicated on the Plans and be well distributed over the area. Rearranging of individual stones will be required as necessary to obtain a reasonably well graded distribution of stone sizes.
- F. Riprap and bedding shall be thoroughly compacted as the construction progresses to provide an even, tight surface.
- G. Riprap protection shall be placed immediately after the embankment is completed.

3.12 GROUTED RIPRAP SLOPE PAVING

- A. Riprap shall be carefully placed in the prepared subbase to the lines and levels indicated on the Plans, with the joints between the stones left open to receive the grout. Stone shall be placed in a manner as to produce a reasonably well graded mass with a minimum practicable percentage of voids.
- B. Where indicated on the Plans, construct weep holes in the riprap by placing approved forms on the subbase and placing the riprap around the forms. Weep holes shall be filled with the material used for bedding of riprap and, during the grouting work, care shall be taken to prevent mortar from entering the weep holes.
- C. Prior to grouting, all surfaces of the riprap shall be thoroughly wetted. The riprap shall be grouted in successive longitudinal strips, approximately 10 feet in width, starting at the lowest strip and working up the slope.
- D. Each batch of mortar shall be placed on the upper portion of the ungrouted portion of the strip and worked into the voids between the stones and down the slopes. Grout shall be distributed over the surfaces of the strips by the use of brooms and worked into place between the stones by the use of spades, trowels, vibrators or other approved equipment.
- E. Adequate precautions shall be taken to prevent the grout from penetrating the stone bedding material. Faces of riprap stones shall remain exposed.
- F. As a final operation, the grout shall be removed from the top surfaces of the riprap stones and from pockets and depressions in the stone faces by use of a stiff stable broom or brush.
- G. Riprap shall not be grouted when the ambient temperature is below 35 degrees Fahrenheit or above 85 degrees Fahrenheit, nor when the grout, without special protection, is subject to freezing temperatures before final set has occurred.
- H. Protect grouted riprap surfaces from rain, flowing water and mechanical injury. No workmen or any load shall be permitted on the grouted riprap surfaces for a period of at least 24 hours.

3.13 GROUTED FLAGSTONE SLOPE PAVING

- A. Flagstone shall be placed on prepared subbase to the lines and levels indicated on the Plans. Prior to placing flagstone, the subbase shall be wetted. Placing of flagstone shall begin from the bottom of the slope and proceed upward, in courses, to the top.

- B. Stones shall be laid flat with the smoother faces of the stone exposed. Stone shall be laid with well broken joints and a minimum of space between units. The space between flagstone joints shall be swept clean of sand and other materials to the full depth of the stones and filled with mortar.
- C. The edges between the stones and the subbase between the stones shall be wetted and the surfaces damp when the mortar is placed. Mortar shall be placed in such a manner as to fill the joints completely to the full depth of the stones, but no mortar shall be left on top of the stones.
- D. Each joint shall be filled with mortar individually. Depositing a volume of mortar on top of the stones and sweeping it into the joints will not be permitted. The top surface of the joints shall be finished flush with the stones, and any excess mortar around the joints or on the face surface of the stones shall be removed with a stiff brush or by other approved means.
- E. flagstone shall not be grouted when the ambient temperature is below 35 degrees Fahrenheit or above 85 degrees Fahrenheit, nor when the grout, without special protection, is subject to freezing temperatures before final set has occurred.
- F. Protect grouted flagstone surfaces from rain, flowing water and mechanical injury. No workmen or load shall be permitted on the grouted flagstone surfaces for a period of at least 24 hours.

3.14 PRECAST CONCRETE GRID SLOPE PAVERS

- A. Grid slope pavers shall be placed on a prepared subbase to the lines and levels indicated on the Plans. Placing of pavers shall begin from the bottom of the slope and proceed upward in courses to the top. The lowermost course of pavers shall be laid with the slab longitudinal members horizontal along the bank, succeeding courses shall be laid to the desired height.
- B. Where indicated on the Plans and where necessary, provide and install wooden stakes, of sufficient size, to anchor slabs. Stakes shall be placed at the lowermost paving course and, alternately, two (2) or three (3) slab widths apart. When laying is completed, fill the interstices of the slab grids to within 1 inch of the top with earth fill as specified on the Plans.

3.15 INTERLOCKING PRECAST CONCRETE SLOPE PAVERS

- A. Area(s) to receive interlocking precast concrete slope pavers shall be free of obstructions such as tree roots, rocks, or other protruding objects or foreign materials.
- B. Voids or soft areas shall be filled with acceptable material and areas will be suitably compacted. Where necessary, hand dressing will be required.
- C. Interlocking precast concrete slope pavers shall be laid on a geotextile filter fabric. Installation of the geotextile fabric shall occur in stages.
 - 1. The geotextile shall be spread at a maximum rate of 200 - 250 square yards or that portion of the geotextile fabric which will be covered by block during the work day.
 - 2. Geotextile fabric shall not remain exposed to U.V. for an extended period.
- D. Geotextile fabric shall be anchored using 12 inch x 3/16 inch pins with 1-1/2 inch diameter washers. Pins shall be placed at 2 foot intervals on edges of geotextile and at 3 foot intervals on interior areas of geotextile.
- E. Overlap at seams a minimum of 24 inches.
- F. Upper geotextile sections will overlap.
- G. Installation of interlocking precast concrete slope pavers shall begin with blocks being placed in a straight line perpendicular to the direction of lay and will continue in a sequential manner. As installation continues, straight lines must be maintained.
- H. Key, toe, and flank trenches shall be constructed and backfilled as shown on the Plans.
- I. When placement of interlocking precast concrete slope pavers is complete, fill voids in lower five feet of pavers with MDOT 21AA crushed limestone. Fill voids in remaining pavers with topsoil, seed, fertilizer, and mulch.

3.16 WIRE MESH GABIONS

- A. Empty wire mesh gabion units shall be assembled at the site of the Work in strict accordance with the printed instructions of the manufacturer of the gabion units. No substitution shall be allowed for lacing wire specified in this Section or that recommended by the wire mesh gabion manufacturer.
- B. Empty gabion units shall be placed on the prepared subbase to the lines, levels and grades indicated on the Plans. Units shall be placed with sides, ends and diaphragms erected to insure the correct position of all creases and that tops of all sides are level.
- C. After installation, adjoining empty gabion units shall be connected by tie wire lacing along the perimeter of their contact surfaces to obtain a monolithic structure. Lacing of adjoining basket units shall be accomplished by continuous stitching with alternating single and double loops at intervals of not more than 5 inches. Lacing wire terminals shall be securely fastened. The use of clip connections to effect final lid closing will not be permitted.
- D. After the initial course of baskets are placed, they shall be partially filled with stone to provide anchorage against deformation and displacement during filling operation.
- E. After adjoining empty baskets are set to line and grade, and common sides with adjacent units, thoroughly laced, the units shall be placed in tension and stretched to remove any kinks in the mesh and to bring units to full, uniform alignment. Stretching of empty basket units shall be done in a manner that will prevent unraveling of wire mesh.
- F. For gabion units 24 inches or more in depth, a minimum of two (2) uniformly spaced connecting wires shall be placed between each stone layer in all cells connecting compartment faces parallel to earth banks.
- G. Connecting wires shall be looped around one mesh opening at each basket face and the wire terminals securely twisted to prevent loosening. For gabion units over 4 feet in depth, a minimum of two (2) uniformly spaced vertical connecting wires per cell, linking the foundation mesh to the basket lid mesh, shall be provided.
- H. The outer layer of stone shall be placed and arranged by hand to insure a neat and compact appearance along all exposed faces. The final layer of stone shall level with the top of the gabion units for proper lid closing.
- I. Lids shall be stretched tight over the stone fill using suitable lid closing tools so that the lid meets the perimeter edges of the front and end panels. Tightly lace all edges, ends and internal cell diaphragms.
- J. Turn all wire projections into baskets. Where complete gabion units cannot be installed, cut, fold and wire baskets to suit site conditions.
- K. Proceed carefully with stone filling operations using hand or machine methods which will not damage the wire mesh coatings of the units. Placing methods shall assure a minimum of voids between stones.
- L. Alignment of the gabion basket units shall be maintained throughout the filling operation. Undue bulging or localized deformation of the basket units shall be avoided by filling in stages of 12 inches courses. At no time shall cell be filled to a depth exceeding 12 inches or more than adjoining cells. Maximum stone drops shall be 3 feet.

3.17 CONCRETE BAG RIPRAP

- A. Bags of unhardened concrete shall be placed as indicated on the Plans, on the prepared subgrade commencing at a concrete base at the toe of the slope and progressing upward. The concrete base shall be no less than 12 inches in width and thickness, with the end of the culvert embedded 4 inches.
- B. Concrete, when placed into the bags, shall be wet enough so that when set into place the bags will adhere together to form a solid wall. Bags shall be filled to 2/3 capacity.

- C. Steel bars, 1/2 inch diameter and no less than 24 inches long, shall be driven through the top row of bags at 12 inches on center. Protrusion of bars from bags will not be permitted.
- D. A 4 inch thick concrete cap shall be placed to the full width and length of the top row of bags.
- E. No concrete shall be placed unless the temperature of the air away from artificial heat is at least 25 degrees F and rising, unless otherwise allowed by the Engineer.
- F. Place no concrete against frost or frozen materials.
- G. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees Fahrenheit.

3.18 FIELD QUALITY CONTROL

- A. Upon completion of the slope protection, the Work shall be final inspected. The final inspection shall consist of a check to confirm the proper placement and backfill of the protection material, assure slopes and elevations as indicated on the Plans and completion of related earth Work.

END OF SECTION 31 35 00

SECTION 31 50 00
TEMPORARY EXCAVATION SUPPORT SYSTEMS

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. 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 are included in the Contract Drawings. Temporary excavation support for all the other near surface excavations shall be designed by the Contractor.

1.02 RELATED SECTIONS SPECIFIED ELSEWHERE

- A. Section 31 23 19 – Control of Groundwater and Surface Water 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. Definitions of terms in OSHA 29 CFR, Subpart P - Excavations, 1926.650(b), in its entirety, shall apply 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 specialty Subcontractor qualifications a minimum of 30 days prior to the execution of the excavation. Qualifications shall demonstrate experience in the

design and construction of at least three prior projects that are similar in nature 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. The plan must be submitted at least 30 days prior to the execution of the excavation and it shall include the following information:
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.

1.06 MANUFACTURE'S SPECIFICATIONS FOR BENTONITE INCLUDING LABORATORY TEST RESULTS.

1. Details of testing methods used to verify the effectiveness of mix design, with respect to strength, hydraulic conductivity criteria and acceptance criteria.
- B. 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
- C. For protective systems for trench excavations, submit, as applicable:
- D. OSHA soil classifications used in design
1. Tabulated data used in design
 2. For sloping and benching systems, submit trench configurations and maximum allowable slopes.
 3. 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.
 4. 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.

1.07 QUALITY ASSURANCE

- A. Qualifications:
1. For Cement-Bentonite (C-B) wall construction:
 - a. Contractor shall meet the same qualifications listed in Specification Section 31 56 00 - Slurry Walls.
- B. Testing of bentonite slurry shall be performed by the Contractor as required hereinafter with the results of every test submitted to the Contractor within the time limit specified herein. Testing methods and equipment shall be 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.
- C. Slurry Trench Excavation Bottom Inspection: Contractor shall measure and record the excavation bottom elevation in the presence of the Owner at the following stages to determine whether soil from trench/excavation sides or other sediment has collected:
1. Immediately after excavation to the final depth.
 2. Immediately after each cleaning and desanding.
- D. Testing and inspection of soldier pile and cast-in-place concrete shall be in accordance with requirements specified elsewhere in the Contract Documents.

1.08 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. Temporary excavation support systems shall provide lateral support, prevent loss of ground, limit ground displacements, and prevent damage to adjacent property (i.e. utilities, structures, roadways, and other facilities) through the entire duration of the excavation activities, and until after design strength of the final structures has been reached.
 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. Temporary excavation support systems shall be set out and constructed to maintain the minimum clear dimensions for permanent structures as shown on the Contract Drawings and to provide adequate working space to construct the permanent structures.
 2. Guide wall tolerances for C-B walls shall be the same as those specified in Specification Section 31 56 00 – Slurry Walls.
 3. Verticality of drilled soldier piles and C-B panels shall be checked every 15 feet of depth during excavation of each element as a minimum. Vertical tolerance shall not exceed 0.5% of the depth.
 4. The depth of the support of excavation system shall not deviate more than 1-ft from the planned depth, unless accepted by the Owner to accommodate field conditions.

1.09 INITIAL GROUND SUPPORT SYSTEMS SHOWN ON DRAWINGS

- A. Contractor shall evaluate the initial support system designs shown on the Drawings and shall provide additional capacity as necessary to ensure the design is fully compatible with the means and methods of construction.

- B. Contractor may 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 to minimum requirements and any limitations included in the Contract Documents.
- C. Contractor shall be solely responsible for any revision of designs shown, and for design of all connections. The design shall be prepared and sealed by a registered Professional Engineer licensed in the State of Michigan, having at least 5 years of experience designing similar support systems in similar ground conditions.

1.10 INITIAL GROUND SUPPORT SYSTEM DESIGN BY CONTRACTOR

- A. Contractor shall be solely responsible for design of initial ground support systems not shown on the Drawings. The design shall be prepared and sealed by a registered Professional Engineer licensed in the State of Michigan, having at least 5 years of experience designing similar support systems in similar ground conditions.
- B. Initial ground support systems shall be designed to the minimum ground loads, hydrostatic loads, and surcharge loads provided in the Geotechnical Baseline Report (GBR). Contractor shall verify that ground loads and surcharge loads for design are adequate for the expected ground conditions, and are appropriate for the type of support system proposed. Contractor shall add construction loads appropriate to the means and methods of construction.
- C. Design of the initial ground support system shall consider:
 - 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

1.11 TRENCH EXCAVATIONS

- A. Protective systems for trench excavation shall conform to OSHA 29 CFR Subpart P, section 1926.652. Protective systems as defined in 1926.652 include sloping and benching systems, shield systems, and support systems.
- 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.

PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Liner Plates:
 - 1. Conform with the requirements of 31 72 00, Tunnel and Shaft Initial Support Systems.
- B. Steel Pile:
 - 1. Structural steel piles shall be rolled steel sections of the weight, shape, and length shown. The material in steel piles shall be structural steel meeting the requirements of ASTM A572/A572M or ASTM A690/A690M. The minimum yield point shall be 50,000 psi.
 - 2. Splices in steel piles shall be made by a full penetration butt weld of the entire cross section. Care shall be taken to properly align adjacent sections so that the axis of the pile

will be straight. Splices in the top 10-feet of the piles will not be permitted. All welding shall be performed by qualified welding operators.

C. Timber Lagging:

1. Wood graded for an extreme fiber stress of at least 1,000 psi. Timber dimension shall be 4"x6" nominal with maximum 8'-0" long. The material of Timber lagging shall be Spruce-Pine-Fir, Mechanically Graded or equal.

D. Internal Bracing System:

1. Structural steel: The material in walers, struts, pile bracing, points, caps, and splices shall be structural steel 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. Bolts for connections shall be ASTM F3125/F3125M, unless indicated otherwise. Bolts used to connect dissimilar metals shall be ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.

E. Structural members shall be furnished full length without splices unless otherwise indicated or approved by the Owner.

F. Cement-Bentonite Slurry:

1. Portland Cement: ASTM C150/C150M, Type I or Type II.

G. Slurry:

1. Refer to Specification Section 31 56 00 – Slurry Walls for minimum requirements for the slurry mix.

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. Initial support systems shall not 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. Initial ground support systems for structure excavations in soil shall consist of 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.
- B. Driven or vibrated sheeting shall not be used.
- C. Bracing members called for in the initial ground support system design shall be installed 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. Contractor shall have equipment on-site able to advance the pre-excavated hole, for installation of the 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. After completion of structure construction and excavation backfilling, steel piles shall be left in-place and cut off at a minimum 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. The maximum permissible height of unlagged (unsupported) face of excavation shall not exceed three (3) feet. If water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation, the maximum height of unlagged face shall not exceed eight (8) inches.
- 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): Prior to commencing guide wall construction, the alignment of the wall shall be pre-excavated to a minimum depth of 10 feet from top of wall to remove obstructions, rubble, loose fill and unsuitable materials. The width of the pre-excavation zone shall be at least twice the thickness of the C-B wall and shall be backfilled with stable, excavatable material and meet the clean fill criteria required elsewhere in the Contract Documents. Support of pre-excavation shall be in accordance with the requirements specified elsewhere in the Contract Documents.
- C. Guide walls shall be continuous, cast-in-place reinforced concrete placed on a stable subgrade. Where fill debris exists at the guide-wall bearing surface, either remove the debris or stabilize the ground to provide a stable bearing. Use suitable temporary internal bracing or other

stabilizing measures as necessary to prevent guide wall movement.

- D. Protection: If at any time the safety of any existing or new construction, utilities, roadways, walkways, or other facilities, shall appear to be endangered, take all necessary means to protect such structures, utilities, etc.

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. Trenches shall be excavated by clamshell, hydromill, or other suitable trenching equipment. The excavating tool shall have a minimum width equal to the specified trench width.
3. Contractor shall always maintain the stability of the excavated trench for the full depth.
4. Contractor shall maintain cement-bentonite slurry in workable condition until completion of the panel excavation.
5. Any deleterious sediment that may settle out of the slurry or fall to the bottom of the trench shall be removed with 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. Bentonite slurry shall be prepared by mixing water and bentonite until the bentonite particles are fully hydrated and the resulting slurry appears homogeneous.
2. The cement shall be thoroughly blended into the slurry until the mix is homogeneous and the cement particles are fully dispersed in the bentonite slurry.

C. Slurry shall be introduced into the trench at the same time trenching is begun and the level of slurry shall be maintained in the trench during excavation.

1. Once the cement-bentonite slurry is introduced into the trench, excavation shall be continuous. The panel shall not be disturbed or joined with a new panel for at least 48 hours or until the hardened cement-bentonite is self-supporting.
2. Leaving a panel open over a weekend or holiday shall be allowed provided slurry levels in the panel are monitored and maintained at all times.
3. Maintain a reserve supply of mixed bentonite slurry equal in volume to 25 percent of the volume of one fully excavated panel. If panel sizes vary, the size of the slurry reserve volume shall be based on the largest panel.

D. Key:

1. Unless otherwise directed, the bottom of the slurry trench will be as shown in the Contract Drawings. The final depth and penetration of the trench shall be measured and checked by the Contractor and approved by 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. After initial slurry hardening, the top of the completed trench shall be checked for free water or surface depressions. Any free water shall be removed, and the trench shall be filled with slurry to the specified elevation. Following initial set of this additional slurry, the top of the trench shall be covered with material to prevent drying of the slurry. No cover material shall be placed until the trench has been inspected by the Contractor and the Owner.

G. Clean-Up:

1. Material excavated from the trench shall be stockpiled or disposed of per the Contract Documents. After completion of the slurry trench, the work surface shall be cleaned of all excess slurry.

3.07 INTERNAL BRACING SYSTEM

- A. Install and maintain support members in tight contact with each other and with surface being supported.
- B. Structural members shall be adequately braced against buckling, with factor of safety of at least 1.5 for maximum axial loading condition, 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. Support or bracing members shall be removed provided that the removal is sequenced with backfill operations or the construction sequence associated with casting the final lining. Rebracing shall be installed as needed and in accordance with the Contract Documents.
- B. Removal of support elements shall be performed in a manner to maintain stability and strength of soils, and to avoid disturbing adjacent utilities and structures. Voids left on the removal process shall be backfilled 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 shall be responsible for adverse effects of vibrations from installing the support systems, regardless of compliance with vibration and air overpressure limits specified herein. In no case shall ground vibration or air overpressure limits be exceeded.
- B. Vibration limits and noise limits shall conform to requirements specified elsewhere in the Contract Documents.
- C. Monitoring equipment shall conform to requirements specified elsewhere in the Contract Documents.
- D. Contractor shall be responsible for monitoring noise and vibration from construction operations.

END OF SECTION 31 50 00

SECTION 31 62 16.13
SHEET STEEL PILES

PART 2 PRODUCTS

1.01 STEEL SHEET PILES

- A. Heavy gauge hot-rolled sheet piling complying with ASTM A328/A328M.
- B. Interlocking: Free-sliding interlocks, allowing a swing angle of at least 5 degrees when threaded and maintaining continuous interlocking when installed.
- C. Sheet piling, including special fabricated sections: Provide full-length sections of the dimensions shown.
 - 1. Fabricated sections: Comply with requirements included in the Section and the piling manufacturer's recommendations for fabricated sections.
 - 2. Provide sheet piling with standard pulling holes.

END OF SECTION 31 62 16.13

SECTION 31 66 15
HELICAL FOUNDATION PILES

PART 2 PRODUCTS

1.01 HELICAL FOUNDATION DESIGN CRITERIA

- A. It is Contractor's responsibility to design, or obtain qualified design, of the helical foundations as indicated in Contract Documents.
 - 1. Information necessary for design that is contained in Contract Documents includes:
 - a. Locations of foundation elements.
 - b. Nominal design load for each foundation element, including dead load, live load and other loads required by building codes.
 - 2. Subsurface geotechnical data may be obtained from _____.
- B. Helical Foundation Elements: One or more helical deformed plates (helix plates) attached to a central shaft with a load transfer device for attachment to a structure; entire element resisting applied loads by soil pressure.
 - 1. Design foundations to support/resist the nominal design loads shown on drawings in accordance with AISC 360 Allowable Stress Design method.
 - 2. Select foundation elements based on allowable installation torque and calculated minimum embedment length; maximum embedment length, if any; and minimum effective torsional resistance.
 - 3. Corrosion Service Life: 50 years, minimum.

END OF SECTION 31 66 15

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 01 22 00 - Unit Prices
- 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, the Work for this Section shall conform 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. The finished surface shall be shaped 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 shall 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 shall be performed by a testing laboratory approved by the Engineer.

1.06 STOCKPILING AGGREGATE

- A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.
- B. Stockpiling of aggregate, in excess of 4 feet 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 shall conform to Series 21 and 22, as specified in MDOT Section 902.05.

2.02 CALCIUM CHLORIDE ADDITIVES

- A. Calcium chloride additives shall conform to ASTM D98 and as specified in MDOT Section 922.12.

2.03 WATER

- A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Potable water from sources approved by Michigan State Department of Public Health may be used.

PART 3 EXECUTION

3.01 EXCAVATION VERIFICATION

- A. Prior to the placing of any aggregate material, examine the excavation for the grades, lines, and levels required to receive the new Work.
- 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. Subgrade or subbase shall be fine graded to the cross section indicated on the Plans, and shall be thoroughly compacted prior to the placing of the aggregate material.

3.05 INSTALLATION - GENERAL

- A. Width, thickness, and type of aggregate materials shall be indicated on the Plans or as directed by the Engineer.
- B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by the Engineer.

3.06 INSTALLATION OF AGGREGATE BASE COURSE

- A. Aggregate base course shall be placed by a mechanical spreader or other approved means in uniform layers to such a depth that when compacted, the course will have the thickness shown on the Plans.
- B. The depth of any one layer, when compacted, shall not be more than 8 inches. If the required compaction cannot be obtained for the full depth of the aggregate base course, the thickness of each course shall be reduced, or, with the approval of the Engineer, adequate equipment shall be used to compact the aggregate to the required unit weight.
- C. Subgrade or subbase shall be shaped to the specified crown and grade and maintained in a smooth condition. If hauling equipment causes ruts or holes in the subgrade or subbase, the hauling equipment will not be permitted on the subgrade or subbase, but shall be operated on the aggregate base course behind the spreader.
- D. Aggregate shall be compacted to at least 95% of maximum unit weight by the use of approved pneumatic-tired compaction equipment or vibratory compactors.

- E. Optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.
- F. When approved by 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. Motor graders, trimmers or other approved equipment shall be used to shape the aggregate base course, and maintain it, until the surface course is placed.
- H. When hauling material over the base course, subbase or subgrade, the Contractor shall limit the weight and speed of Contractor's equipment to avoid damage to the subgrade, subbase or aggregate base course. If the subgrade, subbase or aggregate base course becomes rutted due to the Contractor's operation, the subgrade, subbase or base course shall be removed and replaced 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 his 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. Aggregate base course and aggregate surface shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.
- B. Contractor, at Contractor's expense, shall provide additional materials needed to fill depressions or bind the aggregate.

3.08 TEMPERATURE LIMITATIONS

- A. Aggregate materials shall not be placed when there are indications that the mixtures may become frozen before the maximum unit weight is obtained.
- B. In no case shall the aggregate be placed on a frozen subgrade or base course unless otherwise approved by the Engineer.

3.09 TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density and for thickness of material. Testing and coring required shall be performed by a testing laboratory acceptable to the Owner and approved by the Engineer. The cost for testing and coring shall be at the expense of the Owner.
- B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 feet per traffic lane. The lane width shall be as 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. Maximum unit weight shall be understood 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. Depths may be 1/2 inch less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness.
 - 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. Locations of the depth measurements will be as specified herein unless otherwise determined by the Engineer. Sections found to be deficient in depth shall be corrected by the Contractor 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 32 11 23

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 01 22 00 - Unit Prices
- 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

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO 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 straightedge at locations selected by the Engineer. The variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed the following limits:

- B. For Bituminous Base Course Mixtures:
 - 1. Multiple Courses:
 - a. 3/8 inch for top course
 - b. 3/4 inch for lower courses
- C. For Bituminous Surface Course Mixtures:
 - 1. Multiple Courses:
 - a. 1/8 inch for top course
 - b. 1/4 inch for lower courses
 - 2. Single Course:
 - a. 1/4 inch
- D. Variations in excess of the specified tolerance shall be corrected as determined by the Engineer.

1.05 MATERIAL REPORTS

- A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the Standards referred to in the Specifications.
- B. Contractor shall provide the Engineer, or his authorized representative, with the certified batch plant delivery tickets prior to the placing of the materials.
- C. Contractor shall supply the Engineer with a certified job mix design for each type of bituminous mixture proposed for use on this Project.

1.06 TEST REPORTS

- A. The testing lab shall 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 shall 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 shall 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 shall conform to:
 - 1. AASHTO M17
 - 2. Mineral filler, 3MF, as specified in MDOT Section 902.11

2.03 ANTI-FOAMING AGENTS

- A. The anti-foaming agents shall 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 shall 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 shall 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 shall conform to:
 1. ASTM D244
 2. MDOT Section 904

2.07 COMPOSITION OF MIXTURES

- A. Bituminous mixtures shall be mixed and placed in accordance with applicable requirements specified in MDOT Section 501 except as otherwise specified in this Section.
- B. The blended aggregate used for the bituminous wearing course on this Project shall have an Aggregate Wear Index (AWI) of 260, or higher.
- C. The aggregates, mineral filler (if required), and asphalt binder shall be combined as necessary to produce a mixture of the type as specified on the Plans.
 1. Superpave Hot Mix Asphalt Mixtures shall be in accordance with MDOT Section 501.
 2. Marshall Hot Mix Asphalt Mixtures shall 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"), shall meet the requirements for stability, flow, voids in mineral aggregate (VMA), air voids, fines/binder ratio, fine aggregate angularity, L.A. Abrasion loss, and soft particles as specified 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 shall 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 shall suspend all operations. Work days will be charged during the down time.

2. Before resuming any production, the Contractor shall make all necessary alterations to the materials or plant so that the Job Mix Formula can be maintained within the deviations permitted under the table below.

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
(a) This range allows for normal mixture and testing variations. The mixture shall 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 shall provide uniformity in the gradations of the aggregates placed in the cold feed bins so that the combination of aggregates produced for the mixture by blending the aggregates from two (2) or more cold feed bins will be uniformly fed by means of adjustable feeders onto a belt supplying the asphalt plant.
 1. Feeders shall be equipped with cutoffs which will automatically stop the operations to the asphalt plant at any time the flow of any aggregate fraction is changed so as to affect the uniformity of the finished product.
- J. Contractor has the option of using hot bins for proportioning the aggregates to meet the specified tolerances.
- K. Aggregate gradation tests will be made on aggregate extracted from samples of bituminous mixture taken from the trucks as directed by 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 (1) sample per 250 Tons of mixture, but not more than four (4) 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 (1) sample per 500 Tons of mixture, but no more than two (2) 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, 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, examine the subgrade and base course to ascertain that it is adequate to receive the bituminous concrete pavement to be installed. If the subgrade remains wet after all surface water has been removed, the Engineer may require the installation of edge drain.

3.03 EXISTING IMPROVEMENTS

- A. Investigate and verify location of existing improvements, including structures, to which the new Work is to be connected. Adjustments in line and grade to align the new Work with the existing improvements must be approved by the Engineer, prior to any changes.

3.04 EQUIPMENT REQUIREMENTS

A. General:

1. Contractor shall furnish sufficient equipment for completing the Work in a timely and efficient manner.
2. Equipment shall be on the job site and ready for normal operation before the placing of material is started.
3. Equipment shall be in good working order. Equipment shall be subject to inspections and testing during construction.
4. Equipment shall be of sufficient capacity that the operation can be continuous and a rate of production obtained which insures good workmanship, and eliminates overloading of the equipment or frequent interruptions or delays.
5. Equipment shall conform to the requirements as specified in MDOT Section 501 and as specified herein.

B. Pavers:

1. Paver shall be an approved self-powered machine capable of spreading and finishing the mixture in a uniform layer at the desired thickness and cross section and ready for compaction. The use of any machine in poor mechanical or worn condition, will not be permitted. Paver shall be of such design that the supporting wheels, treads, or other devices ride on the prepared base. The full width of surface being applied shall be screeded by an oscillating or vibrating screed.
2. Paver shall at all times produce a uniformly finished surface, free from tearing or other blemishes that would require hand work. The screed shall be adjustable to provide for tilting to secure the proper drag or compressive action necessary to produce the desired surface texture.
3. Paver shall be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved.
4. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to prevent segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.
5. When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. The extensions shall also be equipped with a continuation of the automatically controlled spreading augers. The screed and any extensions shall be provided with an approved method of heat distribution.

6. Unless specified otherwise, bituminous pavers shall be equipped with an automatically controlled and activated screed and strike-off assembly capable of grade reference and transverse slope control.
 - a. A manufacturer approved grade referencing attachment, not less than 30 feet in length, shall 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 shall 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 shall 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 six 6 inches in thickness.
 2. The machine shall be of a type designed by the manufacturer specifically for reduction in size of pavement material, in place, and be capable of reducing the pavement material to the specified size. The cutting drums shall be enclosed and shall have a sprinkling system around the reduction chamber for pollution control.
 3. The rate of forward speed must be positively controlled in order to ensure consistent size of reduced material. The machine must be equipped with an accurate tachometer which is mounted in full view of the operator.
 4. Crushing equipment shall meet the approval of the Engineer.
- D. Cold Milling Machine:
1. Cold milling machine for removing concrete or bituminous surfaces shall be equipped with automatically controlled and activated cutting drums that are capable of grade reference, transverse slope control, and produce a uniformly textured surface. An approved grade referencing attachment, not less than 30 feet in length shall be used.
 2. Equipment for removing the concrete or bituminous surface shall be capable of accurately removing the surface, in one or more passes, to the required grade and cross section.
- E. Joint Heaters:
1. Joint heaters shall be infrared or other approved heaters, equipped with an automatic ignition and extinguishing system to ensure that the heater operates only when the paver is moving. It shall be of sufficient length and heating capacity to adequately soften the edge of the mat. The heater shall be oriented parallel to the joint edge.
 2. Bituminous pavement shall not be heated by a direct open flame.
- F. Rollers:
1. Steel-wheel rollers shall weight at least 8 tons and shall be self-propelled, vibratory or static, tandem rollers or shall be self-propelled static 3-wheel rollers.

- a. Steel-wheel rollers shall be free from backlash, faulty steering mechanism, or worn king bolts. The steering device shall respond readily and permit the roller to be directed on the alignment desired.
 - b. Rollers shall be equipped with wheel sprinklers and scrapers.
 - c. Roller wheels shall be smooth and free from openings or projections which will mark the surface of the pavement.
2. Vibratory rollers shall have a shutoff to deactivate the vibrators when the roller speed is less than 0.5 mph and shall 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 shall be of the self-propelled type with a total weight, including ballast, not greater than 30 tons.
 - a. It shall be equipped with a minimum of seven (7) wheels situated on the axles in such a way that the rear group of tires will not follow in the tracks of the forward group, but will be so spaced that a minimum tire path overlap of 1/2 inch is obtained.
 - b. The tires shall be smooth and shall be capable of being inflated to or adapted to achieve a pressure necessary to provide ground-contact pressures of at least 80 psi.
 - c. The tire pressures shall not vary by more than 5 psi between individual tires. Contractor shall furnish a tire gage which shall be available at all times to enable the Engineer to check the tire pressures.
 - d. Contractor shall 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 shall be equipped with a mechanism capable of reversing the motion of the roller smoothly.
 5. Roller shall be equipped with wheel sprinklers and scrapers or mats.
 6. Rollers shall be of sufficient size to compact the bituminous mixture to the required density without tearing, displacing, or cracking the mat.
- G. Chip Spreader:
1. Chip spreader shall be self-propelled and shall be equipped with pneumatic tires.
 2. Spreader shall be equipped with a screen mounted below the metering gage.
 3. Spreader shall be capable of spreading the cover material uniformly at widths of 3 to 12 feet, or separate spreaders shall be provided for the specific widths required.
 4. Rate of discharge of the spreader shall be adjustable to spread uniform layers of 10 to 50 pounds/syd.
- H. Bituminous Concrete Curbing Machine:
1. Bituminous concrete curbing machine shall be self-propelled and shall be capable of laying and satisfactorily compacting curved and straight line curb to the cross section specified on the Plans. It shall be equipped with templates for the cross sections required.

3.05 PREPARATION OF FOUNDATIONS

- A. For bituminous base course mixtures required to be placed directly on the subgrade, the density, grade and cross section shall meet the approval of 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, shall be thoroughly cleaned of all dirt and debris.

- C. Existing structures within the limits of the new Work shall be adjusted as specified in the Plans, or as 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 shall meet the approval of the Engineer.
- B. Surfaces that have become too wet or too dry shall be reworked to provide the required density.

3.07 PREPARATION OF EXISTING PAVEMENT

- A. This Work consists of preparation of the existing concrete road for resurfacing. Broken pavement or pavement not bonded to the base pavement, and loose bituminous surfacing or patches shall be removed.
- B. Longitudinal and transverse joints and cracks shall be cleaned in accordance with Article 3.14 of this Section.
- C. Butt joints at the end of surfacing sections and at intersections of adjoining streets shall be made in accordance with Article 3.08 of this Section. The vertical face of the cut shall be maintained true, straight and undamaged until installation of wearing course.

3.08 BUTT JOINTS

- A. If butt joints are specified on the Plans, or by the Engineer, the old surface shall 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 shall be maintained true, straight and undamaged until installation of wearing course.

3.09 EDGE TRIMMING

- A. Trimming and truing the edge of an existing bituminous surface shall be performed as required to give a straight, sharp edge at the proper elevations.
- B. The existing base under the bituminous surface shall be left undisturbed.

3.10 REMOVING BITUMINOUS SURFACING

- A. When removing existing bituminous surface course, the edges of the area to be removed shall 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 shall 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 shall be furnished at the Contractor's expense. Additional aggregate, if required, shall be MDOT 20A or 22A aggregate.
- C. The material shall be scarified and uniformly pulverized to a maximum size of 2 inches, in addition, 95% to 100% of the material shall have a particle size of 1-1/2 inches or smaller.

- D. The material shall be scarified and uniformly pulverized, in one or more passes, to the depth specified on the Plans or as determined by the Engineer.
- E. The maximum length or width of roadbed to be scarified and pulverized at any one time shall be as specified on the Plans or as determined by the Engineer.
- F. The crushed material shall 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 shall be placed, if necessary, to attain the required cross sections.
- G. After the material has been balanced, it shall be thoroughly mixed. In restrictive areas, the material to be mixed may be bladed into a windrow to provide working room for the mixer.
- H. The mixed material shall be shaped and compacted in reasonably close conformity with the lines, grades, and cross sections shown on the Plans or as established by the Engineer. Excess material shall be removed and disposed of by the Contractor at Contractor's expense.
- I. Finished rolling shall be done with a vibratory steel wheel roller.
- J. Aggregate-bituminous pavement mixture shall be compacted to not less than 95% of the unit weight obtained by the AASHTO T 180 test method. The test shall be made on the aggregate-bituminous mixture at the field moisture content existing during the compacting operation. Required density shall be maintained until the material has been surfaced.
- K. Prior to the placing of any surface courses, the pulverized material shall be proof rolled. Proof rolling shall be accomplished with an 18,000 lbs single axle load.
- L. Unstable areas shall be removed and backfilled.

3.13 HAND PATCHING

- A. Where the filling of holes and depressions in the base or the replacing of the patches is specified on the Plans or as determined by the Engineer, the filler material shall 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. The patches shall be compacted to the required grade by use of a machine vibrator or approved roller.

3.14 JOINT CLEANOUT

- A. Where joint cleanout is specified on the Plans or as determined by the Engineer, the joint sealants and foreign material shall be removed to a minimum depth of 1 inch by approved mechanical or hand methods.
- B. The 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 shall be removed. Each joint or crack shall be cleaned and shall be filled with an approved mixture and the mixture shall be compacted with a vibratory machine or by an approved method.

3.16 COLD MILLING CONCRETE OR BITUMINOUS PAVEMENT

- A. Where cold milling concrete or bituminous pavement is specified, the pavement shall be milled to the shape and cross section as shown on the plans. Immediately after cold milling, the surface shall be cleaned.
- B. Contractor shall remove and dispose of any resulting debris.
- C. When allowed by the Engineer, milling materials may be used for temporary wedging.

1. Prior to placing pavement, temporary wedging materials shall 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 shall 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, shall be provided for the construction of sidewalk ramps. In addition, curb drops for sidewalks and driveway approaches shall be provided in locations called for on the Plans or as determined by the Engineer.
- C. Existing improvements, including structures, shall be protected to prevent their surfaces from being discolored during application of bituminous materials.

3.18 BITUMINOUS PRIME COAT OR BOND COAT

- A. The prepared foundation shall be treated with bituminous material for prime coat or bond coat as specified. A bond coat shall be applied to each layer of bituminous mixture before the succeeding layer is placed.
- B. The bituminous material shall be applied uniformly by means of a pressure distributor. In areas inaccessible to the regular distributor operation, the bituminous material shall be applied by means of the hand spraying apparatus of the distributor.
 1. Where necessary to accommodate traffic, the surface shall be treated half-width or as recommended by the Engineer.
 2. The foundation shall be free from moisture when the treatment is applied.
 3. Under no circumstances shall pools of bituminous material be allowed to remain on the surface.
- C. The amount of prime coat to be applied per square yard shall be 0.05 gal/syd unless otherwise specified on the Plans or recommended by the Engineer.
- D. When prime coat is applied, the surface course shall 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 shall be applied at the rate specified by the Engineer. This rate will be between 0 to 0.10 gal/syd on the bituminous or concrete foundation and between 0 to 0.05 gal/syd between subsequent courses.
- G. The bond coat material shall 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 shall not be placed until the bond coat has cured.

3.19 TRANSPORTATION OF MIXTURES

- A. The transportation of the mixtures as specified shall be in accordance with MDOT Section 501.

3.20 PLACING BITUMINOUS MIXTURES

- A. Pavers will be required to have an automatically controlled and activated screed and strike-off assembly except when placing mixtures for:
 1. variable width sections;
 2. sections of pavement less than 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 shall 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 shall be banked against the outside edge of each layer of mixture placed unless the sequence of operations is such that the edges of the material are adequately confined and supported in some other manner. The width of material placed shall be twice the height of the bituminous layer being placed but in no case less than a 6 inch width.
- D. When the application rate for a bituminous wearing course exceeds 220 lbs/syd, the pavement shall be constructed in two (2) or more courses, unless otherwise specified on the Plans or as authorized by the Engineer.
- E. The bituminous mixture shall be placed by an approved self-propelled mechanical paver to such a depth that when compacted, it will have the thickness specified.
 - 1. The mixture shall be dumped into the center of the hopper and care shall be exercised to avoid overloading the paver and spilling the mixture upon the base.
 - 2. The paver speed shall be adjusted at the discretion of 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 shall be stopped and a transverse construction joint placed.
- G. Bituminous mixture shall be placed in one (1) or more layers as called for on the Plans or as approved by the Engineer.
 - 1. To take out irregularities in the existing road surface, wedging with bituminous mixture shall be done by placing several layers with the paver.
 - 2. Corrections to the foundation by wedging with bituminous material shall be made by placing, compacting, and allowing the material to cool prior to paving.
- H. Bituminous mixtures shall be placed using two (2) pavers in echelon or one (1) paver equipped with an approved joint heater. 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.
- I. Echelon paving will be permitted when allowed by the Engineer.
- J. 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 shall be painted with bituminous material before the bituminous mixture is placed in the adjacent section.
- K. In placing the bituminous mixture adjacent to all joints, hand raking or brooming will be required to provide a dense smooth connection.
- L. Connections with existing surfaces at the beginning and end of resurfacing sections, and at intersections shall be made by feathering out the mix, by constructing a butt joint, or as approved by the Engineer.
- M. When placing the bituminous mixture in a lane adjoining a previously placed lane, the mixture shall be placed such that it uniformly overlaps the first lane by 2 to 4 inches and is placed at a height above the cold mat equal to the breakdown roller depression on the hot mat.
 - 1. The overlapping material shall be bumped, back onto the hot lane so that the roller will compress the excess material into the hot side of the joint.

2. If, in the opinion of the Engineer, the overlap is excessive, the excess material shall be trimmed so as to leave an edge having a uniform thickness. The excess material shall be discarded, it shall not be spread across the surface course.
- N. If the lanes are being constructed with two (2) or more pavers in echelon, the loss depths of bituminous material from each paver shall match at the longitudinal joints.

3.21 ROLLING AND COMPACTING OF BITUMINOUS MIXTURES

- A. Each layer of bituminous mixture shall be compacted with approved rollers. At least two (2) rollers will be required when the mixture lay-down rate exceeds 800 syd per hour.
- B. Steel 3-wheel rollers may be used for initial compaction immediately following the paver.
- C. The final rolling operation on each layer of bituminous mixture shall be accomplished by use of tandem steel-wheel rollers or by use of vibratory rollers operated in the static mode.
- D. Roller wheels shall be kept properly moistened with water.
- E. Pneumatic-tired rollers shall be operated in a competent manner and shall not mark or rut the surface or displace the pavement edges. The pneumatic-tired roller shall 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. The roller operations shall 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 shall not be less than two (2) round trip passes over each area.
- F. Rolling of the mixture shall begin as soon after placing without undue displacement, picking up the mat, or cracking. Rolling shall start longitudinally at the extreme sides of the lanes and proceed toward the center of the pavement, overlapping on successive trips by at least half the width of the drive wheel of the roller.
 1. Alternate trips of the roller shall be of slightly different lengths.
 2. The maximum roller speed shall not exceed the manufacturer's recommended speed for the type of mixture or thickness of layer being placed.
- G. When compacting an adjoining lane, the longitudinal joint shall be rolled first with the roller supported mainly on the cold lane with only 3 to 6 inches of the roller extending onto the freshly placed bituminous material.
- H. Finish rolling shall continue until all roller marks are eliminated.
- I. Pneumatic-tired rollers will not be permitted on wearing courses.
- J. Areas too narrow to be rolled directly by standard 8 ton tandem rollers shall be compacted by self-propelled trench rollers of suitable width, approved by the Engineer, and weighting not less than 300 lbs per inch of width.
- K. Skin patching on an area that has been rolled will not be permitted. Any mixture that becomes mixed with foreign material or is in any way defective shall be removed and replaced at the Contractor's expense.

3.22 WEATHER AND SEASONAL LIMITATIONS

- A. Bituminous mixtures shall not be placed nor the prime coat or bond coat applied when rain is threatening or when the moisture on the existing surface would prevent satisfactory bonding.
- B. Unless otherwise approved by the Engineer in writing, seasonal limitations for placing bituminous mixtures shall 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 shall be in accordance with the following:
 1. Mix Temperature Limitations:

Temperature of Surface being Overlaid	Rate of Application of Bituminous Material		
	<120 lbs per syd	120 to 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 shall 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 shall 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 shall be avoided.
 2. A thermometer shall be provided to enable the Engineer to observe the temperature at any time.
 3. Any bituminous material which has been overheated will be rejected.
- B. Asphalt emulsion shall be circulated continuously when heated above atmospheric temperature so as to prevent it from separating.
 1. Heating of asphalt emulsion to the required temperature for application shall be done entirely in the distributor unless a uniform temperature is maintained in the storage tank by means of a circulating heater.
 2. Any asphalt emulsion which has been damaged by continuous heating for too long a time or by alternate heating and cooling will be rejected.

3.24 PATCHING

- A. Where patching is required on a bituminous surface or concrete surface because of small holes or pitted surface, the holes shall be cleaned of all dirt and foreign material.
- B. The bituminous patching material shall be placed, struck off and compacted so that when completed, the patch shall be flush with the adjacent pavement. The compaction may be done with a hand tamper, vibratory compactor or roller.
- C. When patching is required for repairing a cut in the pavement, made for the construction of underground structures and utilities, the granular backfill shall be compacted to not less than 95% of the maximum unit weight. An aggregate base material of not less than 12 inches compacted thickness, or a bituminous base of the specified thickness, shall be used. The top of the base shall be 2 to 2-1/2 inches below the surface of the adjacent pavement. Bituminous patching material shall be placed and compacted.

- D. The surface of the bituminous patch shall be smooth and shall not vary more than 1/4 inch from the crown and grade of the adjacent pavement. Any variations over 1/4 inch from the established grade shall be corrected as determined by the Engineer.

3.25 CHIP SEAL

- A. Seal coating shall consist of one (1) or more applications of bituminous material applied to the prepared surface and one (1) or more coverings of coarse or fine aggregate applied to the bituminous material.
- B. Asphalt emulsion shall be CSEA or CRS-2M and aggregate shall be MDOT 29A unless otherwise specified on the plans.
- C. Cover materials used for seal coating shall be sufficiently dry when it comes in contact with bituminous material. The moisture content shall not exceed three (3) percent by weight, dry basis. Satisfactory means shall be provided for the protection of the coating materials against excessive moisture by covering stockpiles, by aeration or through manipulation.
- D. The bituminous material specified for surface coat shall be uniformly applied by means of the pressure distributor in the number of applications provided and in the amount per square yard as determined by the Engineer. Each application of bituminous material shall cure sufficiently to prevent displacement or pickup by traffic or construction equipment before a succeeding application of bituminous material is made.
- E. Following the application of surface coat bituminous material, the cover material shall be uniformly spread over the surface by means of approved mechanical spreaders, in the amount per square yard as specified or as determined by the Engineer. Truck wheels shall ride on spread cover material and not on bituminous material.
- F. Any irregularities or deficiencies in the uniformity of the cover aggregate on the surface shall be corrected by hand spreading and dragging.
- G. Following the spreading of each course of cover material, the surface shall be rolled by means of approved rollers.
- H. Rolling shall immediately follow the placing of cover material before the bituminous material has set. At no time shall there be more than 300 feet of unrolled cover material. No cover material shall be left unrolled for more than five (5) minutes.
- I. Sufficient rolling shall be done to embed the cover material in the bituminous material without crushing the aggregate.
- J. For areas deficient in cover material after completion of the surface treatment, additional cover material shall be added. For areas with excessive cover material, the excess cover material shall be removed before the next seal is applied. The final application of cover material shall be swept with a power broom.
- K. The completed surface shall be maintained with a drag, broom or other approved equipment to keep the material well distributed on the road until all cover material possible has been embedded in the bituminous material. The length of time required for this maintenance will be from two (2) to five (5) days, as determined by the Engineer, depending on the weather and the materials used.

3.26 BITUMINOUS CONCRETE CURB

- A. The bituminous concrete curb shall be constructed to the design specified on the Plans or as approved by the Engineer and shall include the conditioning and treating of the surface on which the curb is to be placed.
- B. The materials used in the construction and installation of bituminous concrete curbing shall meet the requirements as specified in this Section, and as specified in MDOT Section 904.
- C. Bituminous concrete curb mixture shall 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 approved by the Engineer.

- D. The bituminous curb shall be constructed to conform to the Plans or as determined by the Engineer. The method of construction shall conform to MDOT Section 805, unless otherwise specified.
- E. The bituminous mixture shall be thoroughly compacted by a curbing machine to the cross section shown on the Plans, or as determined by the Engineer. The curb shall be formed to the density to produce a tight surface texture. Curbs showing segregation, slumping, or misalignment shall be removed and replaced at 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 shall be applied to the finished curb at the joint of the curb and pavement, or to the inside face of the curb, or to both, as a protective seal.
- G. Backfilling behind the curb shall not commence until the bituminous mixture has cured.
- H. Backfill material shall be placed and thoroughly tamped and compacted to the satisfaction of the Engineer, without disturbing the curb, and shall be left in a neat and smooth finished appearance.

3.27 BITUMINOUS APPROACHES, SIDEWALKS, AND SHOULDERS

- A. This Work shall consist of constructing a bituminous surface course as specified on the Plans, or as approved by the Engineer. The bituminous surface course shall be placed on a prepared foundation.
- B. The bituminous materials used shall be as specified on the Plans, or as approved by the Engineer. Materials acceptable for use are specified in this Section, and as specified in MDOT Section 904.
- C. Bituminous approach mixture shall be in accordance with MDOT Section 501, unless otherwise approved by the Engineer.
- D. Existing pavement or aggregate base shall be prepared to receive the bituminous surface course as specified in this Section.
- E. Bituminous prime and bond coats used shall meet the requirements specified in this Section. Care shall be taken to prevent spreading of bituminous material on adjoining surfaces. When approved by the Engineer, the prime coat may be omitted.
- F. Bituminous mixture shall be placed to the thickness specified on the Plans or as determined by the Engineer.
- G. Placing the bituminous mixture shall 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 (1) roller may be used with each paver.

3.28 CLEANUP

- A. The area adjacent to the new Work shall be backfilled with sound earth of topsoil quality.
- B. The backfill shall be compacted, leveled and left in a neat, smooth condition. At a seasonally correct time the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, sodded in accordance with Section 32 9223, or _____.

3.29 MONUMENT BOXES

- A. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes. Monument box castings shall be furnished and installed by the Contractor and shall be East Jordan Iron Works No. 1570, or approved equal.

- B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.30 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 shall be performed by a testing laboratory approved by the Engineer.
 - 1. The cost for testing and coring shall be at the expense of the OWNER.
 - 2. The testing laboratory shall furnish the Engineer with two certified copies of the results of all tests.
- B. Testing procedures shall conform to current MDOT Standards.
- C. Testing of asphalt binders, liquid asphalts, asphalt emulsions, tars shall conform to MDOT Section 904.
- D. Rolling shall proceed until the required compaction is attained and the amount of rolling required shall be based on the test results of a nuclear gage or on using a specified minimum number of rollers. When the total tonnage for the Project is in excess of 1,000 tons, the nuclear gage method will be used to govern the compactive requirements.
- E. The control density for the bituminous mixture to be placed, will be determined by use of a modified Marshall Test.
- F. 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 compactive effort will be to establish a rolling procedure which will achieve 100% of the control density but in any case, the density achieved shall not be less than 95% of the control density.
 - c. Density values less than 98% will be sufficient cause for 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 shall be used for the remainder of the mixture to be placed, unless subsequent tests indicate a need to change the number of rollers or the rolling pattern.
 - 3. If difficulties are encountered or if there is a significant change in aggregate or bitumen content, 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. The compactive procedures thus determined shall 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 compactive procedure being used is achieving the required density, or if a change in procedure is necessary.
 - 5. Each layer of bituminous mixture shall be compacted to at least 95% of the control density, using the established procedure.

3.31 PRICE ADJUSTMENTS

- A. Samples of asphalt binder may be taken prior to incorporation into the mixture and from the bituminous mixture. Where results of tests on these samples deviate from specification requirements, the affected material will be subject to price adjustments on the following basis:
 - 1. When the test results deviate from the limits specified in MDOT Table 904-1, "Performance Graded Asphalt Binder Specification", by ten (10) percent or more, the mixture produced will be evaluated by the Engineer and if in his judgment the defective pavement warrants removal, the Contractor shall remove and replace the affected area at his 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 (10) 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 32 12 16

SECTION 32 13 00 RIGID PAVING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install pavement and perform related work necessary to complete work shown or specified. Contractor shall be responsible for all work involved in the repair and replacement of existing streets, roads, drives, parking areas, curbs, gutters, sidewalks, aprons, and other paved areas damaged or destroyed during construction of the work. Replacement in kind with respect to base courses, surface courses, and thicknesses, unless otherwise indicated or directed. Finish elevations, lines, and grades shall be the same as items removed unless otherwise shown on the drawings.
- B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the reference thereto. Latest revisions shall apply, unless otherwise indicated.
- C. Perform cutting and patching of pavements as indicated, specified, or directed by Engineer.

1.02 RELATED DOCUMENTS

- A. Section 01 33 00 - Submittal Procedures
- B. Section 31 23 13 - Subgrade Preparation

1.03 REFERENCE STANDARDS

- A. AASHTO T26 - Quality of Water to be used in Concrete
- B. AASHTO M248 - Standard Specification for Ready-Mixed White and Yellow Traffic Paints
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- E. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete
- F. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete
- G. ASTM D98 - Standard Specification for Calcium Chloride
- H. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristic of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

1.04 SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00.
- B. Submit the following:
 - 1. Name and location of mixing plant and concrete ready-mix plant.
 - 2. Type and composition of proposed materials and mixes, including moisture - density curves.
 - 3. Certificates of Compliance certifying compliance with the referenced specifications and standards.
 - 4. Statement of qualification for independent testing laboratory.
 - 5. Provide a proposed jointing plan for the rigid concrete pavement with location and spacing of epoxy ('green') coated dowel bars shown at transverse joints.

6. The testing lab shall provide the Owner with two (2) certified copies of the test results of the quality of water to be used in the concrete. The sampling and testing of water quality shall be in accordance with AASHTO T26 requirements, and the certification of the tests' results shall be performed by a testing laboratory approved by the Owner.
7. Submit manufacturer's literature of all paints to be used in the Work. Manufacturer's literature shall show paint: type, texture, color, temperature limitations, recommended use, spreading rate, drying time, and cleanup.
8. Test Results: Concrete
 - a. Mix Design.
 - 1) Aggregate gradation
 - 2) Cement content
 - 3) Water content
 - 4) Air Content
 - b. Slump
 - c. Pavement thickness
 - d. Compressive Strength

1.05 QUALITY ASSURANCE

- A. Testing Laboratory Services:
 1. Owner shall employ an independent testing laboratory to perform necessary field density tests to demonstrate to the satisfaction of the Owner that proper compaction is obtained and that placement conditions are in compliance with the specifications.
 2. Contractor shall employ a testing laboratory service for all testing required to determine mix designs, maximum theoretical densities, and specification compliance.

1.06 PROJECT/SITE CONDITIONS

- A. Do not place paving and surfacing materials on wet surface or when weather conditions would prevent the proper construction of paving and surfacing.
- B. Do not place aggregates on frozen subgrade or when air temperature is below 35°F.
- C. Weather limitations for the placement of asphalt concrete, tack coat, and prime coat shall be as stated in ODOT Item 401.06, Item 407.04, and Item 408.04, respectively.
- D. Placement of concrete pavement shall be as stated in ODOT Item 451.06.
- E. Do not place paving and surfacing materials when natural light is not sufficient to properly observe work on operations.
- F. All pavement markings shall be the entire width of the pavement per City of Cleveland requirements.

PART 2 PRODUCTS

2.01 AGGREGATE BASE

- A. Aggregate base shall be in conformance with Item 304 of the referenced ODOT Specifications.

2.02 CONCRETE BASE

- A. Concrete base shall be in conformance with Item 305 of the referenced ODOT Specifications.

2.03 REINFORCED CONCRETE

- A. Reinforced Portland cement concrete pavement, shall conform to Reinforced Portland Cement Concrete Pavement as referenced in ODOT Item 451.

2.04 NON-REINFORCED CONCRETE

- A. Non-reinforced Portland cement concrete pavement, shall conform to Non-Reinforced Portland Cement Concrete Pavement as referenced in ODOT Item 452.

2.05 WALKS, CURB RAMPS AND STEPS

- A. Concrete Sidewalks, and Curb Ramps shall conform to Walks, Curb Ramps & Steps as referenced in ODOT Item 608.

2.06 CURBING

- A. Concrete Curbing shall conform to Curbing, Concrete Medians, and Traffic Islands as referenced in ODOT Item 609 and to Curbing requirements from the City of Cleveland.
- B. Sandstone Curbing shall be removed and replaced in accordance with City of Cleveland requirements and per ODOT Item 609.3. Existing sandstone curb may be reused depending on the condition of the curb.

2.07 REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT, WALKS, AND STEPS

- A. Forms:
 - 1. Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal of forms. Use straight forms, free of distortion and defects.
 - 2. Forms shall meet the requirements of ODOT Item 508.
 - 3. Coat forms with a non-staining form release agent that will not discolor or deface surface of the concrete.
- B. Welded Wire Mesh:
 - 1. Welded plain cold-drawn steel wire fabric, ASTM A185 and ODOT Item 709.10.
- C. Reinforcing Bars:
 - 1. Deformed Steel Bars: ASTM A615 Grade 60 and ODOT Item 709.01.
- D. Concrete Materials:
 - 1. Comply with requirements of applicable referenced ODOT specifications for concrete materials, admixtures, bonding materials, curing materials, and other materials as required.
- E. Expansion Joint Materials:
 - 1. Comply with requirements of ODOT Item 705.03 and Item 705.04 for preformed expansion joint fillers and sealers.
- F. Curing and Sealing Compound:
 - 1. Comply with requirements of ODOT Item 705.07 (Type 2).
- G. Concrete Mix, Design, and Testing:
 - 1. Comply with requirements herein and of ODOT items referenced for concrete mix design, sampling, testing, and quality control.
 - 2. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing or high range water reducing admixture (super-plasticizer), air-entraining admixture, and water, as specified in ODOT specifications.
 - 3. Compressive Strength: Class C, 4,000 psi, minimum at 28 days.
 - 4. Slump Range: In accordance with ODOT Item 499.03.
 - 5. Air Content: 6 percent +/- 2%.

2.08 WATER

- A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.
- B. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be used in Concrete, AASHTO T26.

2.09 CONCRETE ACCELERATORS

- A. Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to ASTM C494/C494M, Type C or Type E.
- B. Calcium chloride in flake or pellet form shall conform to ASTM D98, Type S, Grade 1 or grade 2, flake or pellet form.

2.10 WATER-REDUCING AND WATER-REDUCING RETARDING ADMIXTURES

- A. Water reducing admixtures and water reducing retarding admixtures shall conform to ASTM C494/C494M, Type A or Type D, except that neither type of admixture shall contain calcium chloride.

2.11 PERMANENT PAVEMENT MARKINGS

- A. All markings shall comply with ODOT Item 640 and Item 646 and shall include reflective glass beads.
- B. Regular drying pavement marking paint in white and yellow colors shall conform to AASHTO M248, Type N, traffic paint and shall meet the current ODOT specified ingredients for regular drying traffic paint and shall be selected from ODOT's Qualified Products List.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor is responsible to provide equipment, workmanship, and materials required to achieve a finished product which meets these specifications.
- B. Use compaction equipment suitable for the material being placed. Compacting equipment shall include at least one piece of equipment capable of providing a smooth, even surface for the pavement surface course.
- C. Prior to placing paving and surfacing materials, level the subgrade to produce smooth, even finished pavement grades. Fill all gullies and ruts with additional ODOT 304 aggregate base material. Subgrade and aggregate base materials shall be compacted in accordance with ODOT Item 203.
- D. Do not place paving and surfacing material before subgrade is reviewed and accepted by the Owner. Do not place paving and surfacing materials on a frozen or muddy subgrade.
- E. Provide adequate drainage at all times to prevent water from standing on subgrade.
- F. Placing of concrete should not commence or continue until the condition of the subgrade has been approved by the Owner.
- G. The concrete shall be spread or distributed as soon as placed. If a mechanical spreader is not used, the concrete shall be deposited in a manner that requires a minimum of re-handling to avoid segregation and separation of materials. The concrete shall be deposited to a height sufficiently above grade so that when consolidated and finished it shall conform to the required finished grades.
- H. Concrete along the faces of forms and adjacent to joints shall be consolidated and compacted to fill all voids.
- I. Forms shall not be vibrated to consolidate the concrete.
- J. The placing of concrete shall be continuous as much as possible between transverse joints.

- K. Whenever a temporary halt in operation occurs, the concrete and unfinished end of the slab shall be covered with wet burlap or plastic.
- L. If the interruption of Work continues for more than 20 minutes, a construction joint shall be placed, provided the proposed construction joint is 15 feet (4.5 m) or more from the last joint for reinforced pavement and at least ten (10) feet (3 m) or more from the last joint in plain concrete pavement. Sections of pavement shorter in lengths will not be permitted and, if constructed, shall be removed and replaced at the Contractor's expense.
- M. Integral curbs, where specified or required, shall be constructed monolithic with the pavement slab. The curb material shall be placed before the pavement has started its initial set and shall be of the same mix as the concrete pavement.
- N. Base and back forms will be required when constructing straight curbs, and back forms with templates of the required curb shape shall be used when constructing rolled and mountable curbs. The curb concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which the curb shall be given a final finish to match the texture of the pavement.
- O. After removing forms, any visible areas of honeycomb or minor defects shall be immediately filled with mortar, having one part of Portland cement and two parts fine aggregate, and shall be applied with a wooden float.
- P. Where adjacent pavement is constructed in separate pours, no equipment shall be operated upon recently placed concrete until the pavement has attained at least 85% of the design strength as determined by testing cores taken from the Site, or until the pavement is 14 days old, at the option of the Owner.
- Q. Any equipment wheels operating on the pavement, shall operate at least one foot (300 mm) from the edge of the pavement. The equipment wheels shall be rubber tired.
- R. The paver shall not be permitted on the new slab until the pavement has attained full design strength. The paver shall not operate on any new slab without using wood mats having an approved thickness and width to ensure that the pavement will not be marked or structurally damaged.
- S. If the curing compound is damaged, it shall be repaired by spraying additional curing compound on the damaged areas as soon as the Work is completed.

3.02 CUTTING AND PATCHING

- A. At time of installing permanent pavement, edges of existing pavement shall be cut back 24-inches or more, as required, to sound undamaged material with vertical face cleaned and prepared for bonding with new pavement as indicated, specified, or as directed by Owner.
- B. Where work is located in sidewalks and similar narrow paved areas, the whole width shall have permanent pavement replaced.
- C. Disturbed or eroded gravel base course to be restored as required before placing pavement.
- D. Manhole covers, catchbasin grates, valve boxes, and similar items shall be adjusted to conform with pavement grade or as directed by the Owner; items shall be removed and reconstructed as necessary. This work shall be completed prior to final paving.
- E. Surface of existing pavement to which new pavement is to bond shall be treated with cut back asphalt or emulsified asphalt.

3.03 REINFORCED PORTLAND CEMENT CONCRETE PAVEMENT, WALKS, AND STEPS

- A. Portland cement concrete pavement shall consist of a coarse aggregate base and a reinforced Portland cement concrete surface, as shown on the drawings or specified.
- B. All base and Portland cement concrete shall be installed per ODOT Item 304, Item 451, Item 499, Item 508, Item 509, and Item 608.

3.04 CONCRETE PAVEMENT

- A. Contractor shall develop and submit to the Owner a proposed concrete mix design to meet the requirements of this section. No concrete shall be placed prior to approval of the mix design by the Owner.
- B. Expansion and contraction joints shall be installed as indicated on the drawings, as required, and as directed by the Owner. Expansion joints shall be required whenever new concrete abuts fixed objects or existing concrete surfaces, whether or not shown on the drawings.
- C. Contractor shall always have materials available to protect the surface of the concrete against precipitation. These materials shall consist of burlap, curing paper, or plastic sheeting.
- D. If existing roadway, sidewalk, curb, apron, etc. is to be removed and replaced with new roadway, sidewalk, curb, apron, etc. or new roadway, sidewalk, curb, apron, etc. extended from existing roadway, sidewalk, curb, apron, etc., the existing roadway, sidewalk, curb, apron, etc. shall be removed to the nearest joint of suitable quality or as directed by the Owner.

3.05 FORMWORK

- A. Contractor shall develop and submit to the Owner a proposed concrete mix design to meet the requirements of this section. No concrete shall be placed prior to approval of the mix design by the Owner.
- B. Forms shall be placed and checked for line and grade at least 500 feet (150 m) in advance of placing concrete.
- C. Forms shall be adequately staked and braced to resist the pressure of concrete and the thrust of the equipment.
- D. Forms shall have uniform bearing on the subgrade throughout their entire length and width.
- E. After setting the forms to grade, thoroughly tamp both the inside and outside with an approved mechanical form tamper.
- F. Forms shall be thoroughly cleaned before they are placed.

3.06 FORMS SHALL BE NEATLY AND TIGHTLY JOINED, AND SHALL BE SECURELY STAKED BY AT LEAST THREE (3) STAKES PER FORM.

- A. Forms shall be oiled before concrete is placed against them.
- B. Forms shall be checked for line and grade, after being set.
- C. Forms showing a variance from the staked line by more than 1/4 inch (5 mm) or from the staked grade by more than 1/8 inch (3 mm) in ten (10) feet (3 m) shall be adjusted.
- D. Where the use of flexible forms is required, sufficient back bracing shall be provided to prevent undue deflection of the forms during placement of the concrete.

3.07 FIELD QUALITY CONTROL

- A. Roadway aggregate materials shall be tested in accordance with these specifications. Asphalt paving shall be tested in accordance with ODOT specifications and testing laboratory recommendations. All quality control field testing services shall be provided by the Owner.

3.08 CLEANING

- A. Clean job site of rubbish, excess material, structures, and equipment. Restore damaged property.

3.09 JOINTS

- A. Clean job site of rubbish, excess material, structures, and equipment. Restore damaged property.
- B. Longitudinal and transverse joints shall conform to the details and requirements of ODOT Item 451.08 or as directed by the Owner.

- C. Transverse joints shall be constructed at right angles to the centerline of the pavement, unless otherwise determined by the Owner. The joints shall not vary more than 1/4 of an inch (5 mm) from a true line.
- D. The surface of the pavement adjacent to all joints shall be finished to a true surface. Where indicated on the Drawings, joints shall be edged to the radius shown or a minimum 1/4-inch (5 mm) radius. The surface across the joints shall be tested with a ten (10) foot (3 m) straightedge as the joints are finished and any irregularities shall be corrected before the concrete has hardened.
- E. When pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints of the first slab.
- F. Keyways, where required, shall be accurately formed with templates of metal, wood, or paper securely pinned in place. The gauge or thickness of the material in the templates shall be such that the full keyway, as specified, is formed in the correct location.
- G. Joints shall be blown out with a jet of compressed air to remove the flushing water. After the joint is dry, it shall be cleaned out with a jet of compressed air with a working pressure of at least 90 psi (620 kPa) and then shall be sealed in accordance with ODOT Item 450, with an application of an approved hot or cold applied type joint sealing compound. The sealing compound shall be applied with approved pressure type equipment with the nozzle extending into the groove and the groove shall be filled until the sealer overlaps the pavement about 1/8 of an inch (3 mm).
- H. The load transfer unit shall be epoxy coated dowel bars, spaced and arranged in the positions as indicated by ODOT Item 450, accurately held in place by an approved metal device so as to be perpendicular to the plane of the cross section of the pavement and parallel to the centerline at a distance from the surface equal to 1/2 the thickness of the slab.
- I. The metal device shall consist of connected transverse and longitudinal members arranged to hold each dowel so firmly that its final position after concreting operations shall not vary more than 1/8 of an inch per foot of length (3 mm per meter) from its designated line and grade. The device shall be such as will permit the joint to be completely assembled alongside the Work, and it shall be sufficiently rigid so that the joint can be lifted into place on the subgrade as a unit.
- J. One end of each dowel bar shall be free to move in the slab as the concrete contracts and expands. To accomplish this, 2/3 the length of each dowel shall be thoroughly lubricated with liquid asphalt. The liquid asphalt coating shall be applied to a sawed end of the dowel bar or, in the case of dowel bars with sheared ends, a metal cap shall be placed on the coated end of the dowel bar. The asphalt coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing the dowels in the joint. The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end of the bar.

3.10 PERMANENT PAVEMENT MARKINGS

- A. Apply permanent pavement markings in accordance with ODOT Item 640 and Item 646.
- B. Pavement markings removed during construction, including stop bars, turn arrows, crosswalks, etc., shall be replaced. The color and width of pavement markings shall match existing markings.
- C. Moving marking operations shall be performed by a truck equipped with necessary flashers and warning signs and shall be protected by a similarly equipped trailing vehicle or vehicles separated a sufficient distance to provide adequate advance warning to overtaking traffic. The marking operation should use the extreme left or right lane when possible.
- D. Stationary marking operations in intersections, school zones, gores and other areas shall be protected with traffic control devices such as advance warning signs and cones.
- E. 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.

- F. Surfaces to be painted must be thoroughly dry and free from dirt, loose paint, oil, grease, wax and other contaminants. The costs incurred for removing and disposing of unsuitable materials in preparation of the surfaces to receive the new Work, shall be incidental to the price paid for the pavement markings.
- G. Pavement markings shall be applied when the air temperature is 50°F or higher and the pavement is dry. Contractor shall be responsible for making the decision to apply waterborne paint on any specific day when there is a high probability of rain in the forecast. If applied lines are washed away because of rain, the Contractor shall be responsible for re-applying the lines at no additional expense to the Owner. Pavement marking material shall not be placed before May 1 nor after October 1.
- H. Pavement markings shall be applied with an application thickness of 15-mil and 8-mil dry thickness. Glass beads shall be added at the rate of 32 lbs., per mile, per 4-inch line, during the application process.

END OF SECTION 32 13 00

SECTION 32 13 13 CONCRETE PAVING

PART 1 GENERAL

1.01 SCOPE

- 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
- H. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications.
 - 1. AASHTO M 33M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
 - 2. AASHTO M 324: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
 - 3. AASHTO T 26: Standard Method of Test for Quality of Water to Be Used in Concrete
 - 4. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 5. ASTM A706/A706M: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
 - 6. ASTM A996/A996M: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
 - 7. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 8. ASTM C33/C33M: Standard Specification for Concrete Aggregates
 - 9. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete
 - 10. ASTM C143/C143M: Standard Test Method for Slump of Hydraulic-Cement Concrete
 - 11. ASTM C150/C150M: Standard Specification for Portland Cement
 - 12. ASTM C172/C172M: Standard Practice for Sampling Freshly Mixed Concrete
 - 13. ASTM C260/C260M: Standard Specification for Air-Entraining Admixtures for Concrete
 - 14. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

15. ASTM C494/C494M: Standard Specification for Chemical Admixtures for Concrete
16. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
17. ASTM C989/C989M: Standard Specification for Slag Cement for Use in Concrete and Mortars
18. ASTM D98: Standard Specification for Calcium Chloride
19. ASTM D994/D994M: Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
20. ASTM D1751: Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
21. ASTM D5893/D5893M: Standard Specification for Cold Applied Single Component Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements
22. ASTM D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
23. American Concrete Paving Association
24. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition.

1.04 MATERIAL REPORTS

- A. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the Standards referred to in the Specifications.
- B. The Contractor shall submit a list of his source of material supply to the for review prior to placing any order.
- C. The Contractor shall provide the Engineer, prior to the actual delivery of the ready-mixed concrete, the mix design as required by ASTM C94/C94M .

1.05 THICKNESS AND COMPRESSIVE STRENGTH REPORTS

- A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. The core drilling, testing for thickness and compressive strength, and the certification of the test results shall be performed by a testing laboratory approved by the Engineer.

1.06 WATER QUALITY TEST REPORTS

- A. The testing lab shall provide the Engineer with two (2) certified copies of the test results of the quality of water to be used in the concrete. The sampling and testing of water quality shall be in accordance with AASHTO T 26 requirements, and the certification of the tests' results shall be performed by a testing laboratory approved by the Engineer.

1.07 REQUEST FOR MATERIAL VARIANCE

- A. All requests for variances in the materials, as specified, shall be made in writing to the Engineer.
- B. Two (2) copies of the request shall be submitted 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. Cement shall be low alkali, air-entraining Portland cement conforming to ASTM C150/C150M, Type IA or Type IIIA.

2.02 FINE AGGREGATES

- A. The fine aggregate gradation shall conform to ASTM C33/C33M and to fine aggregate, 2NS, as specified in MDOT, Section 902.08.

2.03 COARSE AGGREGATE

- A. The coarse aggregate gradation shall conform to ASTM C33/C33M and to coarse aggregate, 6A, or 6AA as specified in MDOT, Section 902.03.

2.04 WATER

- A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.
- B. Waters from sources approved by the Michigan Department of Public Health as potable may be used without testing.
- C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be used in Concrete, AASHTO T-26, and specified in MDOT, Section 911.

2.05 CONCRETE ADMIXTURES

- A. Air-Entraining Admixtures
 - 1. Air-entraining admixtures for concrete shall conform to ASTM C260/C260M and as specified in MDOT, Section 903.01.
- B. Concrete Accelerators
 - 1. Chemical admixtures, other than calcium chloride, for accelerating the set of Portland cement concrete shall conform to ASTM C494/C494M, Type C or Type E.
 - 2. Calcium chloride in flake or pellet form shall conform to ASTM D98, Type S, Grade 1 or grade 2, flake or pellet form, and as specified in MDOT, Section 903.04.
 - 3. Calcium chloride in solution form shall conform to MDOT, Section 903.04.
- C. Water-Reducing and Water-Reducing Retarding Admixtures
 - 1. Water-reducing admixtures and water-reducing retarding admixtures shall conform to ASTM C494/C494M, Type A or Type D, except that neither type of admixture shall contain calcium chloride, and as specified in MDOT, Section 903.02.
- D. Pozzolanic Admixtures
 - 1. Fly Ash shall conform to ASTM C618, Type F, and as specified in MDOT, Section 901.07.
 - 2. Ground granulated blast furnace slag shall conform to ASTM C989/C989M, Grade 100, minimum

2.06 CONCRETE CURING COMPOUNDS

- A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 903.06.
- B. Transparent membrane curing compound for curing base course concrete shall conform to ASTM C309, Type 1-D, Class B Vehicle, and as specified in MDOT, Section 903.06.

2.07 LANE TIE BARS

- A. Bar reinforcement for pavement tie bars shall conform 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. Welded steel wire fabric for concrete mesh reinforcement shall conform to ASTM A1064/A1064M, and as specified in MDOT Section 905.06, and shall be fabricated as shown on the Plans.

2.09 DOWEL BARS

- A. Dowel Bars and basket assemblies for Transverse expansion and contraction joints shall be ASTM A615/A615M Grade 40 and conform to MDOT Section 914.07.

2.10 STEEL HOOK BOLTS

- A. Hook bolts shall conform to ASTM A706/A706M, or Grade 60 of ASTM A615/A615M, or ASTM A996/A996M. Hook bolts shall be 5/8 inch diameter. Along the edge of existing concrete, expansion anchored hook bolts shall be used.

2.11 JOINT FILLERS

- A. Fiber joint filler material for expansion joints shall conform to ASTM D1751, and as specified in MDOT, Section 914.03.
- B. Bituminous premolded joint filler material shall conform to ASTM D994/D994M and also AASHTO M 33M.
- C. Polyethylene premolded joint filler for pressure relief joints shall be a flexible, low-density, expanded, extruded polyethylene plank. The polyethylene plank shall be formed by the expansion of polyethylene base resin in an extrusion process and shall be homogeneous, closed-cell and multi-cellular.

2.12 JOINT SEALANTS

- A. Hot-poured type joint sealant shall conform to AASHTO M324 or ASTM D6690 Type II and as specified in MDOT, Section 914.04.
- B. Cold-applied, single component type, joint sealant shall conform to ASTM D5893.

2.13 CONCRETE MIX

- A. Concrete shall yield 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.
- B. Mixes shall be a nominal 564 lbs/cyd mix except that a minimum of 25% Type F Fly Ash shall be used in the mix. The CONTRACTOR shall provide documentation from actual mixes used on projects showing 28 day compressive strength of not less than 3500 PSI when tested under field conditions.
 - 1. Water reducers, additional fly ash, ground granulated blast furnace slag (GGBFS), and other pozzolans, may be used when approved by the Engineer. The fly ash quantity may not exceed 40%; GGBFS quantity shall be not less than 25% not more than 40%.
 - 2. Maximum total replacement of cement shall not exceed 40%. GGBFS and Fly Ash must replace cement on a pound for pound basis.
- C. Cement shall be air-entraining Portland cement ASTM C150/C150M, Type IA. If high-early strength concrete is desired, Type IIIA is required.
- D. High early strength concrete shall be 4500 PSI, 658 lbs/cyd with a water reducer. Water cement ratio shall be between 0.38 and 0.39.
- E. The air content of the concrete shall be dependent 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. The slump of the concrete shall be between 1-1/2 to 2-1/2 inch where machine methods are used for striking off and consolidating the concrete. If the Engineer permits hand finishing, the slump may be increased to 3-1/2 inch.
- G. Ready-mixed concrete shall be in accordance with ASTM C94/C94M, Alternate 2, and shall yield 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. The Engineer shall be provided with the mix design for review and approval, prior to the actual delivery of the concrete.

PART 3 EXECUTION

3.01 VERIFICATION OF EXCAVATION AND FORMING

- A. Prior to the installation of any concrete, examine the excavation and forms for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades are adequate to receive the concrete to be installed.
- B. Correct all 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 the 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 the Engineer.

3.04 BATCH PLANT

- A. An adequate site for the batch plant shall be obtained by the Contractor, at his expense. The site shall be maintained, and the plant operated in accordance with the conditions and requirements established by the community in which the plant is located.

3.05 FINE GRADING

- A. The subgrade shall be fine graded to the cross section shown on the Plans and shall be thoroughly compacted prior to the placing of forms or concrete.

3.06 INSTALLATION - GENERAL

- A. The width, thickness, and type of concrete pavement shall be specified on the Plans or as approved by the Engineer.
- B. At street intersections, curb drops, conforming to the current rules and regulations of Act 8, Michigan PA 1973, shall be provided for the construction of sidewalk ramps.
- C. Curb drops for sidewalk ramps and driveway approaches shall be provided as specified in locations called for on the Plans or as approved by the Engineer.
- D. Construction operations shall be restricted to the existing right-of-way. If additional area is required, the Contractor shall furnish the Engineer with written permission from the property owner for any part of the operation he conducts outside the established right-of-way.

- E. The Contractor shall maintain traffic access at all intersections. Vehicle access shall also be maintained to all commercial and public properties and elsewhere as designated by the Engineer.

3.07 FORMS

- A. Except when paving with a slip-form paver, forms shall be used and shall be made of metal, having an approved section, which shall insure their rigidity under impact, thrust and weight of the heaviest machine carried on them. The thickness of the metal shall be not less than 1/4 inch, except that a minimum thickness of 3/16 inch will be permitted if the form is a trapezoidal cross section.
- B. Forms shall have a minimum length of ten 10 feet and a depth not less than the edge thickness of the Work prescribed, except the subgrade may be a maximum of 1 inch lower than the bottom of the forms when approved by the Engineer. The width of the base in direct bearing on the soil shall be not less than 0.75 of the form depth except that a width of less than 8 inches will not be permitted.
- C. Each 10 feet section of form shall have at least three (3) stake pockets. The forms shall be straight, free from distortion, and shall show no vertical variation greater than 1/8 inch in 10 feet lengths from the true plane surface on the top of the form when tested with a 10 feet straightedge; and shall show 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. The method of connection between form sections shall be such that a locked joint is formed free from vertical movement in excess of 1/8 inch and from horizontal movement in excess of 1/4 inch under the impact, thrust and weight of the heaviest machine carried on the forms.
- F. Sufficient forms shall be provided so that it will not be necessary to remove them in less than 12 hours, or longer if required, after the concrete has been placed.

3.08 EQUIPMENT REQUIREMENTS

- A. Approved, mechanical concrete placing and finishing equipment shall be used for concrete paving except for gapped areas or where otherwise approved by the Engineer.
- B. The Contractor shall furnish sufficient equipment for the placing of concrete pavement. The equipment shall be on the job site and ready for normal operation before the paving operation is started. All equipment shall be in good working order. The equipment shall be subject to inspections and testing during construction.
- C. The equipment shall be of sufficient capacity that the paver can operate continuously and obtain a rate of production that insures good workmanship and eliminates overloading of equipment or frequent interruptions or delays.
- D. Equipment operating on or near the pavement shall be equipped with rubber-tired wheels.
- E. Subgrade Roller or Compactor
 - 1. This equipment shall be self-propelled steel-wheeled or a pneumatic-tired roller weighing not less than 8 tons or a self-propelled vibratory compactor 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 the Engineer.
 - 2. The steel-shod template shall be adjustable to fit the shape of the bottom of the pavement and shall have adequate connection to a rigid frame to maintain the crown.

3. The planer shall be of sufficient weight to plane off all high spots encountered.
- G. Base Trimmer
1. For slip-form construction, a powered, self-propelled base trimmer will be required. This base trimmer shall be capable of trimming the base to the required cross section.
- H. Water Supply Equipment
1. The pumps and pipe lines shall be such capacity and nature as to insure an ample supply and adequate pressure of water, simultaneously, for all the requirements of machinery, mixing, sprinkling subgrade, and all other requirements of the Work.
 2. Water may be supplied in tank wagons to augment inadequate pipe lines or to replace them entirely if a sufficient number of units are employed.
- I. Finishing Machine
1. The finishing machine shall be power driven and of an approved type which will strike off and compact the concrete with a screeding and troweling action. The machine shall be capable of finishing the concrete in the manner specified herein, and shall provide a minimum of two (2) oscillating screeds.
 2. A combination concrete spreader/finishing machine (i.e.: Pav-Saver®) may be used for residential streets not exceeding 100 feet in length and 18 feet in width or when approved by the 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. An approved concrete spreader with a strike-off board or a separate strike-off shall be used to level each layer of concrete, before placing of reinforcement, and before finishing the concrete.
 - a. It shall have sufficient weight and rigidity to retain its shape under working conditions to properly strike off the concrete.
 - b. Two separate spreaders are not required where an approved mesh depressor type machine is used.
 2. A concrete spreader is not required for the construction of residential street concrete pavement when approved by the Engineer.
- K. Vibratory Screed
1. An approved hand-propelled vibratory screed shall be provided for use in gapped areas at driveways and intersections, and where machine methods are not feasible to screed and consolidate the concrete.
 - a. Gaps finished by this method shall be limited to one (1) joint spacing in length and one (1) single lane width.
 2. The screed shall consist of a steel-shod strike board having a minimum thickness of two 2 inches and equipped with a gasoline engine capable of producing at least 5,000 vibrations per minute.
 3. Other vibratory screeds may be approved by the Engineer.
- L. Membrane Sprayer
1. A mechanically-pumped pressure sprayer capable of applying a continuous uniform film of curing compound will be required.

2. The equipment shall provide adequate stirring of the compound during application.

M. Slip-Form Paving Equipment

1. When pavement is placed by the slip-form method, the slip-form paving equipment shall spread, consolidate, screed, and mechanically float the freshly-placed concrete in such a manner that only a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement.
2. The machine shall be equipped to vibrate the concrete for the full width and depth of the pavement being placed.

N. Floats

1. The mechanical float shall be a combination float finisher. Where a mechanical float is an integral part of a slip-form paver, a separate mechanical float will not be required.
2. A float finisher shall consist of a machine having two (2) screeds and be equipped with a suspended pan float. The second screed and the pan float shall be suspended in such a manner that they operate independently of the side forms.
3. A mechanical float will not be required for the construction of residential street concrete pavement.

O. Footbridge

1. A movable bridge shall be provided when necessary to satisfactorily finish the pavement or construct joints. The bridge shall be designed and constructed so that it will not come in contact with the concrete.

P. Transverse Float

1. This float shall be made of metal and shall be at least 10 feet in length and of the box or channel type with a floating face at least 6 inches in width. It shall be constructed so as to be light in weight, rigid and free from warps.

Q. Vibrator

1. The vibrator for consolidating the concrete along the faces of the forms and adjacent to joints shall be an approved electric or mechanical vibrator of an internal type, not less than 2 inches in diameter. It shall have 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. At least two (2) vibrators shall be provided for each concrete paving unit on the project.
3. The vibrators used adjacent to the forms in conventional paving shall be connected with the equipment on which they are mounted such that vibration of the concrete will start automatically with the forward movement of the equipment and stop automatically whenever forward movement stops.

R. Form Tamper

1. A mechanical form tamper of approved design will be required on all projects. It shall be capable of thoroughly and uniformly compacting the soil under the forms.

S. Strike-Off for Reinforcement

1. An approved strike-off shall be used to level the concrete before placing the pavement reinforcement. It shall be adjustable and shall be supported by two (2) flanged wheels on each end which rest on the side forms.
2. It shall have sufficient weight and rigidity to retain its shape under working conditions and properly strike off the concrete.
3. An approved hand strike-off resting on the forms shall be used 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. When not placed on approved chairs, lane tie bars shall be installed by use of an approved mechanical device.
- U. Reinforcement Carrier
1. Reinforcement not placed on chairs shall be transferred from the hauling equipment to a movable bridge which spans the pavement being cast or placed by other approved means which will not result in contamination of the concrete.
 2. The bridge shall be capable of carrying the reinforcement load without appreciably deflecting the forms.
- V. Joint Filling and Sealing Equipment
1. The equipment for filling and sealing joints shall be available for inspection and testing at least 48 hours prior to its use.
 2. The sealing machine shall include a mechanical mixer capable of mixing the sealing components into a uniform, homogeneous mass.
 3. The heating kettle for hot poured sealing material shall be of the indirect-heating or double boiler type, using oil as the heat transfer medium.
 - a. It shall have a thermostatically controlled heat source, a built-in automatic agitator, and thermometers installed to indicate both the temperature of the melted sealing material and that of the oil bath.
 - b. The Contractor shall demonstrate that the equipment proposed for use will consistently produce a joint sealer of proper pouring consistency.
 4. The hot-poured sealing material shall be applied directly from the heating kettle; the kettle shall be equipped with a pressure pump, hose and nozzle suitable for forcing the sealing material to the bottom of the joint and completely filling the joint.
 - a. The rate of application shall be controlled so as to completely fill the joint and not spill the material on the surface of the pavement.
 - b. The hose and nozzle shall maintain the temperature of the sealing materials so that the loss in temperature is not more than 10 degrees F between the nozzle and the heating tank.
 - c. Heat from a direct flame on the nozzle shall not be used to maintain the proper temperature of the sealing material.
 - d. The heating equipment shall be mounted on rubber-tired wheels, and only rubber-tired equipment shall be used to move the heating equipment on the pavement.
 5. Cold applied sealing compound shall be applied by means of pressure equipment that will force the material to the bottom of the joint and completely fill the joint without overflowing onto the surface of the pavement.
- 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. Sandblasting equipment shall be of proper size and capacity to obtain the cleaning specified and shall operate at a nozzle pressure adequate for the performance of the

Work.

2. Nozzles shall be of proper diameter in relation to the width of joint and shall be replaced as necessary due to enlargement by wear.
3. A power wire brush may be used in place of sandblasting equipment.

Y. Air Compressors

1. Air compressors shall be portable and capable of furnishing sufficient air to maintain a nozzle pressure adequate to remove all loose fragments of concrete and foreign material from the joints.
2. Suitable traps shall be employed to maintain the compressed air free of oil and moisture.

Z. Power Broom

1. A mechanical broom with pickup suitable for cleaning the pavement will be required.

AA. Concrete Saw

1. Two (2) self-propelled concrete saws which are adequately powered to cut hardened concrete to a minimum depth as shown on the Plans will be required. The minimum thickness of the saw blade shall be 3/16 inch.
2. Saws shall be equipped with suitable guards.

BB. Miscellaneous Equipment

1. All other small tools to completely and satisfactorily finish the Work, including straightedges for testing pavement and forms, shall be provided by the Contractor.

3.09 PLACEMENT OF FORMS

- A. Forms shall be placed and checked for line and grade at least 500 feet in advance of placing concrete.
- B. Forms shall be adequately staked and braced to resist the pressure of concrete and the thrust of the equipment.
- C. Forms shall have uniform bearing on the subgrade throughout their entire length and width.
- D. After setting the forms to grade, thoroughly tamp both the inside and outside with an approved mechanical form tamper.
- E. Forms shall be thoroughly cleaned before they are placed.
- F. Forms shall be neatly and tightly joined, and shall be securely staked by at least three (3) stakes per form.
- G. Forms shall be oiled before concrete is placed against them.
- H. Forms shall be checked for line and grade, after being set.
- I. Forms showing a variance from the staked line by more than 1/4 inch or from the staked grade by more than 1/8 inch in 10 feet shall be adjusted.
- J. Where the use of flexible forms are required, sufficient back bracing shall be provided to prevent undue deflection of the forms during placement of the concrete.

3.10 PLACING CONCRETE

- A. Placing of concrete should not commence or continue until the condition of the subgrade has been approved by the Engineer.
- B. The concrete shall be spread or distributed as soon as placed. If a mechanical spreader is not used, the concrete shall be deposited in a manner that requires a minimum of re-handling to avoid segregation and separation of materials. The concrete shall be deposited to a height sufficiently above grade so that when consolidated and finished it shall conform to the required

finished grades.

- C. Concrete along the faces of forms and adjacent to joints shall be consolidated and compacted to fill all voids.
- D. Forms shall not be vibrated to consolidate the concrete.
- E. When the pavement is placed in two (2) layers, the first layer may be cast 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. The equipment shall vibrate concrete placed full depth for the complete width and depth of the pavement being placed. For concrete placed in two (2) layers, only the second layer will be required to be vibrated.
- G. The placing of concrete shall be continuous as much as possible between transverse joints.
- H. Whenever a temporary halt in operation occurs, the concrete and unfinished end of the slab shall be covered with wet burlap or plastic.
- I. If the interruption of Work continues for more than 20 minutes, a construction joint shall be placed, provided the proposed construction joint is 15 feet 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. Sections of pavement shorter in lengths will not be permitted and, if constructed, shall be removed and replaced at the Contractor's expense.
- J. Integral curbs, where specified or required, shall be constructed monolithic with the pavement slab. The curb material shall be placed before the pavement has started its initial set and shall be of the same mix as the concrete pavement.
- K. Base and back forms will be required when constructing straight curbs, and back forms with templates of the required curb shape shall be used when constructing rolled and mountable curbs. The curb concrete shall be spaded sufficiently to eliminate all voids and tamped to bring the mortar to the surface, after which the curb shall be given a final finish to match the texture of the pavement.
- L. After removing forms, any visible areas of honeycomb or minor defects shall be immediately filled with mortar, having one part of Portland cement and two parts fine aggregate, and shall be applied with a wooden float.
- M. Where adjacent pavement lanes are constructed in separate pours, no equipment shall be operated upon recently placed concrete until the pavement has attained at least 85% of the design strength as determined by testing cores taken from the project, or until the pavement is 14 days old, at the option of the Engineer.
- N. Any equipment wheels operating on the pavement, shall operate at least 1 foot from the edge of the pavement. The equipment wheels shall be rubber-tired.
- O. The paver shall not be permitted on the new slab until the pavement has attained full design strength. The paver shall not operate on any new slab without using wood mats having an approved thickness and width to insure that the pavement will not be marked or structurally damaged.
- P. Pavers are not permitted to operate on residential streets.
- Q. If the curing compound is damaged, it shall be repaired by spraying additional curing compound on the damaged areas as soon as the Work is completed.
- R. The filler strip on pavement widening projects shall be poured as soon as possible but not later than the first working day following the placing of the slab.
- S. At all intersections and where access is required to property along the Project, construction shall be completed by gapping the proposed pavement. Load transfer, contraction, or end-of-pour joint devices shall be placed at the gapped ends of the pavement.

- T. In lieu of pavement gapping, the Contractor may elect to place a temporary bridge, of a design approved by the Engineer, to provide access. Furnishing, placing, maintaining, and removing the bridge shall be at the Contractor's expense.

3.11 PLACING PAVEMENT REINFORCING

- A. Where reinforcement is required, the sheets or mats shall be placed at the depth below the surface of the finished pavement, as shown on the Plans.
- B. Pavement reinforcement shall be shipped and delivered to the Work in flat sheets or mats.
- C. Adjacent sheets or mats shall be lapped, as indicated on the Plans, and shall be fastened to each other in no less than two (2) places in each pavement lane.
- D. Where the width of pavement varies, the reinforcement requirements shall be the same as called for on the Plans. Split sheets or mats may be used to conform to the particular pavement configuration. Side laps shall not be less than the spacing of the longitudinal wires or bars.
- E. On widening Projects where the pavement slab is less than 6 feet in width, 1/2 inch diameter longitudinal reinforcing bars may be substituted for standard reinforcement, providing the bars are spaced not more than 12 inches center-to-center. The first bar shall be not more than 3 inches from the edges of the widened slab, and the bars shall be lapped a minimum of 12 inches.
- F. Reinforcement shall be installed by one of the following methods:
 - 1. Chairs upon which reinforcement is to be mounted shall support the reinforcement and shall have such bearing on the base that there will be no undue penetration of the base. The maximum spacing of the chairs shall be sufficient to maintain the reinforcement at the specified depth. The reinforcement shall be placed directly from the hauling unit unto the chairs.
 - 2. When reinforcement is placed between two (2) layers of concrete, the first layer shall be mechanically spread and struck off to the required depth below the proposed finished surface. The reinforcement shall be placed directly from the carrier onto the struck off concrete.
 - 3. Any area where the use of the mechanical spreader or mechanical strike-off is not feasible, the reinforcement shall be mounted on chairs.

3.12 JOINTS

- A. All longitudinal and transverse joints shall conform to the details and shall be constructed at the locations shown on the Plans or as directed by the Engineer.
- B. All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement.
- C. Transverse joints shall be constructed at right angles to the centerline of the pavement, unless otherwise called for on the Plans or as determined by the Engineer. The joints shall not vary more than 1/4 inch from a true line.
- D. The surface of the pavement adjacent to all joints shall be finished to a true surface. Where indicated on the Plans, joints shall be edged to the radius shown or a minimum 1/4 inch radius. The surface across the joints shall be tested with a 10 foot straightedge as the joints are finished and any irregularities shall be corrected before the concrete has hardened.
- E. When pavement is laid in partial width slabs, transverse joints in the succeeding slabs shall be placed in line with the like joints of the first slab. In the case of widening existing pavements, transverse joints shall be placed as shown on the Plans, or as directed by the Engineer.
- F. Keyways, where required, shall be accurately formed with templates of metal, wood, or paper securely pinned in place. The gauge or thickness of the material in the templates shall be such that the full keyway, as specified, is formed in the correct location.

G. Longitudinal Joints

1. Longitudinal joints shall be a longitudinal lane tie joint with tie bars or a bulkhead construction joints with hook bolts. Where called for on the Plans a keyway shall be constructed in the bulkhead construction joint.
 - a. Longitudinal Lane Tie Joint (D)
 - 1) Longitudinal lane tie joints with tie bars shall be planes of weakness formed by sawing a groove in the hardened concrete according to the alignment, width and depth shown on the Plans.
 - 2) Tie bars of the type, diameter and length called for on the Plans, shall be placed at the required depth parallel to the finished surface, at right angles to the joint and at the uniform spacing also called for on the Plans or as approved by the Engineer.
 - 3) Bar chairs shall be used to support the lane tie bars or the lane tie bars may be installed by use of a mechanical device, approved by the Engineer. The placing of lane tie bars in the concrete by hand methods will not be permitted.
 - 4) The joint shall be sawed as soon as the concrete will not spall or not more than three (3) days after placement, and shall be completed before traffic of any kind uses the pavement. Immediately following the sawing of the joint, the slurry resulting from the sawing operation shall be completely removed from the joint, and the immediate area by flushing with a jet of water under pressure.
 - 5) The joint shall be blown out with a jet of compressed air to remove the flushing water.
 - (a) After the joint is dry it shall be cleaned out with a jet of compressed air with a working pressure of at least 90 psi and then shall be sealed in accordance with these specifications with an application of an approved hot or cold applied type joint sealing compound.
 - (b) The sealing compound shall be applied with approved pressure type equipment with the nozzle extending into the groove and the groove shall be filled until the sealer overlaps the pavement about 1/8 inch.
 - b. Longitudinal Bulkhead Construction Joint (D)
 - 1) Longitudinal bulkhead construction joints with hook bolts shall be used in part-width construction of concrete pavement and elsewhere as shown on the Plans, or as approved by the Engineer. The size, spacing, and depth of the hook bolts below the surface of the pavement shall be as shown on the Plans.
 - 2) For slip-form paving, lane ties of an approved type may be substituted for hook bolts and shall be spaced at 30 inch centers, unless otherwise indicated on the Plans.
 - (a) Lane ties for slip-form paving shall be placed in the concrete with a pneumatic powered installer or equipment producing equal results.
 - (b) Lane ties, which are not set with adequate consolidation of the concrete or are not within 30 degrees of being perpendicular to the pavement edge in a horizontal plane, shall be replaced with drilled-in expansion-anchored lane ties.
 - 3) Where a bulkhead joint is to be constructed, hook bolts and couplings shall be attached to the forms and shall be held in position during the placing and finishing of the concrete so as to permit the removal of the pavement forms without damage to the concrete or hook bolt assembly. The ends of the couplings shall be protected so that the concrete, dirt or other materials cannot

enter the couplings and prevent a satisfactory connection with either hook bolt.

- 4) Where hook bolts or lane ties are installed for use in future pavement widening, in curb, or curb and gutter construction, a rust preventive oil shall be inserted into the open end of the couplings immediately after removal of the pavement forms by means of a hand operated pump in sufficient quantity to completely cover the internal threads.
 - (a) After application of the protective oil a neoprene or plastic plugs shall be inserted into the ends of the couplings to completely seal the opening without protruding outside of the couplings more than 3/8 inch.
- 5) The concrete shall be edged with a tool having the radius of curvature and depth of lip shown on the Plans. The second pour of concrete shall be edged with a longer lipped edging tool than that used on the first concrete pour.
- 6) After the concrete has cured for the required time, all extraneous material shall be removed from the joint and the joint then sealed with an approved hot-poured or cold-applied elastic-type compound. The use of sandblasters and a jet of compressed air will be required to clean the joint before sealing.

H. Transverse Joints

1. Transverse joints shall be 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) Contraction joints shall consist of a load transfer unit and a joint groove formed by sawing. Contraction joints shall be constructed as indicated on the Plans and shall be spaced a maximum of every 57' - 3" or as provided for elsewhere.
 - 2) The load transfer unit shall be epoxy coated dowel bars, spaced and arranged in the positions indicated on the Plans, accurately held in place by an approved metal device so as to be perpendicular to the plane of the cross section of the pavement and parallel to the centerline at a depth from the surface equal to 1/2 the thickness of the slab.
 - 3) This device shall consist of connected transverse and longitudinal members arranged to hold each dowel so firmly that its final position after concreting operations shall not vary more than 1/8 inch per foot of length from its designated line and grade. The device shall permit the joint to be completely assembled alongside the Work, and it shall be sufficiently rigid so that the joint can be lifted into place on the subgrade as a unit.
 - 4) One end of each dowel bar shall be free to move in the slab as the concrete contracts and expands.
 - (a) To accomplish this, 2/3 the length of each dowel shall be thoroughly lubricated with liquid asphalt. The liquid asphalt coating shall be applied to a sawed end of the dowel bar or, in the case of dowel bars with sheared ends, a metal cap shall be placed on the coated end of the dowel bar.
 - (b) The asphalt coating shall be sufficiently dry before using the dowels so that it will not be removed by handling and placing the dowels in the joint.
 - (c) The bars shall be installed so that the alternate bar on each side of the joint shall be the coated end of the bar.
 - b. Plane of Weakness Joints (WT)
 - 1) Plane of Weakness joints shall be placed in plain concrete pavements only and is to be constructed immediately after the finishing operation has been completed. A groove shall be formed in the plastic concrete with a metal

forming bar to the depth indicated on the Plans.

- 2) A premolded bituminous filler strip shall be placed in the groove formed by the metal bar, from a bridge operating on the pavement forms.
 - 3) The concrete shall then be floated against the sides of the filler, and the joint edged to a 1/8 inch radius.
- c. Plane of Weakness Joint for Concrete Base Course (WTB)
- 1) Dummy joints shall be placed in reinforced concrete pavements only where called for on the Plans.
 - 2) They shall be constructed immediately after the finishing operation has been completed by forming a groove in the plastic concrete with a metal forming strip into which expanded polystyrene or other approved temporary filler is placed.
 - 3) The material shall be installed flush with the surface of the pavement and the area on both sides of the joint shall be finished. Transverse joints with a temporary filler shall not be edged.
 - 4) The pavement reinforcement shall be continuous through this joint.
- d. Expansion Joints (E) and (E1)
- 1) Expansion joints (E1) shall consist of a load transfer unit and a premolded fiber filler and shall be used on reinforced concrete pavements or where shown on the plans.
 - 2) Expansion joints (E) shall consist of a premolded fiber filler without the load transfer unit and shall be used for joints in concrete capping, end connections with structures or existing pavements, plain concrete pavements, and other places where shown on the Plans or where installation of the load transfer unit is not feasible; as approved by the Engineer.
 - 3) The load transfer units shall be assembled and the epoxy coated bars lubricated with liquid asphalt. The liquid-asphalt-coated end of each bar shall be provided with a close fitting metal cap.
 - 4) The fiber filler shall extend the full depth and width of the joint.
 - (a) After installation, the top shall be not less than 1/2 inch and no more than 1 inch below the finished surface.
 - (b) It shall be furnished in lengths not less than the lane widths being poured. Where additional partial lengths are necessary, the minimum length of load transfer unit and premolded fiber filler shall be sufficient to span two (2) dowel bar spacings.
 - (c) Where more than one (1) section is allowed and used in a joint, the sections shall be securely joined together.
 - 5) For expansion joints in curb lanes with integral curb or separate curb and gutter, the fiber filler used in the pavement shall extend completely through the curb section. The fiber filler placed in the curb above the slab shall be 1 inch in width.
 - 6) During installation, the joint shall be held in place by an approved installing device which shall be securely staked.
 - (a) The top edge of the filler shall be protected, while the concrete is being placed, by a metal channel cap of at least 10-gage material having flanges not less than 1-1/2 inches in depth.
 - (b) The channel cap shall be shaped to the proposed crown of the pavement and shall extend over the full length of the filler.

- e. Pressure Relief Joints (PR)
 - 1) The method of constructing a pressure relief joint shall be as indicated on the Plans.
 - 2) The pressure relief joint material shall be a flexible, low-density, expanded, extruded polyethylene plank. This joint material shall be cut off to 1/2 inch below the top of the pavement surface and shall extend 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) End of pour joints in reinforced pavement shall be formed by placing a bulkhead and installing a load transfer device, as specified for contraction joints, except that the ends of the dowel bars shall not be lubricated. The load transfer device shall be so installed that each dowel bar will be embedded in the concrete for 1/2 of its length.
 - 2) When the next pour is made, a space for hot-poured rubber joint filler shall be provided by placing a temporary filler in the fresh concrete.
 - 3) End-of-pour joints shall be constructed using 2-piece dowels and a bulkhead, and shall be placed where it is anticipated that three (3) days or more will elapse between the casting of adjacent pours.
 - 4) Construction joints and end-of-pour joints shall be sealed as specified for transverse contraction joints.
 - 5) End of pour joints in plain concrete pavements shall be formed 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) The pavement across the end of both slabs shall be thickened and the joint shall be edged and sealed.
- 2. All transverse joints in a concrete pavement shall extend entirely through the integral curb or separate curb and gutter. The material used to construct the joint in the curb shall be of the same kind as provided for the pavement.
- 3. Bituminous fiber filler shall be used to construct the expansion joints in the integral curb of reinforced concrete pavements.
 - a. The thickness of the fiber filler material in the curb above the gutter shall be 1 inch.
 - b. The joint material shall be precut so as to conform to the geometric shape and cross-sectional area of the curb, and shall be placed in intimate contact with the filler material in the pavement.
- I. The edges of all transverse joints in the integral curb shall be rounded with an approved finishing tool, having a radius of 1/4 inch.

3.13 CONSOLIDATING AND FINISHING

- A. The sequence of operations after the placing of concrete shall be:
 - 1. striking off and consolidating,
 - 2. floating,
 - 3. edging,
 - 4. and final finishing with burlap drag.
- B. Mechanical methods shall be employed to strike off and consolidate or compact the concrete, except in gapped areas or where the pavement width will not permit the use of machine methods. Gaps less than one (1) joint opening in length may be finished by hand methods,

provided they are finished in single-lane widths.

- C. Strike off, consolidate and compact the concrete to such an elevation that when all finishing operations are completed, the surface will conform to the required finished grade and cross section.
 - 1. At least 4 inches of concrete above the finished pavement grade shall be maintained ahead of the screed for its entire length.
 - 2. In consolidating the surface of the pavement, on residential street construction when a single screed finishing machine is used, it shall operate over each section of the pavement twice.
 - 3. Only sufficient mortar shall be worked to the surface to provide a dense smooth finish.
 - 4. Excessive operation of the machine over a given area will not be permitted. Segregated particles of coarse aggregate which may collect in front of the screed shall be thoroughly mixed by hand with the mass of concrete already on the subgrade.
- D. If it is not possible to use mechanical equipment on irregular areas, an approved, self-propelled vibratory screed shall be employed to strike off and properly consolidate the concrete surface to the required finish grade.
 - 1. The entire area of the pavement shall be consolidated to insure 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. Strike-off boards shall be moved forward with a combined longitudinal and transverse motion, with neither end raised from the side forms during the process.
 - b. A slight amount of excess concrete shall be kept 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. After striking off and consolidating, the surface shall be made uniform by longitudinal or transverse floating by a mechanical method unless the pavement is permitted to be constructed in single lane widths.
- 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. When mechanical equipment is not used for floating, a transverse float at least 10 feet in length shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved ahead 1/2 of its length and the operation repeated.
- I. Care shall be taken to preserve the crown and cross section of the pavement.
- J. The float finishing operation shall not proceed until the concrete has attained a consistency so that no excess concrete is carried ahead of the float but the entire surface can be floated and sealed.
- K. Immediately following the float finishes and while the concrete is still plastic, the Contractor shall test the slab surface for trueness by means of a 10 foot straightedge or acceptable float.
 - 1. The straightedge shall be placed at the center of the slab with the blade parallel to the centerline and pulled slowly and uniformly to the edge. This operation shall be repeated until the surface of the concrete is free from irregularities and makes contact at all points with the bottom of the straightedge. The straightedge shall then be moved forward 1/2 its length and the operations repeated.

2. Depressions found in the surface shall be filled with fresh concrete and consolidated by floating with a long-handled float not less than 10 foot in length. This float may also be used to smooth sections of the surface that may have become rough or torn by dragging with the straightedge.
- L. For pavement constructed by the slip-form method, the edge settlement shall be determined as soon as practical after paving operations begin. Edge settlement in excess of 3/8 inch shall be corrected before the concrete has hardened.
1. When edge settlements in excess of 1/4 inch persist, paving shall be suspended and operational corrections made before the Engineer will permit the resumption of paving. If the Contractor consistently fails to construct pavement within these tolerances, the use of slip-form methods shall be discontinued and pavement placed by means of conventional forms.
 2. When paving is accomplished by the slip-form paving method, all mortar paste shall be wiped from the sides of the slab.
 3. The surface shall then be tested for smoothness with the straightedge. During this operation, the contact of the straightedge with the concrete shall be uniform over the entire length tested. At the time of testing, the surface shall be free from soft mortar or excessive water. The testing straightedge shall be used for this purpose only.
- M. Where the float finisher method is not utilized, as soon as the hand floating is completed, all laitance, surplus water, and inert material shall be worked entirely off the pavement and the surface made smooth by dragging with a rigid straightedge 10 foot in length and the surface shall be tested.
- N. As soon as all excessive moisture has disappeared and while it is still possible to produce a uniform surface of gritty texture, the pavement shall be finished by dragging a seamless strip of damp burlap or cotton fabric, not less than 5 feet nor more than 6 feet in width, over the full width of the pavement.
1. The burlap or cotton drag shall be pulled by a bridge supported on a pavement forms. The fabric shall be renewed as often as necessary to obtain the required texture.
- O. Immediately after the initial finishing with burlap, the edges of the slab and all specified joints shall be finished with an edging tool to the radii indicated on the Plans. The pavement shall then be given a final finish by dragging the damp burlap or cotton fabric over that portion of the pavement disturbed by the edging operation.

3.14 SURFACE REQUIREMENTS

- A. All high spots in the surface, exceeding 1/8 inch from the straightedge but not more than 1/2 inch in 10 feet shall be removed or reduced by rubbing with a carborundum brick and water until contact with coarse aggregate is made. If contact with coarse aggregate is made before reaching an acceptable tolerance, such high spots shall be removed by an approved surface-grinding machine before acceptance of the pavement.
- B. High spots in excess of 1/2 inch in 10 feet will be evaluated by the Engineer and if the Work is rejected, it shall be removed and replaced at the Contractor's expense.
- C. The Contractor shall take immediate steps to eliminate the cause of the defective surface.

3.15 CURING

- A. After the finishing operations have been completed and immediately after the free water has left the surface, the surface of the slab shall be completely coated and sealed with a uniform layer of white membrane curing compound.
- B. The compound shall be applied in a continuous uniform film by means of mechanically pumped pressure sprayer equipment at a rate of 1 gallon per 200 sft of surface. The curing compound shall not be thinned.

- C. The equipment shall provide adequate stirring of the compound during application. The equipment for applying the compound must be on the Project and approved by the Engineer before Work is started.
- 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, the Contractor will be required to apply a new coat of material to the affected areas.
- F. The treated surface shall be protected by the Contractor from injury for a period of at least seven (7) days. All traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound. A minimum of foot traffic will be permitted on the dried film as necessary to properly carry on the Work including the removal of any high spots, provided any damage to the film is immediately repaired by the application of a second coat of the compound.
- G. Immediately after the forms are removed, the entire area of the side of the slab shall be coated with the curing compound at the rate specified for the pavement surfacing.
- H. The Contractor shall provide on the Project sufficient burlap or polyethylene coverings for the protection of the pavement in case of rain or breakdown of the spray equipment. Failure to provide proper curing will be considered as sufficient cause for immediate suspension of the concreting operations.

3.16 REMOVAL OF FORMS

- A. Forms may be removed from freshly placed concrete after it has set for 12 hours, provided it can be done without damage to the pavement or curb edge. If during form removal the pavement or curb edge is being damaged, the form removal shall cease until the concrete has attained greater strength.
 - 1. The period of time for removing forms may be increased or decreased when approved by the Engineer.
- B. Immediately after removal of the forms, the ends of all joints shall be cleaned, and any visible areas of honeycomb or minor defects shall be filled with mortar, composed of 1-part Portland cement and two (2) parts fine aggregate from the same source as used in the pavement, applied with a wooden float.
 - 1. Immediate steps shall be taken by the Contractor to correct the conditions contributing to these defects.
- C. The sides of the pavement shall be sprayed with curing compound immediately upon removal of the forms, except where honeycombed areas are to be pointed, and then immediately cured.
- D. Forms and pins shall not be placed on new pavement that is being cured with membrane.

3.17 SAWING JOINTS

- A. All contraction joints, longitudinal lane-tie joints with tie bars, and end of pour joints shall be sawed.
- B. Joints shall be sawed before any traffic is permitted 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. At least two (2) approved concrete saws shall be available for use at all times, and one saw shall be capable of sawing a joint groove 2-1/2 inch deep.

- D. The saw cut for transverse end-of-pour joints shall be made to receive the joint sealing material.
- E. Longitudinal lane-tie joints with the tie bars shall be sawed in accordance with the alignment and dimensions indicated on the Plans.
- F. For joints formed in one operation, the joint groove shall be sawed before any transverse cracks develop. Raveling or spalling along the joint shall be repaired as specified elsewhere in this Section.
- G. Transverse contraction joints shall be sawed in two stages:
 - 1. Stage 1 sawing
 - a. The first stage shall be a relief cut directly over the center of the load transfer assembly. The initial relief cut shall be made as soon as the saw can be placed on the freshly poured concrete, and the sawing shall continue as long as the pavement can support the saw without making or appreciably raveling of the joint.
 - b. When water is not used in the sawing operation, membrane curing compound shall be applied immediately.
 - c. When water is used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the cut and from the immediate area by flushing with a jet of water. Additional membrane curing compound shall be applied within 12 hours after the relief cut has been made.
 - 2. Stage 2 Sawing
 - a. Second stage sawing of joints shall not start until the concrete has cured for a minimum of 48 hours. The joint groove shall be centered over the relief cut and sawed to the specified dimensions shown on the Plans plus any increase in width of the relief cut due to shrinkage or contraction. Groove width tolerance shall be $\pm 1/16$ inch.
 - b. Joints sawed without the use of water shall be blown clean of all foreign material by a jet of compressed air.
 - c. If water was used in the sawing operation, the slurry resulting from the sawing operation shall be completely removed from the groove and the immediate area by flushing with a jet of water and then blown dry with compressed air.
- H. All transverse joint grooves shall receive a final cleaning with a jet of compressed air adequate to remove all foreign material, just prior to permanent sealing.
- I. If the specified seal is not installed within seven days of final sawing, the joint groove shall be temporarily sealed with a suitable material or device to prevent the infiltration of foreign material.
- J. Traffic shall not be permitted over the full width joint grooves prior to the installation of either the permanent seal or temporary seal.

3.18 PATCHING JOINTS

- A. General
 - 1. After the joints have been sawed and cleaned, they shall be inspected for spalls and voids.
 - 2. All loose, unsound or damaged concrete shall be removed to the satisfaction of the Engineer.
 - 3. Spalls and voids will be classified as minor, intermediate or major spalls and shall be repaired accordingly.
- B. Minor Spalls

1. Any spalls or voids which have increased the specified size of the joint groove beyond any of the following limits, but less than 36 square inches, shall be repaired by patching with an approved epoxy mortar before the seal is installed.
 - 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. The spalled concrete surface shall be thoroughly cleaned by sandblasting, power-wire brushing, or hand-wire brushing. The patch area shall then be blown clean with a jet of compressed air.
3. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.
4. The concrete shall be clean and dry when the epoxy resin mortar is placed. The surface shall be made free of frost by heating with a clean source of heat, approved by the Engineer, until dry. Care shall be taken not to damage the concrete by heating.
5. The epoxy binder will be a mixture of two (2) parts epoxy resin to one (1) part curing agent by volume, or as approved by the Engineer.
6. The epoxy resin compound shall be mixed in a clean metal or polyethylene container with approved stirrer operating at 250 to 500 rpm. While the epoxy resin is being mixed, the curing agent compound shall be gradually added. The mixture shall then be stirred for a minimum of three (3) minutes until it is uniform.
7. After the epoxy binder is thoroughly mixed, a small portion shall be reserved for priming.
 - a. Dry MDOT 2NS sand shall be uniformly blended into the balance of the mixture to give an epoxy mortar of stiff or trowelable consistency. One part of mixed binder to about 3.5 parts of dry sand, by volume, will usually give a workable mix.
8. The spalled surface shall be primed with the freshly mixed epoxy binder scrubbed into the surface with a suitable applicator to insure complete wetting and coverage of all areas to which the epoxy mortar must bond.
9. Immediately after priming, the epoxy mortar shall be placed in the spalled area and finished to the shape of the original pavement surface. If the bond coat is not tacky when the mortar is placed, a second application shall be made. The edge of the patch shall conform with the rest of the joint groove.
10. Dry MDOT 2NS sand shall be sprinkled onto the fresh epoxy mortar surface to eliminate any gloss. After the epoxy mortar has cured sufficiently so that it will not be damaged during sealing operations, the polyethylene insert shall be carefully removed.
11. All joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.
12. When the temperature of the air and the pavement is above 50 degrees F, the hot poured elastic type joint seal may be placed on the day following the placing of the epoxy resin mortar patch. When the temperature of the air and the concrete is below 50 degrees F, the time of curing required for the epoxy mortar shall be as determined by the Engineer.

C. Intermediate Spalls

1. Any spalls larger than 36 square inches, but not extending below the reinforcing mat, shall be repaired by sawing and chiseling out the unsound concrete and patching with Portland cement mortar.

2. A saw cut at least 1 inch deep shall be made parallel to the joint groove at the outer extremity of the spalled area. The concrete shall be chipped out to the saw cut so that a vertical face is present at the back of the repair area, and the two ends of the repair area shall be trimmed to approximately vertical faces.
3. The area to be repaired shall be sandblasted to remove all loose particles and then blown clean with a jet of compressed air to remove the sand and all other foreign materials.
4. The repair area shall be flushed with clean water and the excess water shall be blown out with compressed air.
5. A heavy polyethylene sheet or a rigid material shall be inserted into the joint groove and held tightly against the joint face that is to be patched.
6. The bottom and vertical faces of the repair area shall be primed with a grout of creamy consistency made with a 1:1 mixture of Portland cement and 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. The cement grout shall be carefully applied to the rough surfaces of the spall area and shall be applied immediately prior to placing of fresh mortar so that the prime coat is wet when covered by mortar.
9. The Portland cement patching material shall be tamped into the repair area and finished level to the pavement surface.
 - a. This Portland cement mortar shall consist of 1-part Portland cement to two (2) parts MDOT 2NS sand with a water content of not more than 4 gallons per sack of cement.
 - b. A liquid air-entraining agent to maintain an air content of 8% to 11% shall be added.
 - c. Calcium chloride in an amount of one (1) percent of the cement content may be added as an accelerator, if approved by the Engineer.
10. The edge of the patch at the joint face shall conform with the rest of the joint groove.
11. White membrane curing compound shall be sprayed on the patch surface immediately after the mortar is cast and finished.
12. After 72 hours the polyethylene form shall be carefully removed and all patched joints shall receive a final cleaning with a jet of compressed air to remove all foreign material.

D. Major Spalls

1. When a joint is damaged beneath the depth of the reinforcing mat, it shall be considered a major repair. These major repairs shall be handled on an individual basis under the direction of the Engineer.

3.19 SEALING JOINTS

- A. All transverse expansion, contraction, construction, and longitudinal bulkhead construction joints shall be filled and sealed with an approved hot-poured elastic type compound.
- B. Longitudinal lane-tie joints shall be pressure filled and sealed with either an approved hot-poured or cold-applied elastic type compound. These sealing compounds shall not be placed when the atmospheric or pavement temperatures are less than 50 degrees F or when the weather is rainy or foggy.
- C. After the shoulders are completed and the pavement has cured, the joints and pavement surfaces on each side of the joints shall be cleaned of all extraneous matter.
 1. The cleaning shall be done by sandblasting or other methods approved by the Engineer that will be equally effective in cleaning the concrete.

2. The dust and sand present after the sandblasting or cleaning shall be removed by a jet of compressed air. Hand tools shall be used to remove stones and other foreign materials from the joint groove.
- D. Immediately after the joints are cleaned with the compressed air, and with the surface of the concrete in the joint dry, the joint shall be sealed with an approved hot-poured elastic type compound.
 - E. The hot-poured compound shall be melted in an approved double boiler type kettle. Direct heating will not be permitted. Also, any sealing material heated in excess of the safe heating temperature shall not be used in the Work.
 - F. During the process of pouring the joints, the Engineer may, at his discretion, require that sufficient compound be taken from the melting unit to make flow tests.
 - G. The Engineer may require the Contractor to modify his method of heating or of charging the heating unit with compound that will produce satisfactory results.
 - H. Pouring shall be 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. Pouring of the sealing compound shall be done so as to fill the joint to 1/4 inch below top of pavement. Any sealing compound spilled on the surface of the pavement shall be removed immediately.
 - K. After the first pour has cooled to the temperature of the pavement and settled, a second pour shall be made to bring the sealing compound to 1/4 inch of the surface of the pavement.
 - L. Traffic shall not be permitted over the poured joint until the compound has hardened sufficiently to resist pickup.
 - M. To protect hot-poured and cold-applied sealing compound while it is curing and to prevent pickup by traffic, the sealed joint shall be covered with a strip of paper, 1-1/2 inches wide, or other approved means, immediately following application of the compound. The paper strip shall be left in place until worn off by traffic.

3.20 TRAFFIC CONTROL

- A. Provide all measures necessary to protect and maintain traffic and to protect the Work in accordance with Section 01 5000, Temporary Facilities and Controls, and with the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.).

3.21 PROTECTION AGAINST RAIN

- A. The Contractor shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened.
- B. For this Work, the Contractor shall have available on the job site at all times enough burlap or 6 mil thick polyethylene film to cover and protect one day's Work.
- C. When rain appears eminent, all operations shall stop and personnel shall begin covering.
- D. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.
- E. Curing compound shall be applied to any areas where the compound has been disturbed or washed away. Protection of the new concrete against rain shall be at the Contractor's expense.

3.22 COLD WEATHER PROTECTION

- A. Any time there is a danger of freezing temperatures, the Contractor shall have available on-site a sufficient amount of clean, dry straw or hay or polyethylene film or other approved materials to cover at least one (1) day's production. Cold weather protection shall be at the Contractor's expense. The source of the temperature shall be taken from forecasts prepared by the local weather bureau, recognized as the Official Weather Bureau for the area the new Work is being constructed. The predicted low temperature shall be that forecast to occur during the next 24 hours.
- B. Frozen material shall not be charged into the mixer at any time.
- C. Frost or ice shall be removed from the forms and any steel used in the pavement, prior to placing concrete.
- D. Concrete shall not be placed directly upon a frozen subgrade. The subgrade shall be covered with a layer of straw or hay 12 inches in thickness to protect it against freezing. The straw or hay shall be removed from the finished subgrade immediately ahead of paving operations and piled along the line of construction for use in covering the finished pavement. Prior to the placing of concrete, the subgrade shall be cleaned of loose straw and otherwise prepared in a manner satisfactory to the Engineer. Other covering materials as approved by the Engineer may be used to prevent subgrade freezing.
- E. To accelerate hardening of the concrete when the temperature of the air in the shade and away from artificial heat is between 40 and 45 degrees F, calcium chloride shall be added to the mix at the rate approved by the Engineer. The calcium chloride shall be spread on the materials immediately before discharging into the drum of the mixer. A method approved by the Engineer, shall be used for measuring the amount of dry calcium chloride to be added to each batch of concrete. The calcium chloride shall not be placed in contact with the cement.
- F. Immediately after finishing of the concrete and as soon as hardening of the concrete will permit, the pavement shall be covered and the protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 psi or for a minimum period of 14 days or as approved by the Engineer.
- G. The protective covering shall be placed around and over the forms and it shall extend beyond the edge of the pavement for a distance at least equal to the depth of covering required.
- 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. The mixing and placing of concrete shall stop in sufficient time each day to permit finishing of the concrete and the placing of the required protective covering during daylight hours.
- J. The requirements specified herein for the curing and protection of concrete in cold weather are minimum requirements, and the Contractor shall be responsible for the quality and strength of the concrete placed. Any concrete injured by frost action shall be removed and replaced at the Contractor's expense.
- K. Between October 15 and May 15, when the predicted low temperature is to be below 35 degrees F at any time within 72 hours after placing the pavement, the pavement shall be protected and such protective covering shall remain in place until the concrete has developed a compressive strength of not less than 3,000 psi, or for a minimum period of 14 days, unless otherwise authorized by the Engineer.
- L. Special Protection
 - 1. No pavement may be placed between October 15 and May 15, unless it is specifically provided for in the Contract Documents, or authorized by the Engineer, except that in no case shall concrete be placed when the predicted high temperature is to be below , without written permission of the Engineer. When paving is permitted during the period, the following requirements shall apply:

- a. The temperature of the concrete at the time it is placed on the subgrade shall be not less than 50 degrees F, nor more than 85 degrees F.
- b. In order to maintain a mix temperature between 50 and 85 degrees F the mixing water or the aggregates, or both, shall be heated as required by the Engineer. The water and the aggregates shall be heated to a temperature of not more than 150 degrees F.
 - 1) The heating of aggregates shall be done by the use of steam pipe under the aggregate piles, or by free steam discharged into the aggregate piles, or by steam pipe in the batching bins.
 - 2) The heating of the water and the aggregates shall be controlled so that there will not be any large differences in temperature from batch-to-batch.
- c. When there is any danger of the predicted low temperature dropping below 35 degrees F all the necessary materials for covering and protecting the concrete, equipment for heating the water and aggregates, when required, and calcium chloride shall be on the Project and available for immediate use for the required method of curing and cold weather protection before any pavement is placed.
- d. For predicted low temperatures from 35 to 25 degrees F either 1-layer of waterproof paper blankets or 12 inches of loose dry straw or hay shall be placed.
- e. For predicted low temperatures of 25 to 20 degrees F 1-layer of waterproof paper blankets and 12 inches of loose dry straw or hay shall be placed.
- f. For predicted low temperatures less than 20 degrees F the minimum requirement for cold weather protection will be 1-layer of waterproof paper blankets and 12 inches of loose dry straw or hay overlaid with a waterproof protective covering consisting of tarpaulins, paper blankets, polyethylene sheeting or other approved material.
- 2. When temperature are such that special protection is required as specified above, all concrete placed within the proceeding 72 hours shall be similarly protected.
- 3. When special protection is started, it shall be continued until design strength is reached in accordance with the above requirements unless warmer temperatures prevail for a period of at least 48 hours. Permission to eliminate special protection for such a period shall be as approved by the Engineer.
- M. Protection of the new concrete against cold weather including ordinary and special protection shall be at the Contractor's expense.

3.23 CONCRETE TEMPERATURE LIMITATIONS

- A. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees F.

3.24 CURB DROP

- A. Curb drops shall be provided for existing and future sidewalk ramps, for approaches for existing driveways and at other locations as determined by the Engineer.
- B. Curb drops for sidewalks shall be in accordance with the current rules and regulations of Act 8, Michigan PA 1973, as amended. Curb drops for drive approaches shall be centered with the existing driveway at the property line.
- C. The width of the residential curb drop shall be equal to the width of the driveway determined at the property line plus four feet. Unless otherwise approved by the Engineer, the minimum width of the residential curb drop shall be 14 feet.

3.25 SHOULDERS

- A. The shoulders shall be constructed according to the lines, grades, and cross section shown on the Plans and as specified for the particular type of shoulder material required. The shoulders shall be done in such sequence with the surfacing operations that they will be completed not

more than seven (7) days after the expiration of the curing period, unless otherwise directed by the Engineer.

- B. Aggregate shoulders, when called for, shall be constructed according to the requirements specified under Section 32 1123, Aggregate Base Courses.

3.26 CLEANUP

- A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality.
- B. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.
- C. At a seasonally correct time approved by the Engineer, the disturbed area shall be raked, have topsoil placed thereon, and fertilized and seeded per the requirements of Section 32 9219, Seeding, sodded in accordance with Section 32 9223, Sodding, or _____

3.27 OPENING PAVEMENT

- A. The 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. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes.
- B. Monument box castings shall be furnishing and installed by the Contractor.
- C. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation.
- D. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place.
- E. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition and kind of construction, unless otherwise provided.

3.29 TESTING

- A. During the course of the Work, the Engineer may require the taking of standard test cores and cylinders, by a testing laboratory acceptable to the Owner and approved by the Engineer.
- B. The making of cylinders, the drilling of cores and testing shall be at the expense of the Owner.
- C. For each lane of Work:
 - 1. A minimum of one (1) cylinder for testing compressive strength shall be made for each 500 feet, or fraction thereof, or as determined by the Engineer.
 - 2. A minimum of two (2) cores for testing compressive strength and for checking thickness shall be drilled each 500 feet, or fraction thereof.
- D. Slump tests for consistency of Portland cement concrete shall be made in accordance with ASTM C143/C143M and ASTM C172/C172M.
- E. In the event the test results on a core indicates a deficiency in either thickness or compressive strength or in the event the test results on a cylinder indicates a deficiency in compressive strength, the following adjustments in the unit price for concrete shall be made based on the average of three (3) cores:

- 1. Thickness

Under Required Thickness	Percent of Reduction in Unit Price
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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. The area of a deficient core shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it, when possible.
5. The extra core drilling and testing shall be at the Contractor's expense.

END OF SECTION 32 13 13

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 01 22 00 - Unit Prices
- 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
- F. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM 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 T 26: 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. Written permission for the use of all local disposal sites shall be obtained and copies shall be furnished to the Engineer.
- B. At the request of the Engineer, the Contractor shall provide the Engineer with certification that the various materials to be used conform to the ASTM Standards referred to in the Specification.

1.05 TEST REPORTS

- A. Engineer shall be provided with two (2) certified copies of the test results of the thickness and compressive strength of the concrete. The core drilling, testing for thickness and compressive

strength and the certification of the test results shall be performed by a testing laboratory approved by 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 shall 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. Ready-mixed concrete in accordance with ASTM C94/C94M, Alternate 2 shall be used unless a written request for other than ready-mixed concrete has been submitted, reviewed and approved by the Engineer.
- C. Contractor shall 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 shall 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. The fly ash quantity may not exceed 40%;
 - b. GGBFS quantity shall be not less than 25% nor more than 40%;
 - c. Maximum total replacement of cement shall not exceed 40%;
 - d. GGBFS and Fly Ash must replace cement on a pound for pound basis.
- E. Cement shall be air-entraining Portland cement 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. The air content of the concrete shall be 6.5%± 1.5% by volume.

2.02 WATER

- A. Water to be used for mixing and curing concrete shall be reasonably clean and free from oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.
- B. Waters from sources approved by the Michigan State Department of Public Health as potable may be used without test.
- C. Water requiring testing shall be tested in accordance with the current Method of Test for Quality of Water to be Used in Concrete, AASHTO T 26, and as specified in MDOT, Section 911.

2.03 CONCRETE CURING COMPOUNDS

- A. White membrane curing compound for curing concrete shall conform to ASTM C309, Type 2, Class B Vehicle, and as specified in MDOT, Section 911.

2.04 PREMOLDED JOINT FILLER

- A. Fiber joint filler for expansion joints shall conform to ASTM D1751. Filler shall be of the thickness, as specified herein, or on the Plans, or as approved by the Engineer.

2.05 STEEL HOOK BOLTS

- A. Hook bolts shall conform to ASTM A706/A706M, or Grade 60 of ASTM A615/A615M, or ASTM A996/A996M. Hook bolts shall be 5/8 inch (16 mm) diameter.

2.06 JOINT SEALANT

- A. Hot-poured type joint sealant shall 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 all excavation and compacted subgrades are adequate to receive the concrete to be installed.
- B. Correct all defects and deficiencies before proceeding with the Work.

3.02 EXISTING IMPROVEMENTS

- A. Investigate and verify location of existing improvements to which the new Work is to be connected.
- B. Adjustments in line and grade to align the new Work with the existing improvements must be approved by the Engineer, prior to any change.

3.03 FORMING

- A. The forms shall be of wood or metal, straight and free from warp, clean, and of sufficient strength to resist springing during the process of depositing concrete against them.
- B. The forms shall be the full depth of the concrete.

3.04 SIDEWALKS, SIDEWALK RAMPS, DRIVEWAYS, AND DRIVEWAY APPROACHES

- A. Unless otherwise noted in the Contract Documents, all sidewalks and sidewalk ramps shall be 4 inches thick except at driveways, where the thickness of the sidewalks shall be 6 inches.
- B. Sidewalks shall be 5 feet wide unless otherwise noted on Plans, and shall slope 1/4 inch/ft towards the surface drainage side which in general will be towards the center of the road. Normally sidewalks will be located within the right-of-way, parallel the property lines, at a distance of 1 foot from the property line.
- C. Driveways and approaches shall be 6 inches thick. The width of driveways and driveway approaches shall 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 shall conform to the current rules and regulations of Act 8, Michigan PA 1973.
- B. Where there is no proper curb drop for the sidewalk ramp or driveway approach, the Contractor shall 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, the Contractor shall remove a 24 inch wide curb and gutter section for the construction of sidewalk ramp, as specified above.
- C. The length of curb and gutter removal shall be determined by the Engineer in the field but shall be at least as wide as the proposed sidewalk ramp plus 1 foot on each side.
- D. The removed curb and gutter section shall be replaced with material, equal to what was removed and the joint sealed with hot poured rubber asphalt.

- E. Contractor shall install 5/8 inch 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. Any curbs that are cut or ground down that are not acceptable to the Engineer, shall be removed and replaced as specified above at no additional cost.

3.06 PLACEMENT OF FORMS

- A. Wood forms, straight and free from warp, of nominal depth may be used for sidewalk sections less than 25 feet in length.
- B. Forms shall be staked to line and grade in a manner that will prevent deflection and settlement.
- C. When unit slab areas are to be poured, slab division forms shall be so placed that the slab division joints will be straight and continuous.
- D. Forms shall be set for sidewalk ramps to provide a grade toward the centerline of the right-of-way in accordance with current standards. The grade shall be uniform, except as may be necessary to eliminate short grade changes.
- E. Forms shall be oiled before placing concrete. Forms shall remain in place at least 12 hours after the concrete is placed. There shall be sufficient forms placed ahead of the pouring operations to maintain uninterrupted placement of concrete.
- F. The use of slip form pavers can be allowed when approved by the Engineer in lieu of the construction system described above.

3.07 JOINTS

- A. Transverse and longitudinal expansion and plane-of-weakness joints shall be constructed at the locations specified herein, as indicated on the Plans, or as approved by the Engineer.
- B. The transverse expansion joints shall be placed for the full width and depth of the new Work. The transverse expansion joints placed against any existing pavement shall be a minimum of 6 inches deep but no less than the thickness of the concrete being placed.
- C. Longitudinal expansion joints shall conform to the same requirements as transverse expansion joints.
- D. Joints shall be constructed true to line with their faces perpendicular to the surface of the sidewalk. The top shall be slightly below the finished surface of the sidewalk. Transverse joints shall be constructed at right angles to the centerline of the sidewalk and longitudinal joints shall be constructed parallel to the centerline or as determined by 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 shall be placed in line with like joints in the adjacent slab. Also, in the case of widening existing sidewalks, transverse joints shall be placed in line with like joint in the existing sidewalk.
- F. Transverse expansion joints, 1/2 inch thick, shall be placed 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. Expansion joints, 1/2 inch thick, shall also be placed between the sidewalk and back of abutting parallel curbs, buildings or other rigid structures; concrete driveways and driveway approaches. The expansion joint between sidewalks and buildings shall be placed 1 foot from the property line and parallel to it.
- H. Expansion joints, 1 inch thick, shall be placed between sidewalk ramps or driveway approaches and the back of curbs.

- I. Plane-of-weakness joints shall be formed every 5 feet and shall be produced by use of slab divisions forms extending to the full depth of the concrete or by cutting joints in the concrete, after floating, to a depth equal to 1/4 the thickness of the sidewalk. The cut joints shall not be less than 1/8 inch nor more than 1/4 inch in width and shall be finished smooth and shall be at right angles to the centerline of the sidewalk.

3.08 PLACING AND FINISHING CONCRETE

- A. All concrete shall be placed on a prepared unfrozen, smooth, leveled, rolled and properly compacted base as indicated on the Plans. The surface of the subbase shall be moist with no visible water present prior to placement of the concrete.
- B. The concrete shall be deposited, in a single layer, to the depth specified in the Plans or in the Proposal. The concrete shall be thoroughly spaded or vibrated and compacted to fill in all the voids along the forms and joints. The concrete shall be struck off with a strike board until all voids are removed and the surface has the required grade and cross section as indicated on the Plans.
- C. The surface of the concrete shall be floated just enough to produce a smooth surface free from irregularities. All edges and joints shall be rounded with an edger having a 1/4 inch radius. The surface of sidewalks, driveways and approaches shall be broomed to slightly roughen the surface.
- D. The surface of sidewalk ramps shall be textured with a coarse broom transversely to the ramp slope. The texture on sidewalk ramps shall be coarser than the remainder of the sidewalk.

3.09 CURING

- A. After finishing operations have been completed and immediately after the free water has left the surface, the surface of the concrete (and sides if slip-forming is used) shall be completely coated and sealed with a uniform layer of white membrane curing compound. The curing compound shall not be thinned. The curing compound shall be applied at the rate of 1 gallon per 200 sft of surface.

3.10 BARRICADES

- A. Suitable barricades and lights shall be placed around all newly poured sidewalks, sidewalk ramps, driveways, driveway approaches and curb and gutter section in order to protect the new Work from damage from pedestrians, vehicles and others until the concrete has hardened.
- B. Barricades shall be left in place for a minimum of two (2) days, except for driveway approaches and curb and gutter section. Barricades shall remain in place for a minimum of three (3) days.
- C. Any concrete that suffers surface or structural damage shall be removed and replaced by the Contractor at Contractor's expense.

3.11 PROTECTION

- A. Contractor shall adequately protect the new concrete from the effects of rain before the concrete has sufficiently hardened. For this Work the Contractor shall have available on the job site at all times enough burlap or 6 mil polyethylene film to cover and protect one (1) day's work.
 1. When rain appears eminent, all operations shall stop and personnel shall begin covering. As soon as the rain ceases, the concrete shall be uncovered and the surface burlap dragged where necessary.
 2. Curing compound shall be applied to any areas where the compound has been disturbed or washed away.
- B. If concrete is placed between October 15 and May 15, the Contractor shall have available on the site sufficient amount of clean, dry straw or hay to cover one day's production.
 1. If the temperature reaches 40 degrees F and is falling, the hay or straw shall be placed 12 inches thick, immediately after the curing compound is applied.

2. If the temperature is 30 degrees F and falling the curing shall be by 6 mil polyurethane film placed on the concrete as soon as the surface moisture has disappeared, and then covered with 12 inches of straw or hay.
 3. Also, whenever the temperature in the shade falls below 50 degrees F, the water, sand and coarse aggregate shall be heated in that order sufficiently to maintain a uniform temperature of the concrete at between 70 to 80 degrees F.
- C. Concrete shall not be placed when the temperature of the concrete at the point of placement is above 90 degrees F.

3.12 CLEANUP

- A. After the concrete has gained sufficient strength, but no sooner than within 12 hours, the fixed forms shall be removed and the spaces on both sides shall be immediately backfilled with sound earth of topsoil quality. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.
- B. At a seasonally correct time approved by the Engineer, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded 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. The cores shall be checked for depth and compressive strength.
 1. The core drilling and tests shall be done by a testing laboratory designated by the Owner and at the expense of the Owner.
 2. The testing laboratory shall furnish the Engineer with two (2) certified copies of the test results.
- 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 shall 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
0 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 shall be determined by the drilling and testing of two (2) additional cores, one (1) on each side of the deficient core and 20 feet from it when possible.
 1. The extra core drilling and testing shall 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 32 13 15

SECTION 32 15 00 AGGREGATE SURFACING

PART 1 GENERAL

1.01 SCOPE

- A. This section includes the requirements for constructing aggregate surfacing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 01 89 00 - Site Construction Performance Requirements
- C. Section 32 12 16 - Bituminous Paving
- D. Section 32 13 13 - Concrete Paving
- E. Section 32 92 19 - Seeding
- F. Section 32 92 23 - Sodding

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM 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. AASHTO: American Association of State Highways and Transportation Officials
 - 4. MDOT: Michigan Department of Transportation, Standard Specifications for Construction, latest edition

1.04 ALLOWABLE TOLERANCES

- A. The finished surface shall be shaped to conform to plan grade and cross section within a tolerance of 3/4 inch in 10 feet.

1.05 TEST REPORTS

- A. The testing lab shall 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 shall be performed by a testing laboratory approved by the Engineer.

1.06 STOCKPILING AGGREGATE

- A. Aggregate shall be deposited in stockpiles in such a manner that the material may be removed from the stockpile by methods which will provide aggregate having a uniform gradation.
- B. Stockpiling of aggregate, in excess of 4 feet 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 under Part 3 of this Section.

PART 2 PRODUCTS

2.01 DENSE-GRADED AGGREGATE

- A. The dense-graded aggregate gradation shall conform to 22A or 23A as specified in MDOT Section 902.05.

2.02 CALCIUM CHLORIDE ADDITIVES

- A. The calcium chloride additives shall conform to ASTM D98 and as specified in MDOT, Section 903.04.

2.03 WATER

- A. Water used for compaction and dust control shall be reasonably clean and free from substances injurious to the finished product. Water from sources approved by the Michigan State Department of Public Health as potable may be used.

PART 3 EXECUTION

3.01 EXCAVATION VERIFICATION

- A. Prior to the placing of any aggregate material, examine the excavation for the grades, lines, and levels required to receive the new Work. Ascertain that all excavation and compacted subgrades or subbases are adequate to receive the new Work. Correct all defects and deficiencies before proceeding with the Work.

3.02 SUBGRADE CONDITIONS

- A. Prior to the placing of any aggregate material, examine the subgrade or subbase to assure that it is adequate to receive the aggregate to be placed. If the subgrade or subbase remains wet after all surface water has been removed, the Engineer may require the installation of edge drain.

3.03 EXISTING BASE

- A. Prior to the placing of any aggregate material for surfacing, examine the existing base for grade and condition to receive the new Work. Ascertain that the base is adequately compacted to receive the aggregate surfacing to be installed.
- B. Correct all defects and deficiencies before proceeding with the Work.

3.04 EXISTING IMPROVEMENTS

- A. Investigate and verify locations of existing improvements, including structures, to which the new Work will be in contact.
- B. Necessary adjustments in line and grade, to align the new Work with the existing improvements, must be approved by the Engineer, prior to any changes.

3.05 PREPARATION OF SUBGRADE OR SUBBASE

- A. The subgrade or subbase shall be fine graded to the cross section indicated on the Plans, and shall be thoroughly compacted prior to the placing of the aggregate material.

3.06 INSTALLATION - GENERAL

- A. The width, thickness, and type of aggregate materials shall be indicated on the Plans or as determined by the Engineer.
- B. No aggregate material shall be placed until the subgrade, or subbase, or existing aggregate surface has been approved by the Engineer.

3.07 AGGREGATE SURFACE COURSE

- A. Where the base for the new aggregate surface course is an existing aggregate surface, the existing surfacing, shall be either graded or scarified and graded to remove irregularities and to provide a bond between the old and new surfaces.
- B. The aggregate surface course shall be placed by a mechanical spreader or other approved means, in uniform layers to such a depth that when compacted, the course will have the thickness shown on the Plans.
- C. The depth of the surface course, when compacted, shall not exceed 6 inches, unless otherwise specified on the Plans or approved by the Engineer.

1. The aggregate shall be of a uniform mixture when placed on the prepared base. It shall be uniformly spread and then trimmed with a road grader, trimmer or other approved means until the surface is free from waves and irregularities.
 2. The trimming shall be alternated by rolling with a pneumatic-tired or tamping type roller. The entire operation shall continue until the surface course is compacted to at least 95% of its maximum unit weight.
- D. When the operation is completed, the surface course shall conform to the required lines, grades and cross sections.
- E. The optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.
- F. When approved by the Engineer, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.
- G. With the approval of the Engineer, chloride additives may be used by the Contractor to facilitate his 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 his expense.

3.08 AGGREGATE SHOULDERS AND APPROACHES

- A. The construction of shoulders and approaches shall be of the material, width and depth as shown on the Plans.
- B. When shoulders and approaches are specified by class, they shall conform to MDOT, Section 307 for shoulders and approaches specified as: Class I, Class II, Class III or Class IV.
- C. The subgrade for the shoulders and approaches shall be graded to an elevation below the finished surface that will permit the placing of the specified thickness of materials.
- D. The subgrade of shoulders and approaches shall be approved by the Engineer prior to the placing of aggregate.
- E. The aggregate shall be placed on the prepared subgrade by a mechanical spreader or other approved means, to a depth of not more than 5 inches. If the specified thickness exceeds 5 inches, the shoulder or approach shall be constructed in two or more courses.
- F. Dumping the aggregate on the road surface and grading it onto the shoulder or approach will not be permitted.
- G. The aggregate shall be compacted to not less than 100% of the maximum unit weight for the first 5 feet outside of the pavement edge and 98% of the maximum unit weight for the remainder of the area. When the operation is completed, the surface course shall conform to the required lines, grades and cross sections.
- H. On resurfacing projects, the existing aggregate shoulder or approach shall be scarified prior to the placing of new aggregate materials.
1. The placement of aggregate shall proceed the placing of the top course of bituminous mixture on the adjoining pavement.
 2. Final shaping and compaction of the shoulder or approach shall follow the placement of the top course of bituminous mixture unless otherwise determined by the Engineer.
- I. The optimum moisture content shall be maintained until the prescribed unit weight is obtained and each layer shall be compacted until the maximum unit weight is attained before placing the succeeding layer.
- J. When approved by the Engineer, additional water may be applied by an approved means, to the aggregate to aid in the compaction and shaping of the material.
- K. With the approval of the Engineer, chloride additives may be used by the Contractor to facilitate his 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 his expense.

3.09 MAINTENANCE DURING CONSTRUCTION

- A. The aggregate surface shall be continuously maintained in a smooth and firm condition during all phases of the construction operation.
- B. The Contractor, at his expense, shall provide additional materials needed to fill depressions or bind the aggregate.

3.10 TEMPERATURE LIMITATIONS

- A. Aggregate materials shall not be placed when there are indications that the mixtures may become frozen before the required density is obtained.
- B. In no case shall the aggregate be placed on a frozen subgrade or base course unless otherwise approved by the Engineer.

3.11 CLEANUP

- A. Immediately following the compacting of the surface course, the voids on both sides of the aggregate course shall be backfilled with sound earth of topsoil quality.
- B. The backfill shall be compacted, leveled and left in a neat, workmanlike condition.
- C. At a seasonally correct time approved by the Engineer, the disturbed area shall be raked, have topsoil placed thereon, fertilized and seeded per the requirements of Section 32 9219, Seeding, sodded in accordance with Section 32 9223, Sodding, or _____.

3.12 OPENING AGGREGATE SURFACED ROADS

- A. The Engineer reserves the right to open the aggregate surfacing to traffic at any time during construction.

3.13 MONUMENT BOXES

- A. All government, plat, and street intersection monuments within existing or proposed pavement shall be preserved by enclosing in standard monument boxes.
 - 1. Monument box castings shall be furnished and installed by the Contractor and shall be East Jordan Iron Works No. 1570, or approved equal.
- B. Existing monument boxes shall be adjusted to meet the proposed pavement elevation by removing the castings and resetting to the required elevation. Support for the monument box shall be concrete bedding, so constructed as to hold them firmly in place. The adjacent pavement, curb, or curb and gutter shall be replaced to the new elevation, condition, and kind of construction, unless otherwise provided.

3.14 TESTING

- A. During the course of the Work, the Engineer may require testing for compaction or density and for thickness of material. The testing and coring required shall be performed by a testing laboratory acceptable to the Owner and approved by the Engineer.
 - 1. The cost for testing and coring shall be at the expense of the Owner.
- B. When thickness tests are done, a minimum of one depth (thickness) measurement will be made every 400 feet of traffic lane.
 - 1. The lane width shall be as indicated on the Plans or as determined by the Engineer. 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 1,200 square yards of such areas (or fraction thereof).
 - 3. The location of the depth measurement will be at the discretion of the Engineer.

- C. The maximum unit weight when used as a measure of compaction or density of soils shall be understood to mean the maximum unit weight per cubic foot (or cubic meter) as determined by ASTM D1557, Method C.

3.15 DEFECTIVE WORK

A. Thickness

1. Measurements of aggregate base and/or surface course thickness will be made to the nearest 1/4 inch.
 - a. Depths may be 1/2 inch less than the thickness indicated on the Plans provided that the average of all measurements taken at regular intervals shall be equal to or greater than the specified thickness.
 - 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. Locations of the depth measurements will be as specified herein unless otherwise determined by the Engineer. Sections found to be deficient in depth shall be corrected by the Contractor using methods approved by the Engineer.

B. Weight

1. 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.
 - a. When the aggregate material is measured by weight in Tons (or metric tons), the pay weights for aggregates will be the scale weight of the material, including admixtures, unless the moisture content is more than six (6) percent.
 - b. If the tests indicate a moisture content in excess of six (6) percent, the excess over six (6) percent will be deducted from the scale weight of the aggregate until such time as moisture tests indicate that the moisture content of the material is not more than six (6) percent.

END OF SECTION 32 15 00

SECTION 32 17 13 PARKING BUMPERS

GENERAL

1.01 SCOPE

- 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. Unit shall be stored in a location and a manner that will afford protection from damage due to construction operations or vandalism.
- B. Parking bumpers shall be lifted using acceptable slings or other equipment which will not cause cracking, breaking or chipping of the units during handling. Bumpers shall not be dropped.

PRODUCTS

2.01 CONCRETE

- A. The concrete shall 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.

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. Steel pins, as supplied by the manufacturer, shall be used to anchor parking bumpers. The pins shall have a minimum diameter of 9/16 inch and the length no less than the height of the bumper plus 12 inches.

2.04 FABRICATION AND MANUFACTURE

- A. Precast concrete parking bumpers shall be factory cast to the size and dimensions indicated on the Plans by the manufacturer's standard fabrication methods. Units shall be cast with reinforcing steel bars and shall have a minimum of two (2) cast-in or drilled anchor holes as indicated.

- B. All edges, corners, angles and returns shall be sharp and true without burrs or breaks and all plane surfaces shall be flat.
- C. Parking bumper units shall be steam or moist cured using manufacturer's standard methods to provide the compressive strength specified.
 - 1. Standard type units shall be provided with flat, solid bottoms.
 - 2. Drain type units shall have flat, solid bottoms with slotted drainage openings as indicated on the Plans. Concrete finish for concrete parking bumper units shall be rough sand type.

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.

EXECUTION

3.01 INSTALLATION

- A. Parking bumper units shall be placed, as nearly as possible, to the locations and lines indicated on the Plans.
- B. In unloading and placing units, suitable skids, slings, straps or other lifting devices which will not cause damage or breakage of the units shall be used. Parking bumpers shall not be dragged, bumped or dropped during installation.
- C. Installation shall be such as to protect the paving and the parking bumpers at all times.
- D. Parking bumpers shall be secured in place at the locations shown on the Plans and by methods recommended by the manufacturer. Where drilling of pavement is called for, drilling equipment shall be acceptable to the Engineer.

END OF SECTION 32 17 13

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 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ASTM 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. Where applicable pavement markings shall conform 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.

1.05 SUBMITTAL OF MANUFACTURER'S LITERATURE

- A. Submit manufacturer's literature of all paints to be used in the Work. Manufacturer's literature shall show paint: type, texture, color, temperature limitations, recommended use, spreading rate, drying time, and cleanup.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials to the Project site in original, unopened waterproof containers. Packaging containers shall bear manufacturing labels intact and legible.
- B. The label shall contain the following information: name and address of manufacturer, shipping point, trade mark or trade name, kind of paint, formula, amount in U.S. gallons, date of manufacture and lot number, type of paint and AASHTO Specification Number.
- 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. Handling of materials shall be in accordance with the manufacturer's recommendations.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Contractor shall comply with the appropriate environmental limitations (air temperature, pavement temperature, and relative humidity) as outlined in MDOT Section 811.03.D.

PART 2 PRODUCTS

2.01 REGULAR DRY TRAFFIC MARKING PAINT

- A. Regular drying pavement marking paint in white and yellow colors shall comply with MDOT Section 920.
 - 1. Regular Dry traffic paint shall be selected from MDOT's Qualified Products List.

2.02 WATERBORNE PAVEMENT MARKING PAINT

- A. Waterborne pavement marking material in white and yellow colors shall comply with FS TT-P-1952 (Type I, II, or III), AASHTO MP 24 and MDOT Section 920.
 - 1. Waterborne pavement marking paint shall be selected from MDOT's Qualified Products List.

2.03 THERMOPLASTIC PAVEMENT MARKINGS

- A. Hot applied thermoplastic pavement markings in white and yellow colors shall conform to AASHTO M 249, white and yellow thermoplastic striping materials (solid form), and MDOT Section 920.
 - 1. Hot applied thermoplastic paving marking and shall be selected from MDOT's Qualified Products List.

2.04 COLD PLASTIC PAVEMENT MARKINGS

- A. Preformed cold plastic pavement markings in white and yellow colors shall comply with ASTM D4505 and conform to MDOT Section 920.
 - 1. Cold applied plastic pavement markings and shall be selected from MDOT's Qualified Products List.

2.05 POLYUREA PAVEMENT MARKINGS

- A. Two-component, polyurea pavement marking material in white and yellow colors shall conform to MDOT Section 920.
 - 1. Polyurea pavement marking material shall be selected from MDOT's Qualified Products List.

2.06 TEMPORARY PAVEMENT MARKING TAPE

- A. Temporary Pavement Markings shall comply with ASTM D4592, Type R and Type NR and shall conform to MDOT Section 922.06.A.
 - 1. Temporary Pavement Markings shall be selected from MDOT's Qualified Products List.

2.07 GLASS BEADS

- A. Glass beads for reflectorizing white and yellow paint markings of pavement by the drop-in method on fresh paint stripes shall comply with AASHTO M 247 and conform to MDOT Section 920.02.
 - 1. Glass beads for use in pavement markings for the type of paint specified shall be selected 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. Costs incurred for removing and disposing of unsuitable materials in preparation of the surfaces to receive the new Work, shall be incidental to the price paid for the pavement markings.

3.03 PERFORMANCE - GENERAL

- A. Pavement marking operation shall be limited to the type of Work and the limits as specified on the Plans. If additional area is required by Contractor for storage of equipment or supplies, Contractor shall furnish Engineer with written permission obtained from the property owner of the storage area, permitting the storage.
- B. Unless otherwise specified on the Plans or approved by Engineer, Contractor shall conduct his operations and use of his equipment in such a manner that traffic will be maintained throughout the Project.
- C. For Work within public rights-of-way and other areas as determined by Engineer, the provisions for maintaining traffic shall be as specified in the Michigan Manual of Uniform Traffic Control Devices (MMUTCD). Costs incurred in maintaining traffic shall be at Contractor's expense.
- D. Contractor's equipment shall have sufficient paint capacity to enable sustained pavement marking operations and shall be equipped so as to assure uniform application of the paint and thermoplastic pavement markings.
 - 1. Equipment shall have mechanical bead dispensers or pressurized bead dispensers. In general, the equipment shall be that necessary to accomplish the marking operations in a safe, efficient, and workmanlike manner.
 - 2. For parking lots and other small areas, approved portable equipment and use of hand methods will be allowed.
- E. The color of the paint, and the width or type of markings shall be as specified on the Plans or as directed by Engineer.
- F. Markings shall be applied so that they adhere adequately to the surface.
- G. Markings shall be applied in accordance with the applicable requirements of MDOT Section 811 for permanent pavement markings or MDOT Section 812.03 for temporary pavement markings.
 - 1. Unless otherwise specified, removal of temporary pavement markings shall be incidental to the Project.

3.04 LAYOUT FOR MARKINGS

- A. Layout work necessary for the location and placing of markings, as specified on the Plans or as determined by Engineer, shall be the responsibility of Contractor and shall be at his expense.

3.05 APPLICATION OF WATERBORNE MARKINGS

- A. Waterborne paint shall be applied when the air temperature is 50 degrees F or higher and the pavement is dry.
- B. Contractor shall be responsible for making the decision to apply waterborne paint on any specific day when there is a high probability of rain in the forecast.
 - 1. If applied lines are washed away because of rain, Contractor shall be responsible for re-applying the lines at no additional expense to Owner.
- C. Waterborne pavement marking materials may be placed immediately on new bituminous pavement.
 - 1. Waterborne pavement marking material shall not be placed before May 1, or after October 1.

- D. Waterborne paint shall be applied with an application thickness of 15-mil and 8-mil dry thickness. Glass beads shall be added at the rate of 32 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 shall be responsible for insuring that the pavement is free of excess moisture that may effect proper bonding prior to beginning work.
- B. Testing for moisture shall be documented and provided to Engineer.
- C. Minimum ambient air temperature shall be 48 degrees F and rising at the start of marking operations. If work is started and the air temperature falls below 45 degrees F, and continual cooling is indicated, all work shall be stopped. The minimum pavement temperature is 50 degrees F.
- D. Thermoplastic material shall be heated and applied within the temperature range recommended by the manufacturer.
 - 1. Thermoplastic material shall not be placed before May 14, or after October 1.

3.07 APPLICATION OF POLYUREA PAVEMENT MARKINGS

- A. Polyurea pavement markings shall not be applied over existing non-polyurea pavement markings.
- B. Existing non-polyurea pavement marking shall be completely removed before applying polyurea pavement markings.
- C. Remove curing compounds from concrete pavement.
- D. Apply at 15 to 25-mil thickness. Pavement shall be clean and dry. Pavement temperature shall be 40 degrees F higher unless otherwise approved by Engineer.

3.08 TOLERANCES

- A. New markings and/or retraced markings shall be placed, with reasonable tolerance, in their proper locations.
- B. Incorrect or misplaced markings shall be obliterated and remarked in accordance with Engineer's instructions.
- C. Costs incurred to obliterate and remark incorrect or misplaced markings will be at Contractor's expense.

3.09 PROTECTION OF MARKINGS

- A. Protection of the wet paint and thermoplastic pavement markings shall be the responsibility of Contractor, and all costs incurred to provide the protection will be at his expense.

3.10 WEATHER AND TIME LIMITATIONS

- A. Markings shall not be placed when rain is threatening or when the surface to be painted is wet.
- B. Pavement marking shall be performed during the period May 1 to November 1, unless otherwise approved in writing by Engineer.
- C. No markings shall be applied when the air temperature is less than 50 degrees F, as determined by Engineer.

END OF SECTION 32 17 23

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 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 89 00 - Site Construction Performance Requirements

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standards:
 - 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 Marcellled 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 shall not deprive the Owner of other rights or remedies the Owner may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under the Contract Documents. The obligations of the Contractor under the Contract Documents shall not be limited in any way by the provisions of the specified special Warranty.
- B. Special Warranty:

1. Provide manufacturer's written warranty, running to the benefit of 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. Framing members for fence and gate framing shall be fabricated of the types and sizes of steel framing indicated on the Plans and as specified in this Section. As a minimum, framing members shall conform to the requirements in Part 2 of this Section.
- B. Framing members, posts, rails, and accessories shall be PVC coated when the fence fabric is PVC coated.
- C. Tubular sections shall be hot-dipped galvanized steel tubular materials conforming to ASTM A53/A53M or weight and coating. Steel tubular framing may be welded or seamless steel pipe reasonably straight and free from injurious defect. Burrs at ends of pipe shall be removed. The average weight of the finished steel pipe shall not be less than 95% of the weight specified, which shall include the weight of galvanizing.
- D. Structural and roll-formed steel shapes conforming to ASTM A499, hot-dipped galvanized in accordance with ASTM A123/A123M. Framing members of structural and roll-formed shapes shall be fabricated of new rail steel billets, of the weights specified and galvanized. The weight of the zinc coating of actual surface shall average not less than 2.0 oz per sft and no individual specimen shall show less than 1.8 oz per sft. All weight specified for structural and roll-formed shapes shall include the zinc coating, except that any weight of zinc galvanizing over 4.0 oz. per sft of surface shall be deducted from the weight.

2.02 POSTS AND RAILS

- A. Posts shall be round pipe or square rolled formed sections conforming to the dimensions and weights specified herein.
- B. Round posts shall be hot dipped galvanized with a minimum average zinc coating of 1.8 oz per sft meeting ASTM F1083 for standard weight (Schedule 40) galvanized pipe.
- C. Rolled form sections shall be produced from steel having minimum yield strength of 45,000 PSI and meet the strength and protective coating requirements of ASTM F1043.
- D. Intermediate Posts
 1. Intermediate posts shall be round or square 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. Gate posts shall be round or square conforming to the weights and dimensions (O.D.) 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. Top rail lengths shall be not less than 18 feet and fitted with couplings or swedged for connecting the lengths into a continuous run. Couplings shall be not less than 6 inches, with 0.07 inch minimum wall thickness and shall allow 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. Post tops, extension arms, stretcher bars, rail ends and appurtenances shall be malleable iron or heavy pressed steel and galvanized in accordance with ASTM A153/A153M.
- B. Post tops on fences with a top rail shall be provided with a hole suitable for passing the top rail through the post top and shall fit over the outside of the post with a weathertight closure.
- C. Extension arms for supporting barbed wire shall be a single or "V" type as shown on the Plans, and extend from the top of the post at an angle of approximately 45 degrees. Arms shall be integral with post tops. Extension arms shall carry three (3) barbed wires equally spaced with the topmost wire approximately 12 inches above the fence fabric.
- D. Stretcher bars shall be one piece lengths equal to the full height of the fence fabric. Bands shall be approximately 1 inch wide with beveled edges to secure stretcher bars to end, corner, pull and gate posts.

2.05 WOVEN WIRE FABRIC

- A. Woven wire fabric shall be fabricated in accordance with the best commercial practices. The overall width of the fabric shall be not less than 46-1/2 inches. Fabric stays shall be uniformly spaced on 6-1/4 inch centers maximum.
- B. Galvanized steel woven wire fabric shall conform to ASTM A116, No. 11 Farm Fencing, Design Number 1047-6-11, Grade 60, Class I, Zinc Coating.
- C. Aluminum-coated steel woven wire fencing shall conform to ASTM A116, No. 11 Farm Fencing, Design Number 1047-6-11, Class I, Aluminum Coating.

2.06 CHAIN LINK FABRIC

- A. Fabric shall be zinc (galvanized) coated, vinyl coated or aluminum coated. Zinc coated fabric shall be galvanized after weaving.
- B. Unless otherwise indicated on the Plans or directed by the Engineer, chain link fabric regardless of type, shall be 11 gauge, zinc coated steel. Mesh shall be two 2 inch. Fabric 72 inches in height and over shall have both selvages knuckled. Fabric less than 72 inches in height shall have the top selvaige knuckled.

- C. Zinc-Coated Steel Chain-Link Fence Fabric shall conform to ASTM A392, Class 2 Coating.
- D. Aluminum-Coated Steel Chain-Link Fence Fabric shall conform to ASTM A491, and ASTM A817.
- E. Vinyl-Coated Steel (Extruded Vinyl over Galvanized Steel Wire) Chain-Link Fence Fabric shall conform to ASTM F668, Class 2a.
- F. Fused Vinyl-Coated Steel (Thermally Fused Vinyl Coating over Galvanized Steel Wire) Chain-Link Fence Fabric shall conform to ASTM F668, Class 2b.

2.07 OUTRIGGERS AND BARBED WIRE

- A. Chain link fence posts shall extend on the gate at SCS-2 and SCS-3 locations if existing gate is removed, so that three (3) strands of barbed wire can be installed as previously provided on existing gate.
- B. Chain link fence barbed wire shall conform to ASTM A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications, or equivalent.
- C. Barbed wire shall be fabricated of 2-strand, 12-1/2 gage zinc-coated steel wire (Type Z, Class 3) with 4-point, 14-gage round barbs spaced on 5 inch centers conforming to Design Number 12-4-5-14R of ASTM A121. Wire shall be galvanized after fabrication.

2.08 TENSION WIRE

- A. Tension wire shall be No. 7 gage ASTM A824 with a Type I aluminum coating, a Type II, Class 2 zinc coating, or shall be hot dipped with a Type II, Class 1 galvanized coating followed by a thermally fused vinyl coating. Tension wire shall have a minimum breaking strength of 1950 pound-force.

2.09 FABRIC FASTENERS

- A. Fasteners for securing fabric to framing members shall be No. 12 gage minimum, galvanized, aluminum coated or vinyl coated as compatible with fabric.
- B. Hog rings shall be 11-gage minimum galvanized, aluminum or vinyl coated as compatible with fabric.
- C. Coatings for fasteners shall conform to the requirements of ASTM A641/A641M, Class III.

2.10 WOOD POSTS

- A. Wood posts will only be acceptable when woven wire fencing is specified on the plans or in the Proposal. Wood posts shall be 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. Posts shall have been cut from timber seasoned by stacking in a manner acceptable by the Engineer. Timber as a minimum shall be equal to No. 3 Grade Southern Pine.

2.11 WOOD FRAMING, PICKETS, AND GATES

- A. Framing pickets and gates used in woven wire fencing shall conform to the requirements of PS 20 or the specific application as described in ASTM F537. Wood bracing shall be either Cedar Oak or other approved wood poles not less than 4-1/2 inches in diameter.

2.12 WOOD PRESERVATIVES

- A. The applicable requirements of AWPA U1, Section 6, Commodity Specification A, Use Category 4B shall apply for all preservative pressure treated wood fencing materials.
- B. Brush coated treatment of wood fencing materials shall conform 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. All metal fasteners used in the construction and installation of woven wire fencing shall be corrosive-resistant type conforming to ASTM F537 unless otherwise indicated on the Plans. Staples shall be No. 9 gage steel wire, 1-1/2 inches minimum for softwood and 1 inch minimum for hardwood.

2.14 PRIVACY SLATS

- A. Privacy slats where shown shall be of type and sizes indicated on the Plans.
- B. Wood for privacy slats shall be graded and finished as recommended by the California Redwood Association for landscaping wood.

2.15 GATES

- A. Frames for gates shall be fabricated of Zinc-coated steel frames in accordance with ASTM F1043. Welded joints shall be coated in accordance with Practice ASTM A780/A780M, employing zinc rich primer. Gates shall be provided with intermediate braces and truss rods of sufficient strength to form a rigid frame without twist or sag. Members shall not sag in excess of the lesser of 1% of the gate leaf width or 2 inches.
- B. Gate frame members shall be in accordance with Table B, minimum.
- C. Fabric used for gates shall be the same as that 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. Hinges shall be non-lift-off type, offset to permit 180-degree gate opening. Hinges shall be structurally capable of supporting the gate leaf and allow the gate to open and close without binding. The hinges shall be so designed to permit the gate to swing a full 180 degrees.
- F. Latch shall be forked or plunger bar type with integral padlock eye and shall be operable from either side of gate.
- G. Keeper, where required, shall automatically engage the gate leaf and hold it in the open position until manually released. Keepers shall be provided on each gate leaf over 5 feet.
- H. Double gates shall be provided with mushroom type or flat plate gate stops and anchors. Stops shall be designed to engage the center drop rod or plunger bar of both leaves.
- I. Sliding gates shall comply with ASTM F1184. Slide gates shall be horizontal slide gates supported only from above or cantilever slide gates spanning an opening without a top or bottom support as indicated on the plans. Cantilever slide gates shall be supplied with zinc coated steel frames using external or internal rollers per ASTM F1184.

2.16 CONCRETE

- A. Concrete shall 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.

PART 3 EXECUTION

3.01 FINAL GRADING

- A. Verify that final grading in the area to receive fencing has been completed. Grades shall be without irregularities that would interfere with the fence installation. Report all discrepancies in final grades that would interfere with 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. All measurements for installation of fence work shall be measured 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. Installation of fencing and gates shall meet the requirements of ASTM F567 and CLFMI CLF 2445. All work shall be installed in accordance with the best trade practices, to the best workmanship and in a manner acceptable to the Engineer. The finished fence shall be plumb, taut, true to line and ground contour and rigidly secured in position.

3.04 INSTALLATION OF WOVEN WIRE FENCE

- A. Line posts shall be spaced not more than 16.5 feet center to center. Line posts adjacent to any end, corner, gate or intermediate braced post shall be spaced not more than 10 feet, center-to-center.
- B. Posts shall be set in holes dug minimum depth of 4.5 feet except that a tolerance of ± 3 inches is permitted provided the exposed portion of the post will not be less than 4.3 feet. Posts shall be set with large end down, plumb on side to receive fabric.
- C. Angle posts shall be installed where a deflection in fence alignment exceeds 30 degrees. Install intersection posts in line of intersecting fencing runs. Intersecting runs of fence shall be connected to a common post.
- D. Metal posts shall be driven with a suitable driver acceptable to the Engineer. Metal posts shall be driven to the proper depth, plumb and in conformity with fence lines indicated on the Plans. Metal posts which are bent or otherwise damaged during driving shall be removed and replaced.
- E. End, corner, gate, angle, intersection and intermediate braced posts shall be set in concrete at least 18 inches in diameter and deep.
 - 1. Braces shall be set in concrete at least 18 inches in diameter and 18 inches deep.
 - 2. Corner, angle and intermediate braced posts shall be braced in both directions. Intersection posts shall be braced in three (3) directions.
 - 3. Braces shall be securely fastened to the post near the top.
 - 4. At all grade depressions and alignment angles, line posts shall be set in concrete at least 18 inches in diameter and 4.5 feet deep.
- F. Woven wire fabric shall be installed to the lines and levels indicated on the Plans. Fabric shall be stretched taut and securely fastened to each post with the bottom of the fabric approximately 2 inches above the ground. Each horizontal strand of wire shall be wrapped completely around the end, corner, gate, intermediate braced or angle post and securely fastened by winding the end about the wire where it leads up to the post. Line posts shall not be used as a stretching anchorage.
- G. Splicing of wire in woven wire fabric and barbed wire shall be accomplished in a manner which will develop the full strength of the wire. The distance between the vertical stays adjacent to the splice shall be the same as for the unspliced sections of the fabric. One (1) approved splice may be placed at the end of the roll of fence without regard to the distance from a post.
- H. Fabric shall be securely fastened to each metal post with at least six (6) wire clamps.
- I. Fabric shall be attached to each wood post by at least one (1) fastener for each horizontal strand and as many other fasteners as required to secure wire firmly to post.

- J. Fabric shall be topped with barbed wire as indicated on the Plans. Barbed wire shall be securely fastened to each post.
- K. Gates shall be erected using methods acceptable to the Engineer in the locations shown on the Plans.

3.05 INSTALLATION OF CHAIN LINK FENCE

- A. Posts for chain link fence shall be set and braced as indicated on the Plans, as specified herein, or if not indicated, installation shall meet the requirements of ASTM F567 and CLFMI CLF 2445.
- B. Line posts shall be spaced not more than ten 10 feet center-to-center. Angle posts shall be installed where a deflection of ten (10) degrees or more occurs in fence alignment.
- C. Intermediate, braced posts shall be spaced at 660 foot intervals or midway between end posts, angle posts or corner posts when this distance is less than 1,320 feet but more than 660 foot.
- D. Intersection (corner) posts shall be set in line with intersecting fences. Both intersecting fences shall be connected to the common post.
- E. Posts shall be set in concrete. The depth of concrete footings for line posts shall be not less than 3.5 feet.
 - 1. Footing diameters shall be 9 inches minimum for line posts.
 - 2. Footing diameters for end, corner, angle, intersection, gate and intermediate braced posts shall be 18 inches.
 - 3. Holes for post foundations shall be completely filled with concrete around post.
- F. All fences shall have at least a top rail and a bottom tension wire.
 - 1. Fences 10 feet or more in height, and where otherwise indicated on the plans, shall have center and bottom rails. Bottom and center rails shall be securely connected to posts by means of connections approved by the Engineer.
- G. The top rail shall pass through the line post tops to form a continuous brace from end to end of each stretch of fence fabric. Splice joints shall be provided as indicated on the Plan. Suitable ties or clips shall be provided for attaching the fabric securely to the top rail at intervals not exceeding 24 inches.
- H. The top, center and bottom rail shall be secured to gate, corner, pull, end and line posts as indicated on the Plans.
- I. Horizontal braces of fencing 6 feet high and over shall be securely fastened to all end, corner, angle, intersection, gate, and intermediate braced posts by means of suitable metal connections. Braces shall be positioned midway between top rail and ground and shall extend to the first line posts. Braces shall be trussed as indicated on the Plans.
- J. Posts shall be fitted with post tops.
- K. Install chain link fabric of height indicated on plans. Fabric shall be pulled taunt and tied to posts, rails and tension wires. Fabric shall be secured to framing by means of suitable metal bands, hogs or clips. Fasteners shall be spaced not more than 12 inches apart on posts and not more than 15 inches apart on top rail.
 - 1. Hogs rings for connecting fabric to tension wire shall be spaced on not more than 24 inches centers.
- L. Install extension arms as indicated on the Plans. Intermediate extension arms shall have hole for passage of top rail. Extension arm shall carry three (3) barbed wires equally spaced with the top most barbed wire approximately 12 inches in or out from the fence line.
- M. Provide one (1) stretcher bar for each gate and end post; provide two (2) stretcher bars for each center and pull post. Thread bars through fabric and secure to post with metal bands on 15 inches centers maximum.

- 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. Lower hinge of gate shall be placed on top of concrete footing in which gate post is set. The footing concrete shall extend up to the bottom of the lower hinge.
 4. Cone bolt sockets for double swing gates shall be set in concrete so that plunger pin fits in socket when gate is in closed position.
 5. Gates shall be erected to swing in direction indicated. Install gate stops to limit swing as shown on Plans.
 6. Gates shall be hung plumb, level and secure for full opening without interference.
- P. Privacy slats, where used, shall be of types and sizes indicated on the Plans. Slats shall be secured to fabric using suitable clinch-lock type fasteners acceptable to the Engineer. Slats shall be secured to fabric by 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. After erection of fences, the tops of wood posts shall be cut off to proper elevation.

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
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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 32 31 00

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. Trees, shrubs and ground cover shall comply with state and federal laws with respect to inspection for plant diseases and insect infestation.

1.04 REFERENCE STANDARDS

- A. AAN - American Association of Nurserymen
- B. AANLS - American Association of Nurserymen Landscape Standards
- C. ANSI - American National Standards Institute
- D. ASTM 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. Contractor shall submit to the Engineer certificates of inspection for plant diseases and insect infestation.
- B. Submit a certified analysis of imported topsoil from each off-site source prior to delivery. Deficiencies shall be corrected at Contractor's expense.
- C. Submit sample of mulch and planting mixture prior to delivery to site.
- D. Submit product data for anti-desiccants, tree wound dressing and herbicides prior to use.

1.06 PLANT SELECTION AND INSPECTION

- A. All trees shall be inspected and accepted prior to planting. Contractor may elect either of the following options as applicable:

- B. For sources within 120 miles of the site, the Engineer will tag the trees at the source. Contractor shall request, in writing, at least two (2) weeks prior to any desired inspection date, inspection and approval of the trees at the source. Approved trees will be tagged by the Engineer and the tag shall remain on the tree until planting and final inspection. Contractor shall accompany the Engineer on the inspection.
 - 1. Otherwise, the trees will be delivered to the site. Trees approved for use will be tagged by the Engineer and the tag shall remain on the tree until planting and final inspection. Rejected trees will not be tagged and shall be immediately removed from the site, and new trees shall be brought in for inspection and approval.
- C. Plant material shall be subject to approval by the Engineer at the site prior to planting.

1.07 PREPARATION OF SHIPMENTS

- A. Plant material shall be clearly labeled as to species and variety. The label or tag shall be securely attached to each plant and shall show the scientific name of the plant. Unless otherwise shown on the Plans, all plants shall be balled and burlapped or container grown.
- B. In preparation for spring planting, all balling operations for balled and burlapped stock shall be completed prior to "bud break." In preparation for fall planting of deciduous plants, balling operations shall not commence until after the plants have begun to "harden off."
- C. Stock shall be dug and packed with care immediately prior to shipment. Plants shall be dug and transported so as to provide and retain a firm ball of earth.
- D. The roots shall be carefully protected with wet straw, moss or other material. The root balls shall be adequately protected from rain or sudden changes in the weather. Balled and burlapped plants will not be accepted if the balls of earth are loosened or broken, or wrapped with material made from synthetics or plastic.
- E. Plants furnished in containers shall have their roots well established in the soil mass and shall have grown in the container for at least one (1) growing season. Containers shall be of a size large enough to provide an earth-root mass of adequate diameter and depth for the stem diameter and plant height or spread, as established by accepted nursery practice. No container grown stock will be accepted if it is root bound.
- F. The transporting of all nursery stock shall be in an enclosed or covered vehicle. Deliver plant material immediately prior to planting. Keep plant material 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. Plants shall be rejected when the burlap, stakes, or ropes required in connection with transplanting have been displaced prior to final acceptance.

1.08 STORAGE AND HANDLING

- A. Roots of plants shall be kept moist and adequately protected by topsoil or other approved covering until planted.
- B. Trunks and branches of trees shall be carefully protected from injury of any kind during operations of digging, loading, transporting and planting. Trees that are injured may be rejected.

1.09 PLANTING SEASON

- A. The planting seasons for deciduous plants shall be between March 1 and June 1 and from October 1 until the ground becomes frozen, except that, when unusual planting conditions exist or when container-grown material is used, these planting seasons may be altered.
 - 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. The planting season for evergreen plants shall be between March 1 and June 1.

1.10 GUARANTEE AND ACCEPTANCE

- A. Contractor shall warrant that all trees have been grown, transported, handled and planted properly so as to be in a vigorous growing condition at the start of the establishment period.
- B. Trees, shrubs and ground cover shall be guaranteed for the establishment period(s). Contractor shall replace all trees, shrubs and ground cover showing defective growth, more than 20% dieback, disease, insect infestation or other impairing defects during the Establishment Period with sound, healthy, vigorous growing trees, shrubs and ground cover at no additional expense to the Owner and in accordance with the plans and specifications.
- C. At the end of the Establishment Period, the Contractor shall request final acceptance. Final acceptance will be made by the Engineer and Owner provided the trees are healthy and all requirements of the Project have been fulfilled.

1.11 EXPERIENCE AND QUALIFICATIONS

- A. Concrete shall conform to MDOT Section 1004, use 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. 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, the Contractor shall submit references from the last five (5) projects of a similar nature. Failure to show successful completion of the last five projects of a similar nature may result in the Contractor or Subcontractor being deemed unacceptable for this Work on this Project.

PART 2 PRODUCTS

2.01 TREES AND SHRUBS

- A. All trees and shrubs shall conform to the requirements of AANLS and as specified herein.
- B. Plant material shall conform to the sizes given in the plant list or Proposal. All measurements such as spread, ball size, number of canes, quality designations, etc. shall be in accordance with AAN "American Standard for Nursery Stock".
- C. Plant material shall be typical for their species or variety and shall be sound, healthy, vigorous, and free from plant diseases and insect pests or their eggs. They shall have healthy, well developed root systems.
- D. Plants designated "B&B" shall be balled and burlapped. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balls shall be securely wrapped with burlap and bound with cord. No balled and burlapped plant shall be planted if the ball is cracked or broken. No planting with rot proof burlap or ties shall be permitted. Sand balls are not acceptable.
- E. Trees shall be nursery grown stock which has been pruned to encourage single main stems, compact fibrous root systems and symmetrical branching. Trees of the same species shall be uniform in height and spread. All trees shall be free from all insects, diseases, mechanical injuries or other objectionable features. Root balls shall be of the sizes specified in AANLS for the tree root system.
- F. Container-grown stock shall have been grown in the containers for one (1) growing season minimum. Plants showing "Pot Bound" root ends will not be accepted.
- G. Trees caliper for trees less than 4 inch caliper shall be determined at a point 6 inch above ground when installed. Trees above 4 inch caliper shall be measured at a point 12 inch above the ground.
- H. Ornamental trees and shrubs shall be well formed and shall have a crown typical of the species or variety. Low-branched crown types shall be furnished unless the Plans or Proposal specifies

a tree form or bush form. Material shall be balled and burlapped, unless otherwise indicated.

- I. Plant stock shall have grown to the required size in a normal progressive manner. Heading-back plants to meet sizes called for on the Plans will not be permitted.
- J. Evergreen trees will require ball and burlap or other adequate root protection. Tops shall be of a form typical to the species and not unnaturally sheared or color treated. Anti-desiccant protection may be required for evergreen trees.
- K. Plant material shall be nursery grown at sources in the same or higher hardiness zone as determined by the latest edition of the Plant Hardiness Zone Map, Agricultural Research Service, U.S. Department of Agriculture.
- L. Substitutions will be permitted only upon submission of proof that specified plants are not obtainable and with the authorization of the Engineer. Requests for substitutions and price adjustments due to substitutions must be submitted in accordance with the General Conditions.

2.02 MULCHING

A. Mulching material shall be one of the following as specified on the plans.

1. Compost:

- a. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable as defined in MCLA PA 641 as amended and shall be in compliance with all federal and state laws.
- b. Compost shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor. The mixture shall be free of glass, plastic, metal, and other contaminants, as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.
- c. The manufacturer of the compost shall provide test data and a statement to show that the following criteria are being met by the compost provided for the project. The composition of the compost shall be 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: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.
 - g. To comply with the annual filing requirements with the Michigan Department of Agriculture, Pesticide and Plant Management Division, the supplier of the compost shall certify that the compost meets Michigan P.A. 641, as amended, and EPA 40 CFR, Part 257 and 503 Regulations, Federal Register Vol. 58, No. 32; dated 2/19/93; Rules and Regulations.
 - 1) A data sheet shall accompany the certification. The data sheet shall show the following:
 - (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. Wood chips shall be the product of a mechanical chipper. Chips shall not include twigs, chopped leaves, or pine needles. Suitability of chip material and size will be determined by visual inspection by the Engineer. Wood chips shall be produced from trees free of any insects and diseases.
 - 3. Shredded Bark:
 - a. Shredded bark shall consist of tree bark which has been stripped and shredded from saw logs by means of a debarking machine. Shredded bark shall be produced from trees free of any insect and diseases. The material shall be sufficiently fine and free from extraneous material so that it will readily pass through a conventional mulch blower.
 - 4. Double Shredded Bark:
 - a. Double processed shredded bark mulch shall be shredded bark mulch which has been processed twice.

2.03 TOPSOIL

- A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than one in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have the following range of values:
 - 1. pH 5.0 to 7.5
 - 2. Soluble Salts 500 ppm max
 - 3. Organic Content 5% to 30%
 - 4. Silt Content 35% to 50%
 - 5. Clay Content 5% to 10%
 - 6. Deleterious Mat'l* 5% max *rock, gravel, stone, sticks, roots, sod, etc.
- B. Compost may be mixed with topsoil to obtain the desired content. Topsoil is to be final screened thru a 5/8 inch maximum mesh screen prior to delivery to the Project site.

1. Engineer shall review source and final screen results prior to release of topsoil. Contractor shall submit a certified analysis of the topsoil from each source to the Engineer.
 2. Topsoil shall be placed in 4 inch (100 mm) minimum thickness throughout, or as specified in the plans or Specifications.
- C. Contractor shall obtain his own topsoil borrow pit source and shall obtain necessary permits and agreements for the use of such borrow pits at his own expense.

2.04 SAND

- A. Sand for planting mixture shall be clean, course, ungraded sand conforming to ASTM C33/C33M for fine aggregates.

2.05 FERTILIZER

- A. Fertilizer shall be Agriform 21-Gram Planting Tablets Plus Minors or Engineer approved equal. Planting Tablets shall be tightly compressed, long-lasting and slow-release with an N-P-K analysis of 20-10-5. Apply at manufacturer’s recommendations and soil analysis.

2.06 PEAT

- A. Granulated raw Canadian peat or baled Canadian peat, containing not more than 9% mineral on a dry basis. For ericaceous plants, baled peat with a pH of 4.0 shall be used.

2.07 LANDSCAPE WEED CONTROL FABRIC

- A. Weed barrier fabric shall consist of a geotextile fabric, spun-bonded polypropylene, non-woven fabric and a UV stabilizer.
- B. Fabric shall have the following Minimum Average Roll Values:

Fabric Properties	Minimum Values	Test Method
Unit Weight	3.0 oz/yd ²	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. Steel landscape edging shall be double staked at overlap joints, and designed to receive tapered steel stakes.
- B. Steel Edge shall be 12ga steel, 4 inches wide, by 10 foot length, with 4 stakes. Painted finish shall be Sherwin Williams H68GT85 powder coat paint electrostatically applied and oven baked. Minimum thickness to be 1.5 mils. Color shall be green, brown, or black as determined by the Owner.
- C. Steel stakes shall be Steel, tapered, 14 inch length and finished to match specified steel landscape edging. Stakes shall be designed specifically to anchor steel landscape edging in place, and made by the manufacturer of the steel landscape edging for which they will be used.
- D. Furnish and install manufacturer’s standard start/end sections, 90 degree corners, and splicers as required.

2.09 STAKES FOR GUYING AND BRACING

- A. Stakes used for bracing or guying plants shall be sound wood of nominal 2 x 2 inch stock and shall be approximately 30 inches in length for guying or of the required length for bracing. The stakes shall be pointed on one end by beveling on two (2) sides.
- B. Metal stakes for bracing trees shall be green metal T-section posts with no anchor plates. Posts shall be at least 8 foot long. Posts shall only be used where specified on the plans.

2.10 WIRE FOR GUYING AND BRACING

- A. Wire shall be new and free from bends or kinks.
- B. Wire used for guying trees 4 inches or less in diameter shall be No. 11 steel wire.
- C. Wire used for guying trees over 4 inches in diameter shall be No. 9 galvanized steel wire.

2.11 HOSE

- A. Hose used with wire for guying trees shall be new 1/2 inch reinforced rubber garden hose or steam hose.

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. Balling material shall be untreated burlap or other material which will readily decompose. Synthetic materials such as nylon or plastic will not be permitted.

2.14 PLANTING MIXTURE

- A. Planting mixture shall be a mixture of 1/3 topsoil, 1/3 sand, and 1/3 peat. Add fertilizer at the quantity as recommended by the manufacturer. Planting mixture shall be free from stick, stones, sod, clods or other material which might leave pockets around the roots.

2.15 BIORETENTION PLANTING MIXTURE

- A. Bioretention planting mixture shall have a sandy loam, loamy sand, or loam texture per USDA textural triangle. Maximum clay content shall be 5%.
- B. The soil mixture shall have a pH between 5.5 and 6.5 and an organic content of 1.5 – 3.0%.
- C. The soil mixture shall have an infiltration rate greater than 0.5 inches/hr.
- D. The soil shall be a uniform mix, free of stones, glass, trumps, roots, or other similar objects larger than 1 inch.
- E. No other material or substances shall be mixed or dumped with the bioretention mix that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.
- F. The planting mixture shall be free of Bermuda Grass, Quack grass, Johnson Grass, Mugwort, Nutsedge, Poison Ivy, Canadian Thistle, Tearhub, or other noxious weeds.

2.16 ACCEPTABLE MANUFACTURERS

- A. Plastic guying and bracing material shall be Adj-A-Tye heavy duty poly chain lock by A. M. Leonard Inc., ArborTape by Neptco Inc. or Engineer approved equal.

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Contractor shall stake all plant locations and confirm the locations and type of plants to be placed with 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. Contractor shall not begin excavation until stake out of tree and/or shrub locations are acceptable to the Engineer.
- B. Contractor shall stake enough planting locations for two weeks work. Contractor shall arrange periodic site meetings with the Engineer for the purpose of reviewing the work that has taken place in the prior two weeks and the staking for the next two weeks. Contractor shall notify the Engineer at least three (3) working days prior to the desired date for inspection of staking.
- C. Contractor shall accurately stake plant material location according to the plans. Stakes for trees shall be 36" high above finished grade and painted a bright color to be clearly visible for inspection. Distinguish by color between types of material, i.e., evergreen trees, canopy trees, flowering trees. Staking for shrubs, perennials, and ground covers shall be staked 18 inches high above finished grade and painted white. Stakes shall be placed at the perimeter and at the bed line 30 feet on center. Engineer shall review the locations and make changes in locations as necessary.

3.03 PLANTING

- A. Balled and burlapped plants shall be set plumb. Tree pits shall be excavated as shown on the plans. Contractor shall dispose of subsoil dug from pits, trenches and beds.
- B. Contractor is responsible for planting to correct grades and alignment and all plants shall be set so that, when settled, they will bear the same relation to finish grade as they did before being transplanted. No filling will be permitted around trunks or stems.
- C. At the start of the Work tree pits and beds are to be excavated and the Contractor shall request inspection and approval by Engineer. Approval must be received before backfilling occurs.
- D. The root ball shall be set on a compacted base as detailed. Burlap shall be cut away from top 1/3 of the root ball and all ropes, wires, etc. securing the ball shall be removed.
- E. Plastic tape and/or plastic fabric shall be completely removed from the root ball during the planting operation. "Rot proof" or treated burlap shall also be totally removed.
- F. Container-grown plants shall be planted as specified for balled and burlapped stock, except that when plants are furnished in non-plantable containers, the container shall be removed only at the time of planting. Plants furnished in plantable type containers shall have container sides severed in multiple places and the upper half of the container removed during the planting operation. Care shall be taken to protect tree roots during severing and removal operation.
- G. When the plant has been properly set, the pit shall be backfilled with planting mixture, gradually filling, tamping and settling with water. No soil in a frozen or muddy condition shall be used for backfilling. The backfill shall be placed to an elevation flush with the ground elevation and the rootball, except that a saucer shall be created near the edge of the hole to capture water.
- H. During fall planting, an Engineer approved superphosphate fertilizer shall be applied over the planting mixture at a rate per the manufacturer's instructions.
- I. All evergreen plant material shall be sprayed with an Engineer approved anti-desiccant according to manufacturer's instructions and limitations immediately following planting and during final seasonal watering.

3.04 MULCHING

- A. After backfilling is completed, mulching material shall be placed over the plant hole area to a depth of 5 - 6 inches or as specified on the plans. Thoroughly soak all mulched areas. After watering, all mulched areas shall be raked and left in a complete and finished manner.
- B. Perennial areas shall have 3 inches of mulch or as specified on the plans. Mulch these areas first and then plant ground cover through the mulch.

- C. Planting beds shall be mulched with a 4 inches cover of mulch as shown on the drawings and details, unless otherwise indicated on the drawings. Mulch depths shall be 4 inches at time of inspection.
- D. For plants located on slopes, an earth saucer or berm shall be constructed halfway around each plant on the down slope side. The saucer or berm shall have an inside diameter equal to that of the planting hole, and a maximum height of 6 inches. A trench shall be dug on the down slope side and filled with planting mixture to allow for drainage.

3.05 BRACING AND GUYING

- A. Only evergreen trees equal to or larger than 5 feet 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. Trees required to be braced, shall be braced or guyed immediately after planting.
 - 2. All plants required to be braced shall be braced with a minimum of two (2) stakes. Stakes shall be driven to avoid ball and shall be no closer than 1 foot -foot (300 mm) from the trunk.
 - 3. Stakes shall be driven to a depth which will firmly anchor the plant, but in no case less than 1 foot below the bottom of the planting hole. The wide side of the stake shall face the trunk of the plant.
 - 4. Stakes shall extend to within 4 inches of the lowest plant's main branches. Top of stake shall be firmly attached to the trunk with steel wire or plastic guying and bracing material.
 - 5. When using steel wire, place wire so it forms a figure eight (8) around the stake and trunk. Portions of wire around trunk shall be encased in water hose of sufficient length to contain the wire loop around the trunk. Enclosed trunk loops shall not restrict normal trunk growth.
 - 6. Stakes shall be positioned on opposite sides of trunks and secured to the trunk at approximately 2/3 the height of plant. Warning tape or ribbon shall be tied to the wiring between the tree and the stake.

3.06 PRUNING

- A. Where determined by the Engineer, pruning will be required. All pruning of the new plants shall be done by workmen experienced in this type of Work. Pruning shall be completed prior to planting. Hedge shears shall not be permitted for pruning. Pruning shall be done in accordance with the best standard practices.
- B. Deciduous trees shall have branches pruned to balance the loss of roots in such a manner as to retain the natural form of the tree type.
- C. Evergreen trees shall be pruned only to the extent of removing broken or damaged branches.
- D. Cuts shall be made 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. All plants shall be thoroughly soaked after planting. After all watering, all beds shall be raked and left in a complete and finished manner.
- B. Watering, Fertilizing and Cultivating is required during the Establishment Period. Watering, Fertilizing and Cultivating shall include all measures necessary to establish and maintain plants in a vigorous and healthy growing condition for the entire Establishment Period.
- C. Contractor shall manually water the plants a minimum of once a week or as necessary to keep the plant in a thriving condition from May 15 until October 15 or for the duration of the Establishment Period.

- D. If the planted areas have an automatic irrigation system that the Contractor is relying upon, it is the responsibility of the Contractor to ensure that the irrigation system is functioning properly.
 - 1. If the Contractor concludes that at any time the irrigation system is not working properly, then they shall notify the Engineer or the Owner so that it may 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. Winter protection shall include late fall spraying of all evergreen trees and evergreen shrubs with anti-desiccant, emulsion type agent, at the manufacturer's recommended rate to prevent winter desiccation and late fall watering if required by a dry season.
- H. At the seasons first watering, an Engineer approved organic timed release, balanced fertilizer shall be applied to the ground around the tree at the rate instructed by the manufacturer. In lieu of organic fertilizer, pre-packaged, controlled release fertilizer packets may be used. Use one (1) 2 oz packet of fertilizer per every 1 inch caliper of tree, or one (1) 2 oz packet for every shrub.
- I. During the first and second watering of the growing seasons, the water used for each plant shall be a nitrogen-enriched solution containing available nitrogen at the rate of 8.5 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). No fertilizer shall be applied after July 7.
- J. During the establishment period(s) as called for in the Contract Documents, the Contractor shall do all required watering, cultivating, pruning, fertilizing, weeding, and all other work necessary to keep the planted material vigorously growing sound and healthy. Contractor shall repair or replace any guying or bracing which is damaged, destroyed, or broken. Contractor shall spray any plant material which becomes diseased or infested with insects.
- K. Contractor shall repair or replace any trees which are blown over, knocked down, uprooted or otherwise become impaired or defective.
- L. Contractor shall replace any plant material which is not in good physical condition, has more than 20% die back, shows defective growth, disease, signs of insect infestation, or any other signs of impairing defects during the Establishment Periods.
- M. Contractor shall repair or replace any plant material damaged or impaired by wind, rain, snow, ice, sleet, sun, heat, drought, or any other weather related occurrences.
- N. The costs for all labor, material, and equipment necessary to carry out the provisions of this Article shall be included in the Contractor's bid price for the planting of trees unless otherwise indicated in the Proposal. Contractor shall notify the Engineer prior to beginning any work called for under this Article.
- O. At the end of the Establishment Period, unless otherwise determined by the Engineer, the guying material, wrapping material, identification tags, and inspection tags shall be removed and disposed of off the project and the mulch around all the plants shall be replenished to the required depth of 5 - 6 inches.

3.08 ESTABLISHMENT PERIOD

- A. The Establishment Period shall begin on the day of written acceptance of the installation of the trees, shrubs, bulbs, ground cover or other plant material. Each subsequent establishment period shall begin on the same day of the succeeding year(s). The Establishment Period shall be a minimum of one year unless otherwise indicated in the Contract Documents.

3.09 SCHEDULES

- A. The general planting location, type and size of tree or shrub shall be as indicated on the Plans. Any substitutions of plant material or alteration in plant sizes or specifications shall be approved by the Engineer prior to ordering.

3.10 STEEL LANDSCAPE EDGING

- A. Install steel landscape edging where indicated on Drawings, according to manufacturer's recommendations. Anchor with steel stakes spaced approximately 30 inches on-center, driven below top elevation of edging, or at every stake pocket location in landscape edging sections designed and manufactured to receive stakes. Stakes shall be located in solid undisturbed soil, or in soil compacted to 85% of its maximum density.
- B. Install straight sections true to the alignments as indicated, free of waves or bends, using strings as guides. Install curved sections true to the alignments as indicated, free of waves or bends, following marked alignments approved in the field by the Engineer. Engineer shall be given 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 32 90 00

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 01 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 01 89 00 - Site Construction Performance Requirements
- D. Section 31 22 00 - Grading
- E. Section 32 92 23 - Sodding

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. Chemical fertilizer shall be supplied in suitable bags with the net weight of the contents and guaranteed analysis shown on the container. Bulk shipments shall be accompanied by an analysis and net weight certification of the shipment.
 - 1. Custom mixed fertilizers shall be accompanied by a certification of the weight of each commercial fertilizer used in the mixture and a guaranteed analysis of each shipment expressed in percentages of total Nitrogen (N), total available Phosphoric Acid (P2O5) and total available Potash (K2O) included.

1.04 SOURCE QUALITY CONTROL

- A. A seed mixture proposed for use in the Work shall have been tested for purity and germination by the Seed Producer within nine (9) months of sowing.

1.05 REFERENCE STANDARDS

- 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. Contractor shall perform soil tests -1 per designated area - to confirm the fertilizer and lime necessary for the site. Contractor to limit the amount of fertilizer and lime to what is absolutely necessary to ensure optimal growth.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the Project site in their original, unopened containers. Containers shall be clearly marked showing, name of manufacturer, brand name, trade name or generic name of material, warranty of analysis, net weight of contents and date of packaging, where applicable.
- B. Seed shall be delivered to the site in durable bags, tagged or labeled to show date of tests, warranty of purity and germination analysis, name, lot number and net weight of contents.
- C. Commercial fertilizers shall be delivered to the site of the Work in the original unopened bags. Bags shall not exceed 100 lbs net weight each and shall be clearly marked with guaranteed analysis in a conspicuous location on each bag.
- D. Material shall be stored at the Project site, under shelter, off the ground and shall be protected from damage by moisture, temperature, exposure to elements, vandalism or other action which might otherwise impair their use.
- E. Materials proposed for use in the Work shall be handled in a manner that will protect the material and the personnel involved in the Work. Handle seed in a manner which will protect the mixture from contamination or deterioration.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Seeding is limited to the periods between April 20 and June 1, 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. Contractor shall establish a dense cover of seeded grass on all disturbed areas. These areas shall be maintained until final acceptance of the Work by the Engineer. Engineer will inspect the turf to insure that the grass seed is well established, weed free, in a growing and vigorous condition. Areas that do not meet the approval of the Engineer shall be re-seeded at the Contractor's expense.

PART 2 PRODUCTS

2.01 SEED

- A. Seed and seeding mixtures shall be certified, mature, clean, dry, new crop seed products suitable for the specified applications and having the percentages of purity, germination and proportions, by weight, indicated in Table 1.

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. The specific mixture to be used shall be for the type of soil on the Project and the location of the seeding per Table 2, unless otherwise indicated on the Plans or as designated by the Engineer.

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. Hydroseeding shall consist of a blend of seed, fertilizer and hydromulch.

2.02 MULCHING MATERIAL

A. Straw:

1. Small grain straw or grass or marsh hay acceptable to the Engineer.

B. Wood Excelsior:

1. Green wood fibers, baled or blanket of type and manufacture acceptable to the Engineer.
2. Wood excelsior shall be made of green timber fiber baled so that the bales weigh 80 to 90 pounds at the time of manufacture.
3. Wood excelsior blankets shall be made of a uniform web of interlocking fibers with a backing of fabric netting on one (1) side only. The fabric net shall have a mesh size not exceeding 1-1/2 x 3 inch and shall be a woven of either cotton cord, twisted paper cord or a synthetic, biodegradable fiber.
4. Blankets shall be produced in the form of a tightly compressed roll 36 ±1 inch wide and approximately 120 feet long. Blanket shall have a fiber net on the outside of the fiber mat.
5. Blanket roll weight, when manufactured, shall average 85 lbs ± 10%.
6. Each roll shall have separator sheets of 40 pound Kraft paper placed at the beginning and at the end of each roll to facilitate unrolling and handling at the job site. The Kraft paper sheet at the end of each roll shall also form a wrapper for the roll.

C. Netting:

1. Twisted Kraft paper or synthetic fiber, biodegradable woven mesh net material suitable for the application and acceptable to the Engineer.
2. The net shall consist of a biodegradable mesh with openings not to exceed 1-1/2 x 3 inch.
3. The net shall be furnished 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 to 1 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. Fertilizer shall be a standard commercial grade fertilizer, conforming to state regulations, of the type recommended for grasses. The fertilizer shall contain slow release nitrogen amounting to 75% of the nitrogen available.
- B. Fertilizer shall be uniform in composition, free flowing and suitable for application with method selected.
- C. Fertilizer for hydraulic seeding shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the slurry.

2.05 AGRICULTURAL LIMING MATERIALS

- A. Burnt lime (quick lime), hydrated lime, limestone (calcite and dolomite), marble shells and by-products shall conform to the requirements of ASTM C602.

2.06 WATER

- A. Free of matter harmful to plant growth.

2.07 STAPLES

- A. Wire staples for holding mulching materials in place shall be not less than 6 inches long No. 11 (U.S. Steel Gage) steel wire or longer.

2.08 TOPSOIL

- A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than 1 inch in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have 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. Engineer shall review source and final screen results prior to release of topsoil.
- D. Contractor shall submit a certified analysis of the topsoil from each source to the Engineer.
- E. Topsoil shall be placed in 3 inch minimum thickness throughout, or as specified in the Plans or Specifications.
- F. Contractor shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at Contractor's expense.

2.09 IMPROVED TOPSOIL

- A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. The improved topsoil mixture shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor.

2.10 COMPOST

- A. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable and shall be in compliance with all federal and state laws. The mixture shall be free of objectionable odors, glass, plastic, metal, and other contaminants; as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.
- B. The manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.
- C. The composition of the compost shall be 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: Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.
4. To comply with the annual filing requirements, the supplier of the compost shall 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.
5. A data sheet shall accompany the certification.
 - a. The data sheet shall show 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. The surface of the subgrade immediately prior to being covered with topsoil shall be raked or otherwise loosened to a minimum depth of 2 inch to facilitate making a bond between the subsoil and the topsoil.

3.02 PREPARATION OF SOIL

- A. After the areas to be seeded have been brought to the required grade and properly trimmed and cleaned up, the existing soil shall be brought to a friable condition by harrowing or otherwise loosening and mixing to a depth of at least 4 inches.
- B. Lumps and clods shall be thoroughly broken. When the area to be seeded has been prepared and covered with a layer of topsoil as specified under Part 3 of this Section, this operation will not be required.

3.03 PREPARATION OF MULCH MATERIAL

- A. When seed is to be sown through mulch which has been in place for a period of more than two (2) weeks or which is being held in place by a surface-applied coating of asphalt emulsion or other adhesive, the mulched area shall be prepared for seeding by discing, a spike-toothed harrow, or by other means acceptable to the Engineer.

3.04 PLACING AND SPREADING TOPSOIL

- A. Topsoil shall be placed and spread over the area designated on the Plans, or as determined by the Engineer, to a depth of 4 inches or to such depth as specified on the plans.
- B. Topsoil shall be placed to a depth sufficiently greater than that shown on the Plans or specified so that, after natural settlement or rolling, the completed Work will conform to the lines, grades and elevations shown on the Plans.
- C. Spreading of topsoil shall be completed in such a manner that seeding as specified can proceed without additional moving of topsoil. Topsoil furnished and placed shall be considered incidental to seeding unless otherwise specified in the Proposal.
- D. After topsoil is spread, large earth lumps, rocks, roots, debris, or other foreign matter shall be raked and removed from the topsoiled area and legally disposed of by the Contractor.

3.05 FERTILIZING

- A. Chemical fertilizer shall be applied on the prepared soil surfaces at a minimum rate of 660 lbs per acre of 12-12-12 fertilizer, or such other rate of another fertilizer mixture that yield 240 lbs per acre of chemical nutrient.
- B. Dry fertilizers shall be thoroughly disced, harrowed or raked into the soil to a minimum depth of not less than 1 inch.
- C. Where hydraulic seeders are used for sowing seed, one half the recommended rate of fertilizer may be spread in combination with such sowing with the balance incorporated into the soil prior to seeding. In all other cases, fertilizer shall be incorporated into the soil before any seeding is started.

3.06 SEEDING

- A. Seed of the kind required shall be sown at the rate as specified in Table 2. Seed shall be sown in the presence of an inspector by mechanical spreader, hydraulic seeder or broadcasting. The broadcasting method shall be used for sowing seed only in areas inaccessible to mechanical spreading equipment. Seeding during winds above 15 mph shall not be permitted.
- B. Prior to placing seed materials, water topsoil to a depth of 4 inches at least 48 hours prior to seeding operations to obtain a loose friable seed bed. Time and depth of watering operations shall be varied at the direction of the Engineer for varying conditions at the site of the Work.
- C. Broadcasting methods for sowing seed materials shall be accomplished by spreading one-half of the specified amount of seed in one direction and then broadcasting the remaining one-half of the seed at right angles to the first seeding pattern using the same broadcast method.
- D. Rate of broadcast shall be as 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. Hydroseeding shall be performed using suitably acceptable hydraulic seeding equipment and a homogeneous slurry solution of water, seed, fertilizer and suitable mulch material as approved by the Engineer. Seed slurry mixture shall be distributed uniformly at a rate approved by the Engineer for the seeding materials and/or mulch materials used to suit the seed application rate. Seed application rate shall be 300 lbs per acre.

3.07 MULCHING

- A. Mulching shall consist of placing a mulch material on areas that have been or are to be seeded. Mulch shall be placed in a loose enough condition so as to allow penetration of sunlight and circulation of air, but thick enough to shade the ground, reduce the rate of water evaporation and prevent erosion by wind or water. Mulch shall be secured with suitably acceptable anchoring material.
- B. For surfaces and slopes on which power equipment can be operated, satisfactory mulching materials include the following:
 - 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 1200 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 1200 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. Commercially manufactured netting and/or fiberglass materials shall be anchored in accordance with 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. Fiberglass mulch shall be removed before seeding because of its permanence. Care shall be taken to prevent fiberglass filaments left in place from becoming entwined or wound around shafts of power mowers or other power equipment.
- E. Acceptable proprietary netting and erosion control materials shall be disposed of in accordance with the manufacturer's printed instructions for the material used prior to any seeding operations.

3.09 TURF ESTABLISHMENT

- A. Seeded areas shall be watered whenever excessive drying is evident during the period set for establishment. Watering shall be done in a manner that will prevent erosion due to the application of excessive quantities and the watering equipment shall be of a type that will prevent damage to the cultivated surfaces.
- B. Contractor shall be responsible for the proper care of the seeded areas until final acceptance of the entire Work covered by the Contract.
- C. The seeded areas shall be mowed with mowing equipment acceptable to the Engineer to a height of 2 inches whenever the average height of grass establishment reaches four 4 inches. When the amount of cut grass is heavy, cut grass shall be removed to prevent destruction of the underlying grass.
- D. If weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed, or in the case of rank growths, shall be uprooted, raked and legally disposed of from the area.
- E. Reseed and mulch areas larger than 4 sq inches not having a dense, uniform, vigorous stand of grass acceptable to the Engineer.

- F. The establishment period shall extend for a period from the time of seeding until the seeded area has a uniform stand of grass acceptable to the Engineer. The minimum period shall be 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 32 92 19

SECTION 32 92 23 SODDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes sodding complete with earth bed preparation, providing and placing topsoil, compacting and finishing topsoil, furnishing and placing sod, furnishing and placing stakes, watering sod, rolling and tamping sod, mowing sod, replacing defective or deteriorated sod and maintenance and care of sod in place.

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 22 00 - Grading

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with the applicable requirements of the Insect Pest and Plant Disease Act, Act 189 of 1931, as amended for all nursery grown sod.

1.04 SUBMITTALS

- A. Contractor shall submit copies of Sod Growers Certificate to the Engineer indicating nursery from which sod was taken, grass species and percentage in accordance with the Michigan State Department of Agriculture Regulations referenced above.
- B. When requested by the Engineer, submit evidence of topsoil borrow pit agreement for pits used by the Contractor.
- C. Submit test results for imported topsoil.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Sod shall be delivered to the project site on suitable wooden pallets. Sod shall be delivered in manageable rolls and the amount of sod delivered shall not exceed that which can be installed in one 24-hour period. Sod that has been damaged during delivery will be rejected.
- B. Store sod in such a manner as to protect roots and grass material from exposure to wind and sunlight, freezing or other injury. When stacked, sod shall be placed roots-to-roots or grass-to-grass in rolls. Sod shall be kept moist during storage, under shade or covered with moistened burlap. Sod that has been damaged or has deteriorated because of storage will be rejected.
- C. Sod shall be handled in a manner to prevent breaking or other damage. Sod shall not be handled by pitch forks or by dumping from trucks or other vehicles. Care shall be taken at all times to retain the native soil on the roots of each sod roll during stripping and handling. Sod that has been damaged by handling will be rejected.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Perform sod cutting and removal during soil moisture conditions as specified in Part 3 of this Section.
- B. Sod shall not be placed during drought nor between the dates of June 1 and August 15, inclusive, unless approved by the Engineer.
- C. Sod shall not be placed when the ambient air temperature is below 32 degrees F .

1.07 PROTECTION OF WORK

- A. Provide suitably approved warning signs and barricades for protection of new sodding from pedestrian or vehicular traffic. Protect all newly sodded areas during the progress of the Work

and until the completion of the turf establishment period.

- B. Protect all adjacent construction from topsoil spills and perform such cleanup of affected surfaces before it becomes compacted by traffic.

1.08 PLANTING SCHEDULE

- A. Contractor will be required to have a minimum of 90% of the sod placed at least one (1) month prior to final acceptance of the complete Project to ensure adequate rooting of the sod.

1.09 FINAL ACCEPTANCE

- A. Contractor shall establish a dense cover of sod grass on all disturbed areas. These areas shall be maintained until final acceptance of the Work by the Engineer.
- B. Engineer will inspect the sodded turf to ensure that the sod is well established, weed free, in a growing and vigorous condition. Areas that do not meet the approval of the Engineer shall be re-sodded at the Contractor's expense.

PART 2 PRODUCTS

2.01 SOD - GENERAL

- A. Sod shall be dense, well-rooted growths of perennial and desirable grasses other, than Merion Blue Grass, indigenous to the general locality where it is proposed for use.
- B. Sod shall be free of noxious weed, relatively free of weeds and undesirable plants, and large stones, roots and other material which might be detrimental to the growth, development or future maintenance of the sod.
- C. Sod shall be in strips of uniform width, not less than 10 inches wide, with lengths of not less than 18 inches and an area of not less than 4.5 sq feet.
- D. Sod grown on peat will not be accepted.
- E. Sod shall be of uniform height when harvested. Vegetation more than 4 inches in height shall be mowed to a height of 3 inches.
- F. Sod when harvested shall have the following average thickness:
 - 1. Field Grown Sod - 2 inches
 - 2. Nursery Grown Sod - 1 inch

2.02 NURSERY SOD

- A. Nursery sod, shall be per MDOT section 917, grown on mineral soil with a strong, fibrous root system, and regularly fertilized and maintained according to established practices for at least two (2) years before cutting.

2.03 FIELD OR SALVAGE SOD

- A. Salvage sod existing on areas to be disturbed during construction, or field grown sod meeting the requirements specified above shall be used as indicated on the Plans or as directed by the Engineer.

2.04 TOPSOIL

- A. Topsoil shall be fertile, friable, sandy clay loam without admixture of subsoil. Topsoil is to be free of glass, stones greater than 1 inch in any dimension, weeds, undesirable grasses and other extraneous materials. Topsoil shall have 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%
deleterious mat'l*	5% max
* rock, gravel, stones, sticks, roots, sod, etc.	

- B. Compost may be mixed with topsoil to obtain the desired content.
- C. Topsoil is to be final screened thru a 5/8 inch maximum mesh screen prior to delivery to the Project site. Engineer shall review source and final screen results prior to release of topsoil.
- D. Contractor shall submit a certified analysis of the topsoil from each source to the Engineer. Topsoil shall be placed in 4 inches minimum thickness throughout, or as specified in the plans or Specifications.
- E. The Contractor shall obtain his own topsoil borrow pit source and shall obtain all necessary permits and agreements for the use of such borrow pits at his own expense.

2.05 IMPROVED TOPSOIL

- A. Improved topsoil shall consist of a mixture of 2/3 topsoil and 1/3 compost. The improved topsoil mixture shall have a dark brown or black color, be capable of supporting plant growth without ongoing addition of fertilizers or other soil amendments and shall not have objectionable odor.

2.06 COMPOST

- A. Compost shall be mature/stabilized, humus-like material derived from the aerobic decomposition of yard waste (i.e., grass clippings and leaves) or other materials as designated compostable and shall be in compliance with all federal and state laws. The mixture shall be free of objectionable odors, glass, plastic, metal, and other contaminants; as well as viable weed seeds and other plant parts capable of reproducing. The mixture shall be such that no visible water or dust is produced when handling it.
- B. The manufacturer of the compost shall maintain annually on file with the Michigan Department of Agriculture, Pesticide and Plant Pest Management Division, test data and a statement to show that the following criteria are being met by the compost provided for the project.
- C. The composition of the compost shall be 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 – Shall meet the requirements of EPA 40 CFR; Part 503 Regulations, Federal Register Vol. 58, No. 32, dated 2/19/93; Rules and Regulations.
4. To comply with the annual filing requirements, the supplier of the compost shall 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.
5. A data sheet shall accompany the certification.
6. The data sheet shall show the following:
 - 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

PART 3 EXECUTION

3.01 CONTRACTOR'S VERIFICATION

- A. Prior to placing any topsoil, verify that earth bed in areas to receive sod have been completely stabilized to prevent settling and that grades have been made smooth, uniform and parallel to the finished grades and cross sections shown on the Plans.
- B. Ascertain that the tops and bottoms of all slopes are rounded off to form vertical curves and have been found acceptable to the Engineer.
- C. Do no placing of topsoil until all earth bed conditions are accepted.
- D. Prior to placing sod, verify that topsoil has been placed on the prepared earth bed to the proper depths shown on the Plans and as specified herein. Do not place any sod until topsoil conditions are satisfactory.

3.02 OFF-SITE SOURCE INSPECTION

- A. Prior to commencement of sodding operations, notify the Engineer of the off-site sources from which sod is to be furnished. Engineer, at his discretion, will inspect the sod at the off-site source.

3.03 SOD HARVESTING

- A. Sod shall be harvested by cutting into squares or into rectangular sections. The rectangular sections may vary in length, but shall be of equal width and of a size that will permit them to be lifted and rolled without breaking.
- B. During the stripping process and all other handling of the sod, care shall be taken to retain the native soil on the roots.
- C. Where off-site source inspection of sod is required by the Engineer, no sod shall be harvested until such inspection is complete and sod is accepted. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected.
 1. When the soil is too dry, permission to cut sod may be granted by the Engineer only after it has been sufficiently watered to moisten the soil to the depth at which the sod is to be cut.

3.04 PREPARATION OF SUBGRADE

- A. Complete all fine grading within the areas to be covered with topsoil as necessary to bring the surface of the proposed subgrade to the elevations indicated on the Plans and parallel to the proposed finished grade. The surface of the subgrade, immediately prior to being covered with topsoil, shall be raked or otherwise loosened to a minimum depth of 2 inches to facilitate making a bond between the subsoil and the topsoil.

3.05 PLACING AND SPREADING TOPSOIL

- A. Topsoil shall be placed and spread over the area indicated on the Plans or as directed by the Engineer. Topsoil shall be placed to a depth of 4 inches unless otherwise indicated in the Contract Documents. At a minimum, topsoil placed shall be sufficiently greater than that shown on the Plans so that, after natural settlement or rolling, the completed Work will conform to the lines, grades and elevations indicated on the Plans.
- B. After spreading topsoil, all large lumps, rocks, roots, debris or other foreign matter shall be removed from the topsoil by raking and disposed of off the site of the Work. Spreading shall be completed in such a manner that sodding operations can proceed without additional moving of topsoil. Topsoil furnished and placed shall be incidental to the sodding operations.

3.06 SODDING

- A. No frozen sod shall be laid, nor shall sod be laid on frozen soil.
- B. Sod shall be laid within 24 hours after cutting and shall be properly protected during handling and placing. Sod shall be lifted from trucks or storage piles and placed on a moist earth bed by hand, making close joints without overlapping. All gaps between sections of sod and openings at angles shall be plugged with sod.
- C. When placing sod on slopes, the Work shall begin at the base of the slope and progress upward by carefully placing the sod on the smooth slope, in rows, with the lengths running at right angles to the slope.
 - 1. The transverse joints of sod strips shall be staggered, and the sod carefully laid to produce tight joints.
 - 2. When the tops of slopes are reached, the sod shall be carried back at least 2 feet over the crest and trimmed to a line which is parallel to the top of the bank. The areas back of the crest shall have been previously graded and the surface of the sod, when placed, shall be 2 inches below the level of this area and covered with a layer of topsoil at least 2 inches in depth and thoroughly compacted in a manner that will conduct the surface water from runoff over the edge of the sod.
 - 3. On slopes steeper than one (1) vertical to three (3) horizontal, unless otherwise specified, the sod shall be staked with wooden pegs. There shall be at least one (1) peg in each piece of sod with a maximum between pegs of two (2) feet. Pegs shall be driven flush with the surface of the sod. Laying and staking of the sod shall be done simultaneously.
 - 4. Where sod may be displaced during sodding operations, workmen shall work from ladders or treaded planks.
- D. Rolling of the sod shall be done after initial watering and after the water has sufficiently soaked into the ground so that distortion of the sod surface and excessive compaction of the sod and the soil will not occur. The roller used shall be a water filled type at least 3 feet wide and 30 inches in diameter and shall weigh approximately 300 pounds. Roller shall be adequate to cause sod to make firm contact with the soil. A tamper, acceptable to the Engineer, shall be used to press the sod firmly in place in areas not accessible to a roller. After tamping or rolling, the sod shall present a smooth, even surface, free from bumps or depressions.
- E. Damaged, deteriorated or otherwise defective sod will be rejected by the Contractor and except as otherwise provided herein, removed from the Project. Sod which has been permitted to dry out or become otherwise injured during transportation, handling, storage or placing shall be rejected. Where permitted by the Engineer, rejected sod, if suitable, may be pulverized and

used for filling, where necessary.

3.07 TURF ESTABLISHMENT

- A. After laying, the sod shall be watered until saturated. Sod shall be watered whenever excessive drying is evident during the period set for establishment. Sufficient water shall be applied to wet the sod through completely and to wet at least 2 inches of the sod bed each time watering is required. Watering shall be done in a manner that will prevent erosion due to the application quantities of water. The watering equipment shall be of a type that will prevent damage to the finished surfaces of topsoil and sod. The sod shall be watered as required until firmly knit in place and in a vigorous growing condition.
- B. Two weeks after sodding, sod shall be fertilized at the rate of 900 lbs per acre of 5-20-20 (or equivalent nutrient) fertilizer.
- C. The sodded areas shall be mowed a minimum of three (3) times with mowing equipment acceptable to the Engineer. Sod shall be mowed to a height of 3 inches whenever the average height of the grass becomes 4 inches.
 - 1. When the amount of cut grass is heavy, the cuttings shall be removed from the sodded areas to prevent destruction of the underlying turf.
- D. Where weeds or other undesirable vegetation threaten to smother the planted species, such vegetation shall be mowed or, in the case of rank growths, uprooted, raked and removed from the area. All mowed cuttings, uprooted or raked vegetation, shall be legally disposed of away from the Project Site.
- E. The establishment period shall extend for a period from the time of sodding until the sodded areas have received final acceptance of the entire Work covered by the Contract. The minimum period shall be 45 days.

END OF SECTION 32 92 23

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. Contractor shall note that CCTV software compatibility with Owner's software and databases is required, and a Pre-Inspection deliverable is required to be submitted and approved before beginning 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. Unless otherwise specified, the work for this Section shall conform to the applicable portions of the following standard specifications.
 - 1. NASSCO - National Association of Sewer Service Companies
 - 2. PACP - Pipeline Assessment Certification Program
- B. Qualifications
 - 1. All CCTV operators shall be NASSCO-PACP certified.
 - 2. Database shall be the latest version of NASSCO-PACP Certified Access Database unless otherwise approved by the Engineer.
 - 3. CCTV software shall be current 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 Contract, the Contractor shall CCTV inspect at least three (3) segments or 1,000 feet of pipe and submit the data to the Owner to verify that the CCTV database is compatible with the Owner's PACP Data Management software, GIS integrations software; and that the deliverables are acceptable to the Owner.
- B. The Owner shall verify acceptability of the deliverables within five (5) business days of receipt. The Contractor shall not begin Work on the Project until this software compatibility has been approved.

1.05 SCHEDULE OF WORK

- A. Contractor shall submit to the Owner prior to beginning television inspection a schedule for sequence of sewer lines designated to be televised.

1.06 FINAL SUBMITTALS

- A. Electronic Inspection:

1. Work shall conform to the latest version of NASSCO, Pipeline Assessment and Certification Program (PACP) standards. The documentation of the work shall consist of 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. Electronic Television Inspection shall also include:
 - 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. CCTV inspections shall include complete and accurate PACP mandatory header information and report coding for all sections of sewer. In addition to the required header information, the following additional information is required for this Project:
 - a. Time
 - b. Pipe section reference
 - c. Pipe lining
 - d. Total Length
 - e. Length surveyed
 5. Data shall be submitted on a single drive, as approved by the Owner, and shall be properly identified as to Project, location, time, and date in a manner acceptable to the Owner.
- B. Electronic Video Inspection Recordings:
1. The purpose of video inspection recordings shall be to supply an electronic visual and audio record of problem areas of the lines that may be replayed. The CCTV inspection shall be entirely recorded in a PACP approved electronic format 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 shape files of television and inspection records. Shape files shall include points along the mainline sewer indicating the location of factory taps, roots, failed joints, or any other feature where PACP code is recorded as a part of the sewer and manhole inspection.
 2. The shape files shall 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, pipe reports, screen shots or photos of the observation (factory taps, joints, plugs etc.), and videos shall be hyperlinked to the features in the shape files.

1.07 JOB CONDITIONS

- A. Sewer Flow Control:

1. When sewer line depth of flow at the upstream manhole of the sewer section being worked is above the maximum allowable for television inspection, the flow shall be reduced to the level shown below by operation of pump stations, plugging or blocking of the flow, or by pumping and bypassing of the flow as specified. Sewer flow control shall be in accordance with Section 33 01 30.30 - Sanitary Sewerage Flow Control.
 2. Depth of flow shall not exceed that shown below 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. A sewer line plug shall be inserted into the line upstream of the section being worked. The plug shall be so designed that all or any portion of the sewage can be released. During CCTV inspection flow shall be reduced to within the limits specified above. After the work has been completed, flow shall be restored to normal.
 - d. Pumping and Bypassing
 - e. When pumping and bypassing is required the Contractor shall supply the pumps, conduits, and other equipment to divert the flow of sewage around the manhole section in which work is to be performed.
 - f. The bypass system shall be of sufficient capacity to handle existing flow plus 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. If pumping is required on a 24-hour basis, engines shall be equipped in a manner 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. Consideration shall be given to the rights of adjacent property owners.

PART 2 PRODUCTS

2.01 TELEVISION CAMERA AND EQUIPMENT

- A. Television camera used for the inspection shall be one specifically designed and constructed for such inspection. Camera shall be color, pan, tilt and zoom; or a sidewall scanning (panoramic) camera specifically designed and constructed for sewer inspection.
- B. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions.
- C. Camera, monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Engineer; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

- D. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device, and the accuracy shall be within ± 2 feet.

PART 3 EXECUTION

3.01 PREPARATION

- A. Locating the Work:
1. Contractor shall locate all structures and note sewer diameter and direction of flow. Notify the Owner of detrimental access, structure, and/or sewer conditions which may adversely affect the progress of the Work.
 2. Manholes found that are not shown on the maps issued for the Project shall be identified as to exact location, distance and direction of adjoining manholes, sizes of connecting sewers, and shall be submitted in writing to the Engineer. Any manholes not found or found in a location different than as shown on the maps, shall also be similarly identified and located.
 3. Location data for found of misidentified manholes shall include:
 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. Prior to the Contractor televising the existing sewers, it shall be the responsibility of the Contractor to clean each sewer line in accordance with Section 33 01 30.41 - Cleaning of Sanitary Sewerage Utilities.

3.02 PERFORMANCE

- A. After cleaning, the sewer sections shall be inspected by means of closed-circuit television. The inspection will be done one sewer section at a time and the flow in the section being inspected will be suitably controlled as specified.
- B. The camera shall be moved through the line in the direction of the flow (downstream) except when not physically possible or when doing a reverse inspection.
- C. The maximum rate of travel shall be 30 feet per minute unless otherwise approved by the Engineer. In all instances, the speed of travel shall be slow enough to inspect each pipe joint, tee connection, structural deterioration, inflow and infiltration (I&I) source and deposits.
- D. The camera shall pause, pan, and visually inspect all service connections, maintenance defects, structural defects, miscellaneous abnormal sewer conditions, and anywhere when necessary to permit proper documentation of the sewer's condition. If utilizing a side wall scanning camera, pausing, and panning of each lateral is not necessary if the image clearly depicts the inside of the lateral for post processing.
- E. If during the inspection operation, the television camera will not pass through the entire section of sewer from manhole to manhole, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole (Reverse Inspection).
1. If during the reverse inspection the television camera will not pass through the entire section of sewer, the inspection shall be considered complete.
 2. If however, root cutting, deposit cutting, or cutting intruding services is required to complete the inspection, this Work (upon approved by the Engineer prior to beginning the Work) shall be completed before the television inspection shall be considered complete.

- F. The camera shall be positioned in the line in such a manner so as it is always as near to the center of the line as possible.
- G. The image quality shall be adequate for post-inspection coding. The Contractor shall be required to repeat the inspection at the Contractor's expense if the image quality is unsuitable for any reason.
- H. If observed defects are such that further operations may compromise the structural integrity or cause damage to the pipe, the Contractor shall notify the Engineer in writing of the observed condition and reason(s) continued CCTV inspection would be harmful.
- I. Recording shall be done during times of good visibility. No recording shall be done during periods of visible fog or steam in the sewer, or when the camera lens is dirty, coated, or under water (as outlined below) unless otherwise authorized by the Owner.
- J. Television inspection reports shall be with-in +/- two (2) feet of the measured linear footage between manholes along the existing sewer centerline from the start of pipe to end of 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. Contractor shall provide a PACP certified operator on site at all times during the entire CCTV inspection. If video is to be coded separately from the actual recording, both the onsite Operator and the individual performing the PACP coding shall be PACP certified.
- M. Any portion of the video inspection recording that is of insufficient quality as determined by the Engineer shall be redone by the Contractor at no additional cost to the Owner.

3.03 MAINTAINING TRAFFIC, RESTORATION, AND PROTECTION OF EXISTING IMPROVEMENTS

- A. Contractor shall be responsible for maintaining traffic at all times in accordance with Section 01 50 00 - Temporary Facilities and Controls.
 - 1. The Contractor shall furnish, erect and maintain all signs, barricades, lights, and traffic regulators, in accordance with the requirements of the current "Michigan Manual of Uniform Traffic Control Devices". Furnish all flagmen and watchmen as are necessary to maintain and safeguard traffic during the Work. Furnishing, installing, and maintaining traffic control devices shall be incidental to the Project.
- B. Damage to any existing improvements including fences, utilities, landscaping, lighting, lawns, trees, structures or any other items, shall be restored to their original condition in accordance with Section 01 89 00 - Site Construction Performance Requirements.

3.04 USE OF PREMISES

- A. Contractor shall not trespass upon or in any way disturb private property without first obtaining written permission from the property owner as appropriate to do so. A copy of such written permission shall be furnished to the Owner prior to accessing the site.
- B. It shall be the Contractor's responsibility to work equipment around poles, trees, or other obstructions and to do so at his own expense.
- C. If the Contractor finds it necessary to obtain additional working area, it shall be the Contractor's responsibility for its acquisition.
- D. Contractor shall, at no additional expense, restore such property to the original condition in the sole and unfettered opinion of the Owner. Contractor must take photographs and/or videos of existing properties prior to the disturbance of any property, and make a copy available to the Owner.
- E. Items within the street right-of-way or sewer easement shall be removed, removed and replaced, or restored as directed by the Owner.
- F. Contractor shall ensure all employees have a badge or visible identification during any time that they on the project site or within private property. This identification must be worn so that it is

readily recognized and readable to the public.

END OF SECTION 33 01 30.11

SECTION 33 01 30.30 SANITARY SEWERAGE FLOW CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide materials, labor, equipment, and services necessary to control of 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. Contractor shall submit shop drawings and complete design data showing methods and equipment to be utilized 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. In areas where flows are bypassed, discharge bypass flow to sanitary sewer approved by Engineer. No bypassing to ground surface, receiving waters, storm drains, or bypassing which results in groundwater contamination or potential health hazards shall be permitted.
- 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. Bypass system shall have sufficient capacity to handle existing flow plus 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 33 01 30.30

SECTION 33 01 30.41
CLEANING OF SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Contractor shall provide materials, labor, equipment, and services necessary for sewer line cleaning, manhole cleaning, and internal obstruction removal.
 - 1. Cleaning shall remove sediment, rocks, debris, roots, grease accumulations and obstructions from length of sewer and manholes to be lined, as well as hydraulic root cutting and/or grinding/cutting protruding break-in service connections.
 - 2. Cleaning of sewer and manhole walls in vicinity of lining shall remove grease, scale, encrustation and loose mortar so that no foreign intrusion shall cause imperfections in lining (e.g., bumps, folds, dimples).
 - 3. Sewer cleaning methods shall be washing with high pressure water or other as approved by Engineer.

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. Contractor shall submit a letter that identifies methods that will be used to remove sediment, debris, grease, scale, encrustations, loose concrete, roots and break-in connections throughout 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. Contractor shall submit a schedule that outlines the sequence in which Contractor proposes to conduct his operations and shall be approved by Owner before work is started. Original and updated schedules must be provided to 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 show initial mobilization, start-up, cleaning and televising, and any resultant point repairs shall be included.
 - 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: Equipment shall be capable of removing dirt, grease rocks, sand, roots, and other materials and obstructions from sewer lines and manholes.
- B. Equipment shall have selection of two or more high-velocity nozzles. Nozzles shall be capable of producing scouring action from 15 to 45 degrees in all size lines designated to be cleaned, with nozzle capable of producing flows from fine spray to solid stream.
- C. Equipment shall carry 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. Water shall be conserved and not used unnecessarily.
- C. Only Owner-approved fire hydrant wrenches and shut off valves shall be used.
- D. A visible air gap shall be maintained between the discharge of the fire hose and the Contractor's water storage tank. The air gap shall be visible from the ground surface.
 1. If an air gap is not possible, Contractor shall provide a backflow preventer that has been approved by Owner.

2.04 NO FIRE HYDRANT SHALL BE OBSTRUCTED EXCEPT TO REFILL EMPTY WATER TANKS.

- A. Contractor shall provide temporary piping, valves, certified reduced pressure backflow preventers, equipment, and other items for handling potable water and wastewater approved by Owner.
- B. Do not utilize water source until it has been approved for use by Owner.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall clean the sewer and associated manholes, including drop connections and benches, to remove Deposits Settled (DS), so that the sewer is ready for televising. This will require an unlimited amount of passes of a hydraulic flusher to remove all loose debris and collect it for removal in the downstream manhole. Debris must be removed from the sewer, including any debris that may have been washed up into any service connections (does not include known pre-existing conditions in service connections), drop connections or the bench wall of the manholes. This item does not include any root cutting, deposit removal, or grinding of protruding service connections.
- B. Cleaning shall be performed while the line segments are in service without the need for plugging or flow diversion unless previously approved by Engineer. If necessary, Contractor shall schedule the work to be performed late at night between the hours of 11:00 PM and 6:00

AM. Late night cleaning work shall not begin until Contractor has received approval from Owner for a nighttime traffic control plan submitted by Contractor.

3.02 MAINTENANCE OF TRAFFIC

- A. Contractor shall be responsible for maintaining "local" traffic at all times and for notifying the proper authorities regarding the closing of the roads. Contractor will be responsible for obtaining all permits required for maintenance of traffic.
- B. Contractor shall 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. Contractor shall maintain local traffic at all times during all phases of this project in a manner causing the least amount of inconvenience to the abutting property owners. Temporary driveways, temporary roadways, or run around as may be necessary to provide vehicular access to and from the abutting properties shall be constructed, maintained, and subsequently removed by Contractor as directed by Owner and/or Engineer.
- D. The portion of the pavement not affected by the work shall be kept clear of all material and equipment. If at any time traffic has to be blocked (emergencies only), Contractor shall notify the nearest fire, police departments and service departments.
- E. The cost of maintenance of traffic shall be incidental to the contract and not measured for 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. If an excavation is required, Contractor shall notify, at least 48 hours before breaking ground, all public or private service corporations having wire, poles, pipes, conduit, manholes, or other structures that may be affected by this operation, including all structures which are affected and not shown on these plans. Owners of underground utilities, which are members of the state's one call service, can be notified by calling. Non-member underground utility owners must be called directly.
- C. Maintenance, repair, and replacement of existing utilities shall be in accordance with the rules and regulations of the various utility companies having jurisdiction.
- D. Existing storm sewers, driveway drains, surface drain pipes and other property, removed or damaged during construction shall be repaired and reconnected by Contractor as directed by 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. Contractor shall be aware of flow conditions and be able to identify potential access problems to sewer access points.

3.05 SEWER CLEANING

- A. Contractor shall provide equipment that is specifically designed and constructed for sewer cleaning. Solids and debris resulting from the cleaning operation shall be collected and removed from the downstream manhole and disposed of at a site selected by Owner and approved by appropriate jurisdictional personnel. Under no circumstances shall sewage solids

be dumped onto the surface, street, or into ditches, inlets, or storm drains.

- B. Contractor shall use the manufacturer's recommended size tools for the various size pipes. Equipment recommended by the manufacturer to protect the manhole and pipe, such as pull-in slant jack rollers and roller and yoke assembly, roller manhole jacks, etc. shall be utilized.
- C. Contractor shall clean designated sewer lines using approved methods and equipment.
 - 1. Contractor shall have a CCTV camera in the sewer during all cleaning operations to verify that the cleaning equipment is not damaging the public sewer. The use of CCTV equipment shall be in accordance with Section 33 0130.16, Television Inspection of Sewer Pipelines.
 - 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. Sludge, dirt, rocks, sand, grease and other solids or semisolid materials resulting from cleaning operations shall be trapped and removed at the downstream manhole of the section being cleaned.
- B. Passing materials from manhole section to manhole section, which could cause line stoppage, accumulations of sand in wet wells or damage to pumping equipment, shall not be permitted.
- C. Solids or semi-solid material removed from the wastewater collection system during the cleaning operation shall be removed from the site and disposed of 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. Contractor shall immediately investigate any and all reports of sewage backing up into fixtures served by the sewer section that is being cleaned or televised.
- B. Contractor will be required to notify both Owner and Engineer immediately if he causes any damage to private or public property caused by activities related to this contract. Contractor shall make repairs and/or clean the property immediately in a timeframe that is acceptable to Owner.

3.09 CLEANUP

- A. Contractor shall keep the work area in an uncluttered condition by the frequent removal of debris. Contractor shall remove all debris and unused material and leave the area in a condition similar to the condition of the area before any work was performed.

END OF SECTION 33 01 30.41

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. Materials and procedures required to establish compliance with the specifications shall be submitted upon request to Owner/Engineer for review/approval. Submittals shall include at least the following:
 - 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. The manufacturer of the lining system for wastewater structures shall be a company that specializes in the design and manufacture of corrosion protection materials and/or systems for wastewater structures.
- B. The applicator (company performing the installation) shall be completely trained in leak repair, surface preparation and application of the lining system.
- C. The materials/products shall be suitable for installation in a wastewater environment without any deterioration of the liner.

- D. The applicator shall be trained and provide a letter of certification from the manufacturer for the handling, mixing, application, and inspection of the liner system as described herein.
- E. To ensure total unit responsibility, materials and installation thereof shall be furnished and coordinated by manufacturer/certified applicator.

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 shall 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 devices of others upon which the wastewater structure functions or act of God.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. The materials to be utilized in the lining of wastewater structures shall be designed and manufactured to withstand the severe effects a wastewater environment. The manufacturer of the corrosion protection products shall have at least 10 years of experience in the production of the lining products utilized, and the products shall have satisfactory installation record.
- B. Equipment for installation of lining materials shall be of high quality and as recommended by the manufacturer.
- C. The lining system to be utilized for wastewater structures shall be a multi-layer 'stress skin panel' liner system as described below:
 - 1. Liner:
 - a. Moisture Barrier: Modified polymer (silicone modified polyurea) shall be sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment.
 - b. Surfacers: Polyurethane/polymeric blend foam shall be a polyurethane rigid structure foam that is a low viscosity, two-component foam containing flame retardants.
 - c. Final Corrosion Barrier: Modified polymer (silicone modified polyurea) shall be sprayable, solvent free, two-component polymeric, moisture/chemical barrier specifically developed for the corrosive wastewater environment.
 - 2. Total thickness of multi-layer liner system shall be a minimum of 500 mils.
- D. The product shall be SPECTRASHIELD, manufactured by CCI Spectrum, Inc.

PART 3 EXECUTION

3.01 INITIAL INSPECTION

- A. Applicator shall 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. Prior to conducting any work, an initial inspection of the structure shall be performed to determine 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. New concrete structures shall have endured a minimum of 28 days since manufacture prior to 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. Surface preparation for standard manhole structures shall be in accordance with the manufacturer's recommendations and may include high pressure water cleaning and shall provide a surface compatible for installation of the liner system.
- C. Surface preparation and methods for other structures shall be in accordance with the manufacturer's recommendations, and may include high pressure water cleaning, hydro blasting, abrasive blasting, grinding, or detergent water cleaning, and shall be suited to provide a surface compatible for installation of the liner system.
- D. The surface preparation method shall produce a cleaned, abraded and sound surface with no evidence of laitance, loose concrete, loose brick, loose mortar, contaminants or debris, and shall display a surface profile suitable for application of 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. Upon completion of leak and crack repair, the surface shall be primed in accordance with the manufacturer's recommendations.

3.03 MATERIAL INSTALLATION

- A. Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, environmental controls during application, safety and spray equipment.
- B. Spray equipment shall be specifically designed to accurately ratio and apply the liner system.
- C. Application of multi-component liner system shall be in strict accordance with manufacturer's recommendation. Final installation minimum total thickness shall be 500 mils. A permanent identification and date of work performed shall be affixed 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. Final liner system shall be completely free of pinholes or voids.
- B. Liner thickness shall be the minimum value as described herein.

- C. Visual inspection may be made by Owner/Engineer. Deficiencies noted in the finished liner system shall be marked and repaired according to the recommended procedures set forth by the manufacturer.

END OF SECTION 33 01 30.82

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 01 22 00 - Unit Prices
- B. Section 04 05 11 - Mortaring and Grouting
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 31 23 16 - Structural Excavation and Backfill
- E. Section 31 23 19 - Dewatering
- F. Section 31 23 33 - Trenching and Backfilling
- G. Section 31 70 00 - Tunneling and Mining

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Conform to the applicable requirements of State and local health authorities having jurisdiction for disinfection and testing of water mains.

1.04 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ACI - American Concrete Institute
 - 2. ASTM ASTM International

1.05 SUBMITTALS

- A. Shop Drawings: Indicate manhole and vault locations, elevations, piping, conduit, and sizes and elevations of penetrations.
- B. Product Data: Provide manufacturer's data and installation instructions for precast manhole and vault sections, joint connections, water stops, gaskets, corrosion protection system, flexible pipe joints, chimney seals, manhole and vault castings, and other pertinent information for precast and cast-in-place manholes and vaults.
- C. Manufacturers Certification: Certify that all products furnished meet or exceed the specified requirements, including worst case depth loadings for this project.
- D. Calculations: Submit calculations for review sealed and signed by a registered Professional Structural Engineer in the State of Michigan. Include structural, depth of bury, buoyancy, and all other information necessary to determine adequacy of the item.
- E. Results of manhole and vault leakage and vacuum tests.

1.06 CLOSEOUT SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 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. The top slab of all manholes or vaults shall be designed for an H-20 truck loading.
- F. Minimum manhole or vault base slab thickness shall be eight (8) inches up to twenty five (25) feet depth and twelve (12) inches over twenty five (25) feet depth.
- G. Manholes and vaults shall resist buoyancy due to flooding with a high ground water table elevation at the top of the precast concrete structure. The factor of safety against buoyancy shall be 1.20. Buoyancy calculations shall be provided with the submittal.
- H. Walls backfilled with cohesive soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 135 pounds per square foot (psf) per foot of wall height for walls below the ground water table.
- I. Walls backfilled with granular soil shall be designed for an equivalent horizontal fluid at-rest soil pressure of 125 psf per foot of wall height for walls below the ground water table.
- J. Design walls for surcharge load from adjacent structures or minimum 300 psf surcharge, whichever is greater.
- K. Loads associated with testing manholes and vaults for water-tightness by vacuum testing in accordance with this Section.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Comply with precast concrete manufacturer's instructions for unloading, storing and moving precast manholes, vaults and drainage structures.
- B. Store precast concrete manholes, vaults and drainage structures to prevent damage to Owner's property or other public or private property. Repair property damaged from materials storage.
- C. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

1.09 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

PART 2 PRODUCTS

2.01 VALVE VAULTS, MANHOLES, FRAMES, AND COVERS

- A. Valve Vaults and Manhole Manufacturers:
 - 1. Northern Concrete Pipe, Inc.

2. Mack Industries
 3. Engineer-approved equal
- B. Manhole and Vault Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.
- C. Benching:
1. Provide full height and poured-in-place benching.
 2. Use non-shrink grout as specified in Section 04 0511.
 3. Appropriate granular filler may be used, subject to the approval of Engineer.
- D. Watertight Cover and Frame Manufacturers:
1. East Jordan Iron Works, Inc. - Model 1040 ZPT, Type A.
 2. Neenah Foundry Co. - Model R-1916-F.
 3. Engineer approved equal
- E. Cover and Frame Product Description:
1. ASTM A48/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. Base Slab:
1. Per Contract Drawings, cast-in-place concrete of type specified in Section 03 30 00 - Cast-in-Place Concrete or integral, monolithically cast precast concrete or standard tee pipe base sections.
- C. Pipe to Manhole/vault Connection:
1. Unless noted otherwise on the Contract Drawings, use a resilient type connector, in accordance with ASTM 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.

D. Manhole and Vault Chimney Seals:

1. As shown on the Contract Drawings, seal the outside of the manhole or vault cone or riser section to the grade rings and manhole and vault frame with a heat shrinkable wrap or a compressible rubber seal with 304 stainless steel compression bands.

E. 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. Placement and compaction of surrounding backfill material shall be accomplished to provide 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. Test concrete in accordance with Section 03 30 00.
- B. Vertical Adjustment of Existing Manhole and Drainage Structures:
 1. Where required, adjust top elevation of existing manholes and drainage structures to finished grades shown on Drawings.
 2. Reset existing frames, grates, and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.
 3. Remove concrete without damaging existing vertical reinforcing bars when removal of existing concrete wall is required. Clean vertical bars of concrete and bend into new concrete top slab or splice to required vertical reinforcement, as indicated in the Contract Drawings.
 4. Clean and apply sand-cement-bonding compound on existing concrete surfaces to receive cast-in-place concrete in accordance with Section 03 30 00.

END OF SECTION 33 05 13

SECTION 33 11 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 01 22 00 - Unit Prices
- 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. Water main piping and appurtenances shall be NSF 61 certified. The certification should be stamped on the exterior wall of the pipe/appurtenance.

1.04 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work of this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. 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 C214: Machine-Applied Polyolefin Tape Coatings for Steel Water Pipe
32. AWWA C216: Heat-Shrinkable Cross-Linked Polyolefin Coatings for Steel Water Pipe and Fittings
33. AWWA C218: Liquid Coatings for Aboveground Steel Water Pipe and Fittings
34. AWWA C222: Polyurethane Coatings and Linings for Steel Water Pipe and Fittings
35. AWWA C300: Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
36. AWWA C301: Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
37. AWWA C504: Rubber-Seated Butterfly Valves
38. AWWA C600: Installation of Ductile-Iron Mains and Their Appurtenances
39. AWWA C602: Cement–Mortar Lining of Water Pipelines in Place—4 In. (100 mm) and Larger
40. AWWA C605: Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
41. AWWA C651: Disinfecting Water Mains
42. AWWA C800: Underground Service Line Valves and Fittings

43. AWWA C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
44. AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service
45. AWWA C909: Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger
46. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition
47. NSF 14: Plastics Piping System Components and Related Materials
48. NSF 61: Drinking Water System Components - Health Effects

1.05 SUBMITTALS

- A. Tabulated Laying Schedule:
 1. Where concrete water main pipe is used in the water main Work, a Tabulated Laying Schedule, showing stationing, deflection, elevation, slope and description of pieces shall be submitted to the Engineer. Pipe manufacture shall not be started until the laying schedule has been reviewed by the Engineer.
- B. Product Data:
 1. Submit catalog data showing pipe sizes, and manufacturing standards, as well as design calculations for internal pressure, vacuum and external load conditions, for both non-restrained and restrained joints.
- C. Schedule of Corporation Stops (Tapping Outlets):
 1. A complete schedule of all tapping outlets installed in concrete water main piping shall be kept by the Contractor and submitted to the Engineer at the end of each water main piping section of the Project or on the last day of each week, whichever occurs first.
- D. Affidavits:
 1. Submit manufacturer affidavit of compliance with the Contract Documents shall be submitted to the Engineer and shall include the following, where applicable:
 - a. Pipes, specials and fittings (AWWA C200)
 - b. Cement-mortar protective lining (AWWA C205 and AWWA C602).
 - c. Tape coating for the exterior (AWWA C214 and AWWA C209).
 - d. Shrink wrap for exterior (AWWA C216).
 - e. Paint system for the exterior (AWWA C210, C218 or C222).
 - f. Manufacturer's standard repair procedures.
 - g. Manufacturer's written quality control procedures.
 - h. Manufacturer's Installation Instructions: Indicate special installation requirements.
 - i. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements
- 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 dechlorination 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. The following shall be submitted 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 with a length 10 feet or less. These short pieces shall be in addition to those required under the Tabulated Laying Schedule.

1.08 STORAGE OF MATERIALS

- A. Pipe shall be stored in a manner to minimize infiltration of dirt, debris and other extraneous materials.
- B. Piping materials shall not be stacked higher than 4 feet. Suitable racks, chairs and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.
- C. Store hydrants, valves, wells and prefabricated structures off the ground, drained and kept free of water to protect against damage from freezing. Hydrants, valves, wells, their accessories and appurtenances shall be kept in their original containers until ready for installation.
- D. Gaskets, glands, joint and sealing materials subject to ultra-violet or ozone attack shall be protected from the sunlight, atmosphere and weather; and stored in suitable enclosures until ready for installation.

1.09 HANDLING OF MATERIALS

- A. Load and unload piping using suitably approved hoists and skidding. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping shall be rejected by the Contractor.
- B. Lifting devices shall be suited to the Work and shall 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. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 DUCTILE IRON PIPE SYSTEM

- A. Ductile Iron Pipe shall be AWWA C151/A21.51, with cement mortar lining inside, and 1-mil (25 µm) minimum thickness asphaltic coating outside. Pipe shall have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans or specified in the

Proposal.

- B. Mechanical joints for ductile iron pipe shall be compression gasket type, conforming to AWWA C111/A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.
- C. Push-on, compression gasket type joints shall conform to AWWA C111/A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.
- D. Fittings and plugs shall be ductile iron compact fittings, mechanical joint, pressure rating of 350 psi, conforming to AWWA C153/A21.53, and rubber gasket joints conforming to AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.
- E. Flexible ball and retainer type joints shall be ball and retainer type, boltless, locking, and capable of being deflected up to 15 degrees.
- F. Cement mortar linings for ductile iron pipe shall conform to the requirements of AWWA C104/A21.4 of the thickness specified and shall be permanently set prior to the application of any additional pipe coating.

2.03 PRESTRESSED CONCRETE PRESSURE PIPE SYSTEMS

- A. Concrete piping shall be prestressed concrete, embedded cylinder type, 175 psi plus d-load design pressure conforming to AWWA C301. Seal coat in accordance with AWWA C104/A21.4 as applicable.
- B. Joints for concrete pipe shall be push-on, steel ring, gasket type conforming to AWWA C300 or AWWA C301.
- C. Fittings shall be AWWA C300, Type A, concrete or mortar lined with reinforced concrete or mortar exterior covering. AWWA C300, Type B, cut and welded steel plate, mortar coated on 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. Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings, size 4 inches and larger, shall conform to AWWA C900, Pressure Class 235, DR 18 unless otherwise indicated in the Contract Documents.
- B. Rigid polyvinyl chloride bell and spigot type pressure pipe and couplings, smaller than 4 inches shall be ASTM D2241, SDR 21, pressure class 200.
- C. Molecularly oriented polyvinyl chloride (PVCO) pipe sizes 4 to 24 inches shall be AWWA C909, pressure class 200 unless otherwise indicated in the Contract Documents. PVCO pipe will only be allowed when specifically called for in the Contract Documents.
- D. Compounds used for production of PVC pipe and components shall be suitable for potable water products as required in NSF 14 and NSF 61 and shall be stamped NSF-pw on the exterior pipe wall. Spigot end of pipe shall be marked to visually determine when the spigot is fully seated in the bell of the adjoining pipe.
- E. Joints for PVC pipe shall be push-on or mechanical elastomeric gasket type, conforming to ASTM D3139.
- F. PVC fittings shall only be allowed when called for on the Plans. When allowed, 4-inch and larger PVC fittings and plugs shall be 200 pound (1380 kPa) Pressure Class conforming to AWWA C900 of types and sizes indicated on the Plans. PVC fittings smaller than 4-inches, when allowed, shall be ASTM D2241.

- G. Fittings and plugs for PVC pipe, unless specified otherwise, shall be ductile iron and as specified in Part 2 for Ductile Iron Pipe Systems.
- H. Gaskets for PVC pipe shall be elastomeric seal type conforming to ASTM F477.
- I. Pipe joint lubricants shall be manufacturers standard nontoxic conforming to AWWA C900.

2.05 RESTRAINED JOINTS

- A. Where the Plans or Specifications call for restrained joints they shall be per the following.
 - 1. Restrained joints for ductile iron pipe and fittings shall be designed for a working pressure of 350 psi. Joints shall be capable of being deflected after assembly. Restraints shall be by one of the following methods:
 - a. A positive axial lock between the bell interior surface and a retainer welded on the spigot end of the pipe.
 - b. A thrust restraint wedge which embeds in the pipe with twist off nuts to control wedge setting.
 - 2. Restrained joints for PVC water main pipe shall be designed for a working pressure of 200 psi. Where the restrained portion of the pipe is connected to fittings, restraint shall be provided across the joint by a clamping ring and anchored to the fitting with T-head bolts or stainless-steel rods.
 - a. Restraining devices for PVC water main pipe shall incorporate clamping rings with serrations on the inside surface to provide positive restraint on the outside surface of the pipe and shall provide full support around the circumference of the pipe to maintain roundness.
 - b. Coating on wedge assemblies and related parts shall be two coats of heat cured liquid thermoset epoxy. Coating on casting bodies shall be electrostatically applied and heat cured polyester.

2.06 POLYETHYLENE ENCASEMENT

- A. Polyethylene material for encasement shall be either 4 mil high density, cross-laminated polyethylene film or 8 mil linear low-density polyethylene film per AWWA C105/A21.5.

2.07 VALVES AND HYDRANTS

- A. Butterfly Valves:
 - 1. Butterfly valves shall be rubber-seated tight closing and shall conform to AWWA C504 latest revision.
 - 2. Class 150 Valves (Non-Cyclic Applications)
 - 3. Valves shall be of the flangeless wafer body style. All valves shall be suitable for use with ANSI 150-pound flanges. Bodies shall be cast iron. Valves shall be rated at 175 psi 75 psi. Bodies of all flangeless wafer valves shall have bolt guides to center the body in the pipeline.
 - 4. Valves shall be furnished with self-lubricated bearings of TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.
 - 5. Valve seats shall be of the reinforced resilient type and shall be field replaceable. Seats shall also act as a body liner to prevent flow from contacting the body casting.
 - a. Seats shall have flange sealing to provide a positive seal without use of flange gaskets.
 - b. Seats shall be of Buna-N or EPDM suitable for use with potable water.
 - 6. Shafts shall be one piece and shall be 316 stainless steel. Shaft diameter shall be suitable for the service conditions specified.

7. Shafts shall be finish ground to minimize bearing and shaft seal wear. Shafts on valves 12-inch and larger shall have a non-adjustable thrust collar.
 - a. Shaft seals shall have a stuffing box and pull-down packing gland. Packing shall be furnished with self-adjusting "V" type packing.
 8. Discs shall be aluminum bronze. The disc-to-shaft connections shall be Type 316 stainless steel.
 9. Pins, shaft, and disc of all valves shall be individually machined and completely interchangeable.
 10. Valves shall be available with field interchangeable manual or powered actuators as required. The actuator-to-shaft connection shall be designed to shear and prevent internal valve damage if the disc closes on foreign material in the pipeline.
 11. Factory Testing: Test shall be conducted on each valve in accordance with Manufacturer's Quality Control procedures.
 12. Butterfly valves shall be marked with the valve size, manufacturer's mark, year of manufacture, and class.
 13. Manufacturer: Valves shall be DeZurik, Val-Matic, Clow or equal
- B. Gate Valves:
1. Insert community standard here
- C. Fire Hydrants:
1. Insert community standard here
- D. Air Release Valves:
1. Air Release valves shall have an ASTM A126 Class B cast iron body and cover with a threaded inlet connection of the size shown on the plans or listed in the schedule and a 1/2 inch NPT outlet connection.
 2. Valve body shall have a 2 inch NPT plugged port near the base to facilitate cleanout of large solids as well as a 1/2 inch NPT connection near the top and 1 inch NPT port near the bottom to permit the installation of flushing attachments.
 3. Valves shall have an 18-8 stainless steel float and a replaceable seat of Buna-N or other suitable material. Internal linkage mechanism shall be 18-8 stainless steel, plastic or bronze is not acceptable.
 4. The linkage mechanism shall be capable of being removed from the cover without disassembly of the mechanism.
 5. Valves shall have 3/16 inch diameter stainless steel orifice for working pressures up to 150 psi. Valve shall close drop tight.
 6. The valve shall automatically exhaust accumulated air from a fluid system while the system is pressurized and operational.
 7. For valves installed below grade, each valve shall be equipped with a flood safe kit to prevent inflow into the valve during submerged conditions.

2.08 TAPPING SLEEVES

- A. Tapping Sleeves shall be cast iron or ductile iron, pressure rating of , mechanical joint sleeves conforming to AWWA C153/A21.53, furnished complete with valve, stops, caps, plugs and joint accessories as indicated on the Plan. The sleeve shall be of a 2-section type.
- B. When approved by the Owner, tapping sleeves shall be 18-8 Type 304 stainless steel full circumference band, bolts, nuts and washers; rated for a working pressure of 250 psi. Gasket shall be Buna-N. Flanges shall meet the requirements of AWWA C207, fusion bonded epoxy coated carbon steel.

2.09 VALVE BOXES

- A. Valve boxes shall be 3-piece, 5-1/4 inch diameter, screw type, gray iron castings consisting of base section, bottom section, and top section with lid conforming to ASTM A48/A48M, Class 20. Overall length shall be adjustable to meet grade.

2.10 CORPORATION STOPS

- A. Corporation stops, couplings and plugs shall be water service bronze of type and size detailed on the Plans.

2.11 SERVICE SADDLES

- A. Water service saddles shall be compatible with the main and service lead, with straps of a ductile material to avoid crushing the main out-of-round. A molded gasket of rubber or neoprene shall completely encircle the tapped opening to insure a watertight connection. The use of lead gaskets is not allowed.
- B. Water service saddles shall be bronze with AWWA tapped threads.
- C. Service saddles used with PVC water main shall be double strap, full circular and provide uniform bearing around the circumference. U-bolt type straps are not allowed.

2.12 CURB STOPS

- A. Water service bronze of types and sizes detailed on the Plans.
- B. Curb stops shall include an extension type, 3-piece curb box with extension type base, foot piece, one piece lid and a 3-foot stationary rod, unless otherwise specified.

2.13 THREADED FITTINGS

- A. Where indicated on the Plans, threads for water main service fittings shall conform to the requirements of AWWA C800 and AWWA C800 "Appendix for Materials."

2.14 WATER SERVICE PIPE

- A. Soft Copper shall be Type "K" conforming to ASTM B88, with flared fittings.
- B. Polyvinyl Chloride shall conform 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. High strength low alloy steel or stainless-steel conforming to AWWA C111/A21.11. Balls and fittings shall be bronze alloy or corrosion protected steel.

2.16 STRUCTURES

- A. Material for water main structures shall conform to the details on the plans and the requirements listed below:
 - 1. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3 inch thickness.
 - 2. Concrete block shall be ASTM C139 shape and scored as detailed and as approved.
 - 3. Precast concrete structures shall conform to ASTM C478/C478M, circular with circular reinforcement as detailed. Provide lifting holes in precast units where indicated.

2.17 MANHOLE STEPS

- A. Cast iron manhole steps shall be ASTM A48/A48M, Class 30, with a minimum cross section dimension of 1-inch (25 mm) in any direction.
- B. Steel reinforced plastic manhole steps shall be 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.

- C. Manhole steps shall be of types and sizes indicated on the Plans and shall comply with applicable state and federal occupational and safety standards.

2.18 COVERS AND FRAMES

- A. Structure frame and covers shall be of the types and sizes as detailed on the Plans. Covers shall be ASTM A48/A48M, Class 30, gray iron castings. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects. Surfaces of castings shall be ground to assure proper fit and to prevent rocking. Units shall be frost proof and shall be provided with tapping screws and anchors where indicated on the Plans.

2.19 BOLTS, STUDS, AND NUTS

- A. Bolts, studs, and nuts shall be as specified on the Plans and shall 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. Tee head bolts and nuts shall be high strength, low alloy steel conforming to AWWA C111/A21.11, with a ceramic filled, baked-on fluorocarbon resin coating.

2.20 CONCRETE

- A. Concrete shall 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.

2.21 FLOWABLE FILL

- A. Flowable Fill for filling abandoned Water Mains.
 - 1. Materials:
 - a. Cement: Cement shall conform to ASTM C150/C150M or ASTM C595/C595M
 - b. Fly Ash: Fly ash shall have a maximum loss on ignition of 12 percent and meeting the other requirements of ASTM C618 (Class F)
 - c. The water shall meet the 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. The temperature of the flowable fill mixture as manufactured and delivered shall be 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. Contractor shall submit a history of the mix design for seven (7) day and 28 day strengths, together with any other technical information. The design mix shall also be included as part of the Contractor's submittals for 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 is to be connected and notify the Engineer of the same. Engineer will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as to the necessary adjustments required 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 pipe. Wire brush and wipe clean the outside surfaces of all plain ends and the inside surfaces of all socket ends before installation. Any pipe or fitting which has acquired a coating of mud or other foreign material shall be scrubbed clean with heavily chlorinated water.
- B. Pipe fittings, valves, hydrants, accessories and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged materials shall be rejected and removed from the Project by the Contractor.

3.03 INSTALLATION - GENERAL

- A. Foreign matter shall be prevented from entering the pipe while it is being placed in the trench. During and after laying operations, no debris, clothing or other materials shall be placed in the pipe.

- B. During the progress of all water main Work, watertight plugs shall be carried along and inserted in the end of each pipe as it is laid to prevent foreign matter or rodents from entering the pipe. This watertight plug shall be fastened in the end of the water main in such a manner as to prevent it from floating or being otherwise displaced whenever construction operations are temporarily halted, such as at noon or at the end of the days Work.
- C. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length between bell holes.
- D. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles, shall be employed. Pipe cutting shall be performed using the recommendations of the manufacturer for the type of pipe materials being cut and according to the best trade practices.
- E. When cutting pipe or fittings, care shall be taken to prevent damage to linings and coatings. Damage to linings shall be cause for rejection of the complete Section. Damage to exterior coatings shall be corrected to original Specifications.
- F. Where pipe using a resilient gasket to effect the seal is cut, the cut pipe end shall be tapered at a 30-degree angle with the centerline of the pipe, and ground smooth, on the outside end to remove any sharp edges or burrs which might damage the gasket.
- G. Unless otherwise specified, pipe shall be laid with bell ends facing in the direction of laying. After a length of pipe is placed in the trench, the spigot shall be centered in the bell end of the adjacent pipe section, the pipe shoved into position and brought to true alignment and secured with sand tamped under and on both sides of the pipe except at bell holes. Adequate support shall be provided for all water main pipe.
- H. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 23 33. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 23 33. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.
- I. A continuous and uniform bedding as specified in Section 31 23 33 shall be provided in the trench for all buried pipe.
- J. Backfill shall be as indicated on the Plans and as specified in Section 31 23 33.
- K. Install bolts, studs, and nuts of the type specified per the manufacturer's installation and torquing requirements. Steel bolts, studs, and nuts shall be painted with bituminous paint after installation.

3.04 INSTALLATION OF DUCTILE IRON PIPE

- A. Ductile iron water main shall be installed in accordance with the most current version of AWWA C600.
- B. Push-on-joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be prelubricated before installation using a lubricant recommended by the pipe manufacturer. Seated joint shall be identified by the visible mark on the spigot of the installed pipe section.
- C. Mechanical joints shall be made with bolts, molded resilient gasket and cast iron follower gland. Nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall be brought up evenly at all points around the bell flange and then torqued per the manufacturer's recommendations.
- D. Exposed portions of bolts shall be covered with mastic.
- E. Flexible joint pipe shall be assembled, handled and installed in accordance with the printed recommendations which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to the

Engineer.

3.05 INSTALLATION OF CONCRETE PIPE

- A. Pipe and fittings shall be jointed by means of a resilient gasket and steel spigot ring. The resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe.
- B. Pipe shall be laid in accordance with the accepted tabulated laying schedule and the Plans. Short lengths of pipe 10 feet as specified under part 1 of this Section shall be installed and evenly distributed along the line of the Work, if required.
- C. The bell of the pipe in place shall be cleaned and properly lubricated and pipe section installed. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final shape, prior to driving the pipe home, check each gasket for proper position around the full circumference of the joint and complete installation.
- D. Provide cloth bands wired around each joint outside diameter and grout with Portland cement mortar grout. Completely fill the annular recess between the adjoining bell and spigot pipe ends. Annular spaces between pipe ends on the inside of joints of pipe 24 inches or more in diameter shall be filled with Portland cement mortar grout.

3.06 INSTALLATION OF POLYVINYL CHLORIDE PIPE

- A. Polyvinyl chloride pipe shall be laid with gasketed joints in complete accordance with AWWA C605 and the pipe manufacturers published instructions. The joints shall be sufficiently lubricated using the pipe manufacturers recommended lubricant.
- B. Gaskets for pipe joints shall be inserted with the painted edge facing the end of the bell. Each length of pipe shall be pushed home individually. The pipe shall be positioned so that the reference mark on the spigot end is in line with the bell end.
- C. Tracer wire is to be installed along with PVC water mains. Tracer wire is to be continuous from end to end and terminate at each structure in such a way and with a sufficient length of wire to allow for easy connection to utility tracing equipment. Wire shall be continuity tested after installation. Any wire which fails the continuity test shall be replaced.

3.07 INSTALLATION OF RESTRAINED JOINTS

- A. Restrained joints shall be provided where indicated on the plans. Joints shall be assembled in strict accordance with manufacturer's directions. Joints shall be fully extended after assembly.

3.08 FITTINGS, STRAPPING, AND LUGGED PIPE

- A. Install all fittings to the lines, levels and locations indicated on the Plans.
 - 1. Thrust blocks shall be constructed as indicated on the plans or as required by the Engineer.
 - 2. Fittings shall be provided with restraints as specified herein, as indicated on the Plans, or as required for a functional installation.
- B. Where indicated on the Plans or as determined by the Engineer, bends in water main piping and piping runs subject to impact reaction shall be secured by means of metal strapping. Install all necessary bands, tie rods, nuts, and washers required. No metal strapping shall be used in direct contact with polyvinyl chloride pipe.
- C. Where lugged pipe and special fittings are indicated on the Plans, furnish and install all necessary tie rods, nuts, and washers.

3.09 POLYETHYLENE ENCASEMENT

- A. Where called for on the plans, ductile iron water main, fittings and hydrants shall be encased in a polyethylene film tube.
- B. The polyethylene film tube shall be installed 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. Service taps, bends, tees and other connections shall be made to polyethylene encased pipe in accordance with section 4.4.6 of AWWA C105/A21.5
- C. Cost of the polyethylene encasement shall be incidental to the water main.

3.10 VALVES

- A. Valves shall be installed to the grade, lines, levels and locations indicated on the Plans.
- B. Valve connections shall be as specified for the piping materials used. Valves shall be set with the stem plumb on permanent, firm foundations as indicated on the Plans.
- C. Where required, valves shall be supported with special supports as indicated on the Plans and as approved by the Engineer. Valves shall be installed so as not to receive support from the connecting pipe.
- D. In no case shall valve installation be used 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. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment rings, etc. as shown and as required for a complete installation.
- B. Construction of water main structures shall conform to the type of construction and dimensions indicated on the Plans and as described below.
 1. Block Structures:
 - a. Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar.
 - b. Mortar joints shall be full and close in all courses. Joints shall be uniform in thickness throughout the structures. Strike all joints and properly point to provide true, smooth surfaces.
 - c. Courses shall be 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. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick or block gate wells and other water main structures indicated on the Plans. Plaster coat shall be 1/2 inch thick and shall be applied to the outer surfaces of the structures.
- D. Provide and install to the elevations shown cast iron covers, frames, adjusting rings, anchors, etc., indicated on the Plans and as required. Castings shall be set in a full bed of cement mortar 1/2 inch thick minimum. Mortar joints shall be struck smooth.
- E. Install steps for structures of types and in locations indicated on the Plans. Steps shall be installed on 16 inch centers, unless shown otherwise on the plans.
- F. Pipe placed in structures for inlet or outlet connections shall extend through the walls and beyond the outside wall surfaces a sufficient distance to allow for complete connections. Openings between pipes and walls shall be sealed with a full bed of cement mortar. Pipe shall be supported by concrete supports.

3.12 VALVE BOXES

- A. Install valve boxes to the grade, lines, levels and locations indicated on the Plans. Valve boxes shall not transmit shock or stress to the valve and shall be set plumb with covers centered over operating nuts and flush with the indicated surface elevations. Valve boxes that shift or fill during backfilling shall be uncovered and reset.

3.13 HYDRANTS

- A. All hydrants shall be installed plumb to the lines, levels, grades and locations indicated on the Plans. Hydrants shall be set to the established grade, shall have their nozzles parallel to or at right angles to and facing the grade or curb.
- B. Hydrant drain/weep holes shall be plugged.
- C. Where necessary to adjust for proper hydrant location, the Contractor shall install additional pipe between the water main and road box. Hydrant and valve extensions shall be installed to adjust hydrant to proper grade.
- D. Contractor shall plumb all hydrants at the time they are set with a plumb line or other means acceptable to the Engineer.
- E. Upon substantial completion of cleanup, the Contractor shall recheck all hydrants for plumb and grade and shall make all adjustments as necessary at this time. The Work of constructing fire hydrants shall not be considered complete until these final adjustments for plumb and grade have been made.

3.14 FIRE HYDRANT APPROACHES

- A. Fire hydrant approaches shall consist of culvert pipe with end protection and a gravel approach.
- B. The culvert pipe shall be of the size and type shown on the Plans. The culvert pipe shall be installed to 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. Pipe bedding shall consist of bank run sand meeting the requirements of MDOT Class II granular material and compacted to 95% of maximum unit weight.
- C. Each end of the culvert pipe shall be protected against erosion, as shown on the Plans.
- D. The gravel approach shall extend from the edge of the traveled portion of the road to the fire hydrant and shall be a minimum of 10 feet.
 - 1. The gravel approach shall consist of 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 where indicated on the Plans. Install all valves, fittings, caps, plugs and piping as required. Fittings and joint materials used for air release assemblies shall be as specified herein for the water main piping materials used.

3.16 BLOW-OFF ASSEMBLY

- A. Provide all materials and construct blow-off assemblies where indicated on the Plans. Blow-off assemblies and pipe shall be installed to the lines, levels and elevations shown.
- B. Install all valves, fittings, reducers, piping, plugs, joints, etc., as detailed. Blow-off assemblies shall be installed on stable, undisturbed earth materials with changes in directions and returns provided with bedding and restraints as indicated on the Plans, as specified herein and as required for a complete installation.
- C. Blow-off assemblies shall include valve boxes 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. The tapping sleeve shall be assembled around the main, and the tapping performed in strict accordance with the manufacturer's recommendations.
- C. Tapping shall be accomplished without interruption of service.

3.18 ANCHORS, ENCASEMENTS, AND RESTRAINTS

- A. Plugs, tees, sleeves, bends, caps, straps and lug piping shall be provided with suitable anchors, encasements and restraints as indicated on the Plans. Anchoring, encasement and restraint methods shall be as detailed. All bearings shall be as shown.
- B. Anchors, encasements and restraints shall rest on firm, stable, compacted subgrade and shall be provided for all standard and special fittings.

3.19 WATER SERVICE LINES

- A. When so indicated in the Proposal, or on the Plans, the Contractor shall provide water service lines in accordance with this Section. Otherwise, water service lines are not required.
- B. Water service lines shall be installed after the water main has been successfully tested and put into service, including the installation of fire hydrants. The service lines shall be of the type indicated on the Plans and shall be a minimum of 3/4 inch or as otherwise indicated on the Plans or Proposal.
- C. Water service lines shall be provided for all lots or parcels at the locations indicated on the Plans, within these Contract Documents or as designated by the Engineer. Service lines shall extend 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. Water service lines under concrete or asphalt pavements shall be installed by boring or tunneling, unless otherwise indicated on the Plans or approved by the Engineer.
- E. Backfilling of open cut construction for water services shall be in accordance with Section 31 23 33, after the service line, including curb stop, has been laid and approved by the Engineer. Prior to backfilling the service line the Contractor shall request an inspection by the Engineer and obtain approval of the service line.
- 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. Water jetting shall not be permitted.
 - 3. Final installation of the service pipe must be in accordance with manufacturer's recommendations and no joints or fittings shall be allowed under roadway surfaces.
- G. Existing water mains shall be kept in service until all water services have been connected to the new mains. Contractor shall repair all water services damaged during the installation of the new water mains. Only after the new mains have been tested and accepted and put into service, will service connections be made to the new mains.
- H. Reconnection of Water Services
 - 1. The connection of existing service lines to the new mains shall be made within the street rights-of-way or within the easements, utilizing the existing curb stops.

2. Existing lead water service lines shall be abandoned and new water service lines installed from the new water main to the water meter.
- I. Backfill, method of construction under pavements, and new water service lines shall be as specified in this Section.

3.20 CORPORATION STOPS

- A. Corporation stops shall be located on water main piping where indicated on the Plans, or as determined by the Engineer.
- B. Corporation stops on PVC water mains shall be made with full circle service saddles.
- C. Install a minimum of two (2) corporation stops in each valve well.
- D. One - 1 inch tapping outlets shall be installed at approximately 20 foot intervals along the entire length of the concrete water main.
 1. These tapping outlets shall be constructed as detailed on the plans and shall be positioned 45 degrees off vertical.
 2. The location of the tapping outlets shall be marked by means of No 4 reinforcing rod. The rod shall be placed in a vertical position immediately adjacent to, but not touching, the water main and the top, 6 inches below finished grade.

3.21 SERVICE SADDLES

- A. Where service saddles are to be installed, the entire circumference of the main shall be free of all loose material. Installation of the saddle and tapping of the main shall be in accordance with manufacturer's recommendations.

3.22 CURB STOPS

- A. Install curb stops of the types and sizes indicated on the Plans. Curb stops shall include furnishing and installing a curb box.

3.23 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 threaded opening. The drain pipe shall be installed in the opposite end of the water main from the stand pipe. The drain pipe should bend up to a 90 degree angle with the end of the pipe being a minimum of 6 inches above the top of the water main.
- D. Using the stand pipe, fill the water main to be abandoned with flowable fill material. The material shall be placed 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 shall consist of removing and relaying and existing water main to avoid an existing or proposed utility. Existing pipe shall be removed and disposed of. Bends and vertical anchors shall be installed as shown on the plans. Verticals anchors and thrust blocks shall be sufficient to resist thrust forces.

3.25 ABANDON EXISTING GATE VALVE AND WELL

- A. Gate valve and well and other water main structures on the existing water main shall be abandoned and the structures shall be abandoned in accordance with the following:
 - 1. The abandonment of existing structures shall consist of removing and salvaging the existing frame and cover. The valve shall be opened. Masonry shall be broken down to an elevation at least 3 feet below the subgrade.
 - 2. The abandoned structure shall be backfilled with flowable fill to 1 foot above the pipes and the remainder of the structure with sand-cement mixture at a 10 to 1 ratio to subgrade elevation or to 1 foot below finished grade.

3.26 REMOVE GATE VALVE AND WELL

- A. Gate valve and well and other water main structures on the existing water main shall be removed in accordance with the following:
 - 1. The removal of existing structures shall consist of removing and salvaging the existing frame and cover, and valve.
 - 2. The ends of the existing water main shall be plugged and braced. The complete structure shall be removed entirely and disposed of.
 - 3. The excavation shall be backfilled with sand and compacted to 95 percent of its maximum unit weight.

3.27 REMOVE EXISTING FIRE HYDRANTS

- A. Fire hydrants on the existing water main shall be removed by excavating and removing the existing fire hydrant, gate valve, and valve box.
 - 1. The existing hydrant lead shall be capped and blocked.
 - 2. The fire hydrant, valve, and box shall be salvaged and delivered to a location as designated by the Owner.
 - 3. The excavation shall be backfilled with sand and compacted to 95 percent of its maximum unit weight.

3.28 RELOCATION OF FIRE HYDRANTS

- A. Relocation of hydrants shall include the provision of new hydrant shoes, frost jacket and restraints. 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. After the pipe has been laid and backfilled, the pipe shall be hydrostatically tested for leakage.
 - 2. A meeting shall be held by Engineer, Contractor, affected subcontractors and Owner prior to any testing of mains, valves, hydrants and appurtenances.
 - 3. Contractor shall notify Engineer in writing at least 48 hours prior to hydrostatic testing of mains, valves, hydrants and appurtenances.
 - 4. Contractor shall furnish the pump, pipe connection, hydrants, valves and any other necessary apparatus including gages and meters and all personnel necessary for conducting the test.

5. Before applying the test pressure, all air shall be expelled from the pipe. If necessary to accomplish this, taps shall be made at points of higher elevation and afterwards plugged.
 6. Hydrostatic testing shall be witnessed and accepted by Engineer.
 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. Hydrostatic testing shall conform to AWWA C600.
- B. Testing Ductile Iron Water Main
1. The test shall be made at a pressure of 150 psi gage minimum. The full pressure shall be held for at least two (2) hours.
 2. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by the Contractor with sound material and the test shall be repeated until specified requirements are met.
 3. The maximum permissible leakage measured by water meter from the section of main tested under pressure, shall not exceed a rate of 10.49 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) for each section tested.
- C. Testing PVC Water Main
1. The test shall be made at a pressure of 150 psi gage minimum. The full pressure shall be held for at least two (2) hours.
 2. Any faulty pipe fitting, gate valves or other accessories which permit leaks during testing shall be replaced by the Contractor with sound material and the test shall be repeated until specified requirements are met.
 3. The maximum permissible leakage measured by water meter from the section of main tested under pressure, shall not exceed a rate of 10.5 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) for each section tested.

3.30 FLUSHING

- A. After completion of water main installation , flush the new mains, valves, hydrants and appurtenances completely.
 1. Flushing shall be completed prior to hydrostatic pressure testing and chlorination.
 2. Contractor shall notify Engineer in writing at least 24 hours prior to flushing mains, valves, hydrants and appurtenances.
 3. Flushing shall be witnessed and accepted by Engineer.
- B. Heavily chlorinated water discharged from a disinfected system shall be controlled adequately to protect any surface water resource or adjacent property from potential environmental damage, or from creation of a hazard to traffic.
- C. Remove and dispose of all temporary installations at completion of the flushing operation.
- D. After flushing, and prior to final approval of the system, the Contractor shall pump down all fire hydrants and verify that the hydrant valve is properly seated to prevent the hydrant standpipe from filling with water.

3.31 DISINFECTION

- A. Contractor shall disinfect 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 introduction of a chlorine-water solution throughout the water main piping.

- B. The liquid mixture shall be applied by means of a solution-feed chlorinating device. Contractor shall install corporation stop and feed chlorine solution through the corporation stop at the beginning of the main or valved section.
- C. A slow flow of water shall be let into the main approximately at the point of injection of the chlorine solution, at a rate such that the chlorine dosage of the entering water shall be at least 25 parts per million (ppm). An open discharge shall be maintained at the far end of the section of main being chlorinated, and the introduction of chlorine solution and water shall continue until the water discharging at the far end shall carry the required dosage of chlorine.
- D. As the main is filled with chlorinated water, each outlet from the main shall be opened and sufficient water drawn off to assure that the full dosage of chlorine reaches each outlet.
- E. Back pressure causing a reversal of flow in the main being chlorinated shall be prevented, and pressure in the main shall be held down to a point which will make it impossible for chlorinated water to be forced into other sections of the main or water system.
- F. The chlorine treated water shall remain in the main at least 24 hours, and at the end of that time the chlorine residual at pipe extremities and other representative points shall be at least 10 ppm. If the chlorine residual less than 10 ppm at the end of 24 hours, further application of chlorine shall be made and the retention period repeated until the required 10 ppm residual is obtained.
- G. Should the initial treatment of all or any section of the mains, in the opinion of the Engineer, prove ineffective, the chlorination procedure shall be repeated until confirmed tests show that water sampled from the new mains conforms to the foregoing requirements.
- H. Contractor shall collect water samples and cause analyses to be made at his own expense.
- I. Testing laboratory and sample collection shall meet the approval of public health authorities having jurisdiction.

3.32 WATER FOR CLEANING, TESTING AND DISINFECTION

- A. Water for cleaning, testing and disinfection shall be obtained from a potable water supply.
- B. 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.
- C. Contractor shall provide and remove temporary connections between the source water system and the mains constructed under this contract. Temporary connections shall meet the approval of the Engineer, the authority controlling the source water system, and Public Health authorities having jurisdiction.

3.33 BACTERIOLOGICAL ANALYSIS

- A. Prior to placing a water main in service, not less than two (2) consecutive water samples taken 24 hours apart for bacteriological analysis shall be collected and each analysis shall show results meeting state and local drinking water standards.
- B. Contractor shall collect water samples and cause analyses to be made at his own expense.
- C. Samples shall be collected in accordance with AWWA C651.
- D. Testing laboratory and sample collection shall meet the approval of public agency having jurisdiction.

3.34 CLEANING (PIGGING)

- A. When required in the plans or specifications, all water main shall be mechanically cleaned. Cleaning shall be with a metal bodied, mandrel type solid plug (pig) with scrapers. The pig shall be pulled or otherwise propelled through the entire line prior to testing or connecting to any existing water main.

END OF SECTION 33 11 00

SECTION 33 30 00
SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes sanitary sewer Work indicated on the Plans complete with pipe, joints, structures, pipe bedding, installation, television inspection and testing.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01 22 00 - Unit Prices
- B. Section 04 05 11 - Mortaring and Grouting
- 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 31 70 00 - Tunneling and Mining

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Testing shall conform to the applicable requirements of State and local authorities having jurisdiction, and shall include such tests as: deflection, air, exfiltration and infiltration.

1.04 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. ANSI - American National Standard Institute
 - 2. ASTM A48/A48M: Standard Specification for Gray Iron Castings
 - 3. ASTM A53/A53M: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 4. ASTM A153/A153M: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 5. ASTM A185: Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - 6. ASTM A615/A615M: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 7. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 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 C12: Standard Practice for Installing Vitrified Clay Pipe Lines
 - 11. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
 - 12. ASTM C55: Standard Specification for Concrete Building Brick
 - 13. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 14. ASTM C94/C94M: Standard Specification for Ready-Mixed Concrete

15. AWWA C104/A21.4: Cement–Mortar Lining for Ductile-Iron Pipe and Fittings
16. AWWA C105/A21.5: Polyethylene Encasement for Ductile-Iron Pipe Systems
17. AWWA C111/A21.11: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
18. AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast
19. AWWA C153/A21.53: Ductile-Iron Compact Fittings
20. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
21. ASTM C150/C150M: Standard Specification for Portland Cement
22. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
23. ASTM C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
24. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
25. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
26. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
27. ASTM C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
28. ASTM C828: Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
29. ASTM C969: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
30. ASTM C1091: Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines
31. ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
32. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
33. ASTM D2680: Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
34. ASTM D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
35. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
36. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
37. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
38. ASTM F679: Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
39. ASTM F949: Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
40. ASTM F1417: Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

41. ASTM F1803: Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter
42. ASTM F2487: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines
43. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition
44. NASSCO - National Association of Sewer Service Companies
45. NCPI - National Clay Pipe Institute

1.05 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.

1.06 TOLERANCES

- A. The actual grade of the invert of the sewer shall not deviate from plan grade by more than 0.1 foot per 100 feet, and not more than 0.2 feet in total for a sewer run from manhole to manhole.
- B. Alignment of sewer shall be within 0.2 foot per 100 feet and within 6 inches in total for a sewer run from manhole to manhole.

1.07 SUBMITTALS

- A. Submit independent grade checks in accordance with Part 3 of this section.
- B. Submit manufacturer's data for pipe bulkheading devices in accordance Part 3 of this Section.
- C. A complete field report of the location of all wyes, risers and building leads shall be submitted to the Engineer at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.
 1. The complete field report shall include witnessing by the Contractor of the ends of all building leads placed. Witnessing shall consist of recording three (3) horizontal distances to the nearest 1 foot with the lines of measurement at minimum angles of 45 degrees with respect to one another.
 2. Witnessing shall also include recording of the depth to nearest 6 inches from the invert at the end of the lead to the finish ground above the end of the lead.
 3. No payment will be made for un-witnessed installation or for improperly witnessed installations.
- D. As part of the television inspection, a wye location report shall be submitted to the Engineer. The report shall contain the precise location of each wye, notes, photographs, and other pertinent information.
- E. Submit two (2) copies of the laboratory test reports required per Part 1 of this Section to the Engineer.
- F. Shop Drawings shall be provided of all manhole tees.

1.08 STORAGE OF MATERIALS

- A. Piping material shall not be stacked higher than 4 feet. Suitable racks, chairs, and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.
- B. All joint and sealing materials used in the sanitary sewer system shall be protected from sunlight and stored in cool and clean place until ready for installation.

1.09 HANDLING OF MATERIAL

- A. Load and unload piping using suitably approved hoists, skids, etc. Piping shall not be dropped, bumped or allowed to impact against itself. Damaged piping not be used by the Contractor.

- B. Lifting devices shall be suited to the Work and shall 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 to specify in detail the various types of sewer pipe, joints, manholes, etc. which have been indicated throughout the Plans and Specifications. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 DUCTILE IRON PIPE SYSTEM

- A. Ductile Iron Pipe shall be AWWA C151/A21.51, with cement mortar lining inside, and 1-mil (25 µm) minimum thickness asphaltic coating outside. Pipe shall have a minimum wall thickness class for the pipe nominal inside diameter as indicated on the Plans or specified in the Proposal.
- B. Mechanical joints for ductile iron pipe shall be compression gasket type, conforming to AWWA C111/A21.11 except that slots with the same width as the diameter of the bolt holes in mechanical joints shall not be allowed in the bell flange.
- C. Push-on, compression gasket type joints shall conform to AWWA C111/A21.11 with spigot of pipe marked to visually determine when the spigot is fully seated in the bell of the adjoining section.
- D. Fittings and plugs shall be ductile iron compact fittings, mechanical joint, pressure rating of 350 psi, conforming to AWWA C153/A21.53, and rubber gasket joints conforming to AWWA C111/A21.11, with double thickness cement mortar lining and coal tar enamel coating on the outside of fittings.
- E. Flexible ball and retainer type joints shall be ball and retainer type, boltless, locking, and capable of being deflected up to 15 degrees.
- F. Cement mortar linings for ductile iron pipe shall conform to the requirements of AWWA C104/A21.4 of the thickness specified and shall be permanently set prior to the application of any additional pipe coating.

2.03 CLAY PIPE SYSTEMS

- A. Pipe shall conform to ASTM C700, extra strength vitrified clay pipe.
- B. Joints for all clay pipe shall meet the requirements of ASTM C425.
 - 1. Joints for house leads shall be limited to approved compression type joints with the sealing element bonded to the bearing surfaces.
- C. Only lubricant as supplied by the pipe manufacturer shall be used on the bell and spigot in making up joints and the joints shall be coupled in accordance with the pipe manufacturer's requirements.
- D. Wyes and tees shall be manufactured to the same standards as the pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.04 PRECAST CONCRETE PIPE SYSTEMS

- A. Non-reinforced Concrete Pipe:
 - 1. Pipe shall conform to ASTM C14, Class III, nonreinforced concrete sewer pipe.
- B. Reinforced Precast Concrete Pipe System:
 - 1. Pipe 12 inch through 30 inch diameter shall be ASTM C76, Class II through V (as specified on the plans), Wall B or Wall C, circular reinforced.

2. Pipe 36 inch through 108 inch diameter shall be ASTM C76, Class I through V (as specified on the plans), Wall B or Wall C, circular or elliptical reinforced.
 - a. When elliptical reinforcement is used, the following method of indexing the steel and the pipe barrel shall be used:
 - 1) A dummy lift pin form shall be set in the outer pipe wall form projecting into the pipe wall a minimum 1-3/4 inches and a maximum of . An additional spacer chair shall be welded to the elliptical steel cage at the proper location so as 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, for providing a means of indexing the pipe in the field to assure proper placement of the pipe.
 - 3) Prior to shipment of the pipe, they shall be striped along the inside top with a minimum wide indelible marker so that final inspection of the pipe orientation can be made following completion of the installation.
3. For pipe 114 inches or larger in diameter, the design information in accordance with Section 6 of ASTM C76 shall be submitted to the Engineer for approval, prior to fabrication. The design of pipes shall meet the D-load requirements for the class of pipe indicated on the Plans.

C. Joints for Concrete Pipe:

1. Premium joints for concrete pipe shall be ASTM C443 limited as follows:
 - a. Section 6.1 of ASTM C443, "Physical Requirements for Gaskets," shall be replaced with Section 6.9 of ASTM C361, "Rubber Gaskets." Also, Section 5 of ASTM C443 shall be limited to a modified grooved tongue to receive an "O" ring rubber gasket.
2. For concrete pipe sizes 12 inch through 24 inch, the modified grooved tongue and bell ends of the pipe shall be made smooth and shall not have over a 3-1/2 degree slope formed to fit the rubber gasket to tolerances as determined by the manufacturer. Pipe tongue shall not be out of round by more than $\pm 1/16$ inch.
3. For pipe sizes 27 inch through 108 inch , the modified groove and bell ends of the pipe shall be smooth and shall not have over a 2-degree slope, formed to fit the rubber gasket to tolerances as determined by the manufacturer.
4. For pipe sizes and larger, the tongue shall be reinforced with an amount of circular steel equivalent in area to the inner steel cage specified for the pipe barrel and the bell shall be reinforced with an amount of circular steel equivalent in area to the outer steel cage specified for the pipe barrel.
5. For pipe sizes under 36 inches in diameter, including C14-XM5 extra strength, the bell or tongue shall be reinforced. Where the reinforcing steel for the tongue, barrel and bell is not continuous, the steel shall be lapped a minimum of 2 inches.
6. Only lubricant, as supplied by the pipe manufacturer, shall be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirements.
7. Joints in concrete pipe 36 inches in diameter and larger shall have the inside annular space filled with cement mortar and troweled flush. Mortar shall consist of 1-part Portland Cement and two (2) parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for dry packing.

D. Wyes and Tees:

1. Wyes and tees shall be manufactured to the same standards as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.05 ABS PIPE

- A. Acrylonitrile-Butadiene-Styrene (ABS) truss pipe shall be in accordance with ASTM D2680. The pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. The truss voids are filled with lightweight concrete to provide additional compressive strength and bracing.
- B. Joints for ABS composite pipe shall be in accordance with ASTM D2680, Type S.C., a solvent-cemented joint in which pipe solvent cements into a coupling socket to form the joint closure. Installation of the solvent cement shall be in strict accord with the manufacturer's recommendations.
- C. Wyes and tees shall be manufactured to the same standard as the pipe. Spurs shall be of the same size and type as the house lead/riser pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe.

2.06 PVC TRUSS PIPE

- A. Polyvinyl Chloride (PVC) truss pipe shall be in accordance with ASTM D2680. The pipe shall be of a double wall construction, braced with a truss-type structure with all three (3) formed in one (1) extrusion. The truss voids are filled with lightweight concrete to provide additional compressive strength and bracing.
- B. Joints for Polyvinyl Chloride (PVC) pipe shall be elastomeric gasketed conforming to ASTM D3212, push on type joint.
- C. Wyes or tees shall be a molded wye or tee fitting in accordance with ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2.07 PVC SOLID WALL PIPE

- A. PVC Solid Wall Pipe in sizes 6 through 15 inch shall be in accordance with ASTM D3034, SDR 35, and in sizes 18 through 27 inch shall be in accordance with ASTM F679, SDR35, polyvinyl chloride pipe (PVC).
- B. Joints for polyvinyl chloride pipe (PVC) shall be ASTM D3212, push-on type. A joint in which an elastomeric ring gasket is compressed in the annular space between a bell end or socket and a spigot end of pipe.
- C. Wyes or tees shall be a molded wye or tee fitting in accordance with ASTM D2680, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Wye and tee fittings shall be furnished with the spurs securely fastened by the manufacturer to the barrel of the pipe. There shall be no projection on the inner surface of the pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.

2.08 DUAL WALL CORRUGATED PVC PIPE – SMOOTH INTERIOR

- A. Dual Wall Corrugated PVC Pipe (DWCP) shall be a single extrusion of PVC with a smooth interior and corrugated outer walls. Corrugated outer profile shall be annular and seamless. Pipe and fittings shall be in accordance with ASTM F949. Joints shall be bell and spigot type with an elastomeric gasket meeting the requirements of ASTM F477 and be suitable for sanitary sewer service and the testing requirements of this section.

- B. Wyes or tees shall be a molded wye or tee fitting in accordance with ASTM F949, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.
- C. Connections to manholes that utilize a rubber boot (Kor-N-Seal) shall be accomplished by sealing the rubber boot to a rubber gasket installed on the outside of the pipe with the stainless steel band and clamp assemblies on the outside of the rubber boot.
 - 1. For sizes 21 inch and larger use two stainless band assemblies (with two screw clamp assemblies per band assembly) on the outside of the rubber boot, with the screw clamps staggered around the pipe so that the take-up pressure is equalized.
- D. Connections to manholes with an A-Lok type connection shall use a manhole sleeve designed for connection to an A-Lok assembly with the recommended A-Lok ring number.
- E. Acceptable manufacturers of Dual wall corrugated PVC pipe include Contech A2000, Uponor ETI Ultra-Corr or Engineer approved equal.

2.09 CLOSED PROFILE PVC PIPE

- A. Closed Profile PVC Pipe (CPPP) and fittings shall be manufactured in accordance with ASTM F1803.
- B. PVC profile wall pipe shall be made from a compound meeting the requirements of cell classification 12364A as defined by ASTM D1784.
- C. PVC profile wall pipe joints shall be rubber gasketed, bell and spigot type joints.
- D. Gaskets shall meet the requirements of ASTM F477 and be molded into a circular form or extruded to the proper section, then spliced into circular form, and shall be made of a properly cured high grade elastomeric compound.
- E. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. Field installed gaskets and field cut beveled lengths of pipe shall be done in accordance with the manufacturer's instructions and recommended equipment and materials.
- F. Pipe gaskets and spigots will be thoroughly cleaned and lubricated before assembly.
- G. Manhole connections shall be made with ALOK or Press Seal PSX rubber couplings only. No other connections are allowed.
- H. The pipe shall be handled with nylon slings. Cables or chains shall not be used.
- I. Lateral connections to PVC profile wall pipe may be made using Inserta-tee as manufactured by the Fowler Manufacturing Company, or the Predco Fast Fit tap system.
 - 1. Saddle or tapping tees will be installed per manufacturer's recommendation.
- J. Exposed channels in field cut ends need to be plugged with 3M Industrial Sealant DP-605 or approved equal.
- K. Acceptable Manufacturer of Closed Profile PVC Pipe is Lamson Vylon Pipe.

2.10 STRUCTURES

- A. Material for sanitary sewer structures shall conform to the requirements as indicated on the plans and as specified below. Precast concrete structures are required except when constructing a structure over an existing sewer which may require limited use of concrete block or brick as approved by the Engineer.
- B. Concrete Brick:
 - 1. Concrete brick shall be in accordance with ASTM C55, Grade S-II, solid units of nominal 3-inch (75 mm) thickness.
- C. Concrete Block:

1. Block shall conform to ASTM C139, Portland cement conforming to ASTM C150/C150M, Type II. Blocks shall be solid curved blocks with the inside and outside surfaces parallel and curved to the required radii. The blocks shall have a groove or other approved type of joint at the ends.

D. Precast Concrete

1. Precast concrete manhole, flat top slabs, risers, cone, transition sections and bottom sections shall conform to ASTM C478/C478M, and shall be circular with circular reinforcement.
 - a. For depths greater than 32 feet, manhole shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
 - b. Base slab shall be minimum 8 inches thick for depths up to 25 feet and minimum 12 inches thick for depths greater than 25 feet.
2. Transition sections, reducers and flat top slabs shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
3. Precast doghouse sections shall be used for:
 - a. connections to existing sewer 15 inches and smaller on straight through runs and depths no greater than 20 feet;
 - b. and on right angle runs, with a maximum of four cutouts for depths up to 12 feet.
 - c. Openings in precast doghouse sections shall be cast in the pipe before curing and no breaking or chipping of sections will be allowed after the manhole section has cured.
 - d. The size of the opening shall be cast as indicated on the Plans.
4. Precast bottom sections shall be cast with the bottom end flat to provide bearing of the full wall thickness.
5. The openings for sewer pipe shall be cast in the manhole section by the manufacturer.
6. Connections to manholes for pipe sizes 6 through 24 inch shall use a mechanically compressible flexible joint, as indicated on the Plans.
7. Connections to manholes for pipe sizes 27 inch and larger shall be grouted, as indicated on the Plans.
8. Manhole sections shall have modified grooved tongue joints with "O" ring gaskets or a tongue and groove joint with a Butyl Rubber based gasket type sealant meeting the requirements of ASTM C990 and having a nominal size of 1 inch.
9. Eccentric cone sections of a manhole shall have modified grooved tongue joints with "O" ring gaskets and be provided with 4-stud inserts cast in the top. The top shall have a smooth finished surface.
10. Concrete grade rings shall have smooth finished top and bottom surfaces. Grade rings shall be provided with "O" ring gaskets.
11. Manholes on sewers to be subjected to air tests shall be equipped with a 1/2 inch diameter galvanized capped pipe nipple extending through the manhole wall, 3 inches into the manhole, and at an elevation equal to the top of the sewer pipe.
12. Pipe, 48 inches in diameter or larger, shall be installed as an integral part of the manhole (manhole tees) which shall be constructed of 3,500 psi concrete placed in one continuous pour to 12 inches above the top of pipe as indicated on the Plans.
13. Precast manhole tees will be allowed on straight through runs with no angle at the manhole and where stubs or openings in manhole are above the tee section.
14. Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. The precast tees must be a monolithic pour with wire

cage inspection prior to concrete placement. Joints for tee shall be the same as the joints on the sanitary sewer.

E. Manhole Steps:

1. Cast iron manhole steps shall conform to ASTM A48/A48M, Class 30, gray iron with a minimum cross section dimension of 1 inch in any direction.
2. Steel reinforced plastic manhole steps shall be 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 and shall be in accordance with ASTM C478/C478M.
3. Manhole steps shall be of the types and sizes indicated on the Plans and shall comply with applicable Michigan Occupational Safety and Health Standards (MIOSHA).

F. Manhole Frames and Covers:

1. Manhole frames and covers shall conform to ASTM A48/A48M, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, cold sheets, holes and other defects.
2. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.
3. For sanitary manholes, use a bolted waterproof frame with a pressure tight cover. Bolted down frame and cover shall be installed as indicated on the Plans.

2.11 STEEL PIPE

- A. Pipe shall conform to ASTM A53/A53M, black and hot-dipped galvanized welded and seamless pipe of standard weight.

2.12 BOLT, STUDS, NUTS

- A. Bolt, studs, and nuts shall conform to the following ASTM Standards:
1. Cadmium Plating: ASTM B766, Grade N.S.
 2. Zinc Coating: ASTM A153/A153M or ASTM B633, Type G.S.

2.13 CONCRETE

- A. Concrete shall 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.

2.14 CONCRETE REINFORCEMENT

- A. Use ASTM A615/A615M, Grade 60 for bars and ASTM A1064/A1064M for welded wire fabric.
- B. In accordance with MDOT Section 905, use ASTM A615/A615M, Grade 60 for bars and ASTM A185 for welded wire fabric.

2.15 FLOWABLE FILL

A. Abandoned Water Mains:

1. Materials:
 - a. Cement: Cement shall conform to ASTM C150/C150M or ASTM C595/C595M
 - b. Fly Ash: Fly ash shall have a maximum loss on ignition of 12 percent and meeting the other requirements of ASTM C618 (Class F)
 - c. The water shall meet the 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. The temperature of the flowable fill mixture as manufactured and delivered shall be at least 50 degrees F.
- C. The flowable fill can be mixed by pugmill, central concrete mixer, ready mix truck, turbine mixer, or other acceptable equipment or method.
- D. Contractor shall submit a history of the mix design for seven (7) day and 28 day strengths, together with any other technical information. The design mix shall also be included as part of the Contractor's submittals for project.

PART 3 EXECUTION

3.01 VERIFICATION OF EXCAVATION AND BEDDING

- A. Prior to the installation of any sanitary 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 sanitary sewer materials to be installed.
- C. Correct all defects and deficiencies before proceeding with the Work.

3.02 EXISTING SANITARY SEWERS

- A. Contractor shall expose the existing sanitary sewer and structures to which the new Work is to be connected and notify the Engineer of same. Engineer will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as to the necessary adjustments required to align the new sanitary sewer work with the existing system.
- B. Connecting to an existing manhole requires removing the existing flow channel and constructing a new flow channel as necessary.
- C. When connecting a new sewer to an existing sewer or a new building lead to an existing building lead, where the pipe joints are not compatible, use a "Fernco" rubber adapter. When connecting clay to clay, concrete to concrete or plastic to plastic, use stainless steel shear ring type couplers.

3.03 VERIFICATION OF PIPE CLASS AND JOINTS

- A. Prior to the installation of any sanitary sewer piping, ascertain that the class of pipe, joint material and bedding are as specified herein and as indicated on the Plans.

3.04 PREPARATION OF PIPE ENDS

- A. The outside surface of the spigot end and the inside surface of the bell end shall be cleaned and free of any foreign material, other than sealant recommended by the manufacturer, prior to installation.

3.05 EXAMINATION OF MATERIAL

- A. Pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective or damaged material shall be rejected and removed from the Project by the Contractor.

3.06 INSTALLATION - GENERAL

- A. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.
- B. Pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid shall be checked by the Contractor with line and grade pole or laser system to insure proper result is obtained.

1. When employing a laser system, the Contractor shall have an alternate and independent means of checking the line and grade. Contractor shall check line and grade every 100 feet.
- C. The finished work shall be straight and shall be sighted through between manholes.
- D. Construction shall begin at the outlet end and proceed upstream with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the bedding.
- E. Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.
- F. After laying of pipe, care shall be taken so as not to disturb its line and grade. Any pipe found off grade or out of line shall be re-laid.
- G. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize airborne particles shall be employed.
- H. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of pipe materials being cut and according to the best trade practices.
- I. When cutting of pipe or fittings, care shall be taken to prevent damage to the lining and the exterior surface. Damage to either shall be cause for rejection of complete section.
- J. During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water and sewage. A dewatering system, in accordance with Section 31 23 19 - Dewatering, shall be provided and maintained by the Contractor. The dewatering system shall remain in operation until the trench is backfilled.
- K. Where pipe is located in a flood plain or otherwise susceptible to flotation it shall be anchored against flotation.
- L. Backfill shall be as indicated on the Plans and as specified in Section 31 23 33 - Trenching and Backfilling.

3.07 PIPE LAYING

- A. Rigid Pipe:
 1. Installation of rigid pipe shall conform to ASTM C12.
 2. All pipe shall be jointed by means of a resilient gasket. The resilient gasket shall be lubricated and installed to form a watertight joint between the bell and spigot of the pipe. The bell of the pipe in place shall be cleaned and properly lubricated prior to the installation of the next pipe spigot. The pipe shall be centered in the bell or groove. After the spigot is well entered into the bell and the gasket is fully compressed and brought to final shape, check the gasket for proper position around the full circumference of the joint. Complete installation by pushing the pipe tightly together to form a smooth and continuous invert.
 3. Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes on the top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than five (5) degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs and grouted.
 4. When adapters are required to properly connect the new pipe to an existing pipe of other materials or manufacture, the nominal inside diameter of adapters shall be the same size as the nominal pipe diameter to which it is to be connected.
- B. Flexible Pipe:

1. Installation of flexible pipe shall conform to ASTM D2321.
2. Except as otherwise specified herein, installation of ABS and PVC piping shall be made in complete accordance with the published installation guide of the pipe manufacturer.
3. Joints for ABS pipe shall be made by first applying a coat of primer to the inside of the socket and to the outside of the spigot end of the pipe.
 - a. Without delay, apply a coating of cement to the same surfaces in sufficient quantity that when the spigot is fully inserted into the socket, a bead of excess cement will form around the complete circumference of the outside junction of the spigot and socket.
 - b. Remove the excess cement and allow the assembly to cure 24 hours.
4. Joints for PVC pipe shall be made by using a lubricant immediately before joining.
 - a. Apply lubricant on the bell and spigot, coating the entire circumference of the bell and spigot bevel plus 1 inch behind the taper. Insert lubricated spigot into the bell, and using normal force insert spigot until insertion stripe mark is flush with the bell entrance.
5. When jointing ABS or PVC pipe, rotate the pipe when inserting it approximately 1/4 to 1/2 turns.
6. Taps to previously installed ABS and PVC pipes, where in-line fittings are not provided, shall be made with chemically welded saddle fittings unless otherwise indicated on the Plans.
 - a. Holes for saddle connections shall be by mechanical hole cutters, or by keyhole saw or saber saw.
 - b. Holes for saddles shall be laid out with a template and shall be deburred and beveled to provide a smooth hole shaped to conform precisely to the fitting.
 - c. After the cemented saddle has been fixed to the pipe surface, quickly install band clamps each side of the saddle and tighten.

3.08 PIPE BEDDING

- A. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 23 33 - Trenching and Backfilling.
- B. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations.
- C. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 23 33 - Trenching and Backfilling.
- D. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.
- E. A continuous and uniform bedding as specified in Section 31 23 33 - Trenching and Backfilling, shall be provided in the trench for all buried pipe.

3.09 INSTALLATION OF DUCTILE IRON PIPE

- A. Ductile iron sewer main shall be installed in accordance with the most current version of AWWA C600.
- B. Push-on-joints shall be made by means of a compression type push-on resilient gasket. Gasket shall be prelubricated before installation using a lubricant recommended by the pipe manufacturer. Seated joint shall be identified by the visible mark on the spigot of the installed pipe section.
- C. Mechanical joints shall be made with bolts, molded resilient gasket and cast iron follower gland. Nuts shall be screwed up finger tight before using a wrench. The gland and rubber gasket shall

be brought up evenly at all points around the bell flange and then torqued per the manufacturer's recommendations.

- D. Exposed portions of bolts shall be covered with mastic.
- E. Flexible joint pipe shall be assembled, handled and installed in accordance with the printed recommendations which accompanies the pipe and is provided by the manufacturer of the piping materials being installed. Methods of handling and installation shall be acceptable to the Engineer.

3.10 INSTALLATION OF RESTRAINED JOINTS

- A. Restrained joints shall be provided where indicated on the plans. Joints shall be assembled in strict accordance with manufacturer's directions. Joints shall be fully extended after assembly.

3.11 POLYETHYLENE ENCASEMENT

- A. Where called for on the plans, ductile iron sewer main and fittings shall be encased in a polyethylene film tube.
- B. The polyethylene film tube shall be installed 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. Service taps, bends, tees and other connections shall be made to polyethylene encased pipe in accordance with section 4.4.6 of AWWA C105/A21.5
- C. Cost of the polyethylene encasement shall be incidental to the sewer main.

3.12 INSTALLING PVC PIPE IN CASINGS

- A. When installed inside of a casing, the pipe shall not rest on the bell as it is pushed into the casing. Casing spacers shall be used in accordance with the manufacturer's recommendations.
- B. Three spacers should be used per pipe length. Follow the casing spacer manufacturers' recommendation. One of the spacers must be secured to the pipe at the second homing mark; the others should be equally spaced.
- C. Joint restraint shall be used in the casing.
- D. Annular space between PVC pipe and the casing pipe shall be filled with cellular grout. After installation of pipe in casing, the casing shall be kept dewatered until grouting is completed. Grout shall be placed by gravity flow following recommendations supplied by the pipe manufacturer. The pipe shall be kept full of water during the grouting process. Make certain the void is completely filled around the first pipe before moving on to the next.
 - 1. Block the pipe in place with casing spacers.
 - 2. Fill the entire pipe segment to be grouted with water.
 - 3. Use a lightweight cellular grout mix.
 - 4. Gravity flow or pump the grout into the annular space. Long runs may require pumping – keep the pressure less than 5 psi in the annular space. Pressure shall be monitored with an approved pressure gauge. Extreme caution is advised in pumping grouts in this annular space.
 - 5. All grouting shall be in accordance with pipe manufacturer's procedures and recommendations.
- E. A lightweight cellular grout minimizes floatation forces and can be gravity flowed or pumped at extremely low pressures without collapsing the carrier pipe. The grouting pressures must be closely monitored with a sensitive pressure gauge with 1 to 2 psi graduations. When not controlled, pressure grouting can collapse the PVC carrier pipe.
- F. Contractor shall submit for Shop Drawing approval his procedure for placing the grout, joint restraint, and casing spacers for pipes installed in bores.

3.13 MANHOLE STRUCTURES

- A. Construct sanitary sewer manhole and other sanitary structures to the grades, lines and levels indicated on the Plans, or as specified herein.
- B. Structures shall be precast concrete, complete with concrete bases, reinforcing, frames, covers, and adjustment rings, as shown and as required for a complete installation.
- C. Sanitary manholes as called for on the Plans shall carry a stub opening as specified herein.
- D. Wye openings in manholes are prohibited unless indicated on Plans.
- E. Sanitary sewer structures shall conform to the type of material and dimensions indicated on the Plans. Construct as detailed on the Plans.
- F. Manholes shall be completed and ready for final inspection either before 600 feet of additional sewer construction is completed or within one (1) week after the manhole is constructed, whichever comes first.
- G. Block Structures:
 - 1. Sanitary manholes may only be constructed with block where specifically shown on the plans or where approved by the Engineer.
 - 2. The first course of concrete block shall be placed on the prepared base in a full bed of mortar.
 - 3. Mortar joints shall be full and closed in all courses. Courses shall be level throughout.
 - 4. Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable. Joints shall be uniform in thickness throughout the structure. Strike all joints and properly point to provide true, smooth surfaces.
 - 5. Prior to applying plaster coat, block shall be thoroughly wetted with water and the surface allowed to dry sufficiently to effect proper bonding.
 - 6. Cement mortar plaster coat shall be applied to the exterior surfaces of all brick and/or concrete block sections of all manholes. Plaster coat shall be 1/2 inch thick.
- H. Where precast doghouse sections cannot be used, the manhole shall be brick or block to 8 inches above top of highest pipe. Above that point manholes shall be precast concrete as shown on the plans.
- I. Provide and install all cast iron covers, frames, adjusting rings, and anchors to the elevation indicated on the Plans, or as specified herein. Castings shall be set on 1 inch diameter rubber "O" ring gasket, resting on adjustment rings. The casting shall be anchored to the precast concrete cone section as indicated on the Plans.
- J. Steps are to be installed at the plant by the manufacturer of precast units. Field install steps in other than precast structures of the types and in the locations indicated on the Plans.
- K. Concrete flow channels shall be constructed in each manhole, as indicated on the Plans.
 - 1. For manholes with outlet pipe diameter of 24 inches or less, construct concrete flow channel straight through a manhole to conform as closely as possible in shape, and slope to that of the connecting sewers.
 - 2. The channel walls shall be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers.
 - 3. The concrete flow channel shall be constructed with a 3/4 to 1-1/4 inch gap provided at the pipe ends to maintain joint flexibility.
- L. For manholes with outlet pipe diameters from 27 to 42 inches or for manholes constructed over existing sewers to 42 inches in diameter, the channel shall be constructed by filling around the pipe to the spring line and splitting the pipe at the spring line and removing the top half after the manhole is constructed.

3.14 SANITARY SEWER STUB OPENING

- A. Stub openings shall be at least two (2) pipe lengths, with a minimum length of 10 feet (unless otherwise indicated on the Plan), and the first joint located approximately 18 inches from the outside manhole wall. The end of the stub shall have a manufactured bell, which shall be plugged with a watertight manufacturer plug that is blocked to prevent movement.

3.15 VENT ASSEMBLY

- A. Provide materials and construct vent assemblies where indicated on the Plans. Install all piping, fittings, joints, vents, etc., as detailed.
- B. Vent assemblies shall be installed on undisturbed earth and provided with restraints as indicated on the Plans, and as required for a complete installation.
- C. Vent assemblies shall be connected to manholes as indicated on the Plans.

3.16 DROP CONNECTION ASSEMBLY

- A. Provide materials and construct drop connection assembly where indicated on the Plans. Install all piping, fittings, joints, etc., as detailed.
- B. Tapping of existing manholes for drop connections shall be made by drilling holes through the wall of the manhole at 4 inches centers along the periphery of the opening, to create a plane of weakness joint, before breaking out section. Nonshrink grout shall be used to seal the opening and a 3,500 psi concrete collar 12 inches thick shall be poured around the pipe. Drop connections to existing or new manholes shall be made as indicated on the Plans.

3.17 BULKHEADS

- A. A solid masonry or approved water and airtight bulkhead shall be placed at each point of beginning and at each stub that is constructed or as indicated on the Plans.
- B. At the completion of construction and testing, all the bulkheads shall be removed, unless otherwise indicated on the Plans or as directed by the Engineer.

3.18 WYES

- A. One 6 inch wye or tee branch shall be provided for each lot or parcel 100 feet or less in width that is served by the sewer, or every 100 feet for lots or parcels in excess of 100 feet in width that is served by the sewer, unless otherwise indicated on the Plans or specified.
- B. In all cases, unless otherwise indicated, wyes shall be placed as near as practical to the lower 1/3 point of vacant lots or parcels to be served, and it shall be the responsibility of the Contractor to see that the wyes are so placed.
- C. Wyes to developed lots or parcels shall be placed at the location nearest the existing sanitary service lead.
- D. If the Contractor fails to place any wyes as herein outlined he shall return to the site and place additional wyes, in an approved manner, at his expense.
- E. If a concrete pipe with an inset opening is being used, a compression type joint shall be cast into bell end of the opening. Wye openings shall be closed with a 6 inch stopper, as recommended by the manufacturer, to make a watertight closure.

3.19 RISERS

- A. Risers shall be installed where the sewer is more than 12 feet below the established grade or future grade, and carried to between 9 to 10 feet of the established grade or future grade, as indicated on the Plans. Pipe 6 inches in diameter, with approved compression type joints, shall be installed in the manner indicated on the Plans.
- B. Riser openings shall be closed with a stopper, as recommended by the manufacturer, to make a watertight closure.

3.20 BUILDING LEADS

- A. Building leads shall be 6 inches diameter pipe and shall be laid on a uniform slope of 1/8 inch per foot unless greater slope will provide depth considered adequate by the Engineer.
- B. Building leads shall be provided to within 1 foot of property line for all lots or parcels on both sides of the street, unless otherwise indicated on the Plans. If in an easement, the lead shall be provided to within of the easement line.
- C. Building lead depth, 4 feet horizontal from property line or permanent easement line, shall be between 8 to 9 feet deep. From this point, a 45-degree bend shall be placed and a short length of pipe such that the end depth will be between 5 to 6 feet deep.
- D. Building leads under or within 5 feet of concrete or asphalt pavements shall be installed by boring or tunneling.
- E. Each building lead shall be closed with a stopper, as recommended by the manufacturer, to make a watertight closure.

3.21 WYE, RISER OR BUILDING LEAD MARKER

- A. Unless otherwise indicated in the Plans or Specifications, prior to the backfilling of a wye, riser or building lead, a 2 by 2 inch (minimum cross section) wooden marker shall be placed from a point immediately in front of the service connection to 1 foot below the finish ground surface. Do not rest the marker on any portion of the service connection or stopper.

3.22 ABANDONING SANITARY SEWER WITH FLOWABLE FILL

- A. Install a bulkhead in each end of the sanitary sewer to be abandoned leaving a small opening in the very top of each bulkhead
- B. Install a minimum 2 inch 2-inch (50 mm) diameter stand pipe in the top of the bulkhead of the sanitary sewer 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 air release pipe in the bulkhead in the opposite end of the sanitary sewer from the stand pipe. The air release pipe should bend up to a 90 degree angle with the end of the pipe being a minimum of 6 inches above the top of the sanitary sewer.
- D. Using the stand pipe, pump flowable fill into the sanitary sewer to be abandoned. The flowable fill shall be pumped into the sanitary sewer until free water flows from the air release pipe at the opposite end. Continue filling the sanitary sewer until the material released at the air release pipe is representative of the flowable fill being introduced at the fill end of the sanitary sewer.
- E. Remove the stand pipe and air release pipe and plug the hole in both bulkheads.

3.23 ABANDON EXISTING MANHOLES

- A. Manholes on the existing sanitary sewer shall be abandoned and the structures shall be removed in accordance with the following:
 - 1. Removal of existing structures shall consist of removing and salvaging the existing frame and cover.
 - 2. Ends of the existing sanitary sewer shall be bulkheaded.
 - 3. Top of masonry shall be broken down to an elevation at least 30 inches below the proposed subgrade or finished grade.
 - 4. Abandoned structure shall be backfilled with flowable fill to 1 foot above the pipes and the remainder of the structure with sand-cement mixture at a 10 to 1 ratio to subgrade elevation.

3.24 FIELD QUALITY CONTROL

- A. After all the pipe, structures, and leads have been laid, constructed and backfilled, the system shall be final inspected and tested. The inspection and testing shall consist of the following parts:
 - 1. first inspection
 - 2. television inspection
 - 3. testing
- B. The first inspection shall be completed and all repairs made in ample time so that the television inspection of the underground portion of the system, can be completed within four (4) weeks of the completion of the construction.
- C. Television inspection shall be considered completed when the necessary construction repairs have been made and the installation re-televised when required, and the system is acceptable for the testing phase.
 - 1. When re-television is necessary, an additional two (2) weeks will be allowed for completion.
- D. Testing of the system shall immediately follow the television inspection and shall be completed within a 2-week period.
- E. Failure to maintain a schedule in compliance with this specification will automatically cause the stoppage of other work at the particular site in question until such time as the final inspection of the completed underground portion of the system has progressed to within acceptable limits.
- F. First Inspection:
 - 1. Contractor shall have the underground portion of the sewer system ready for the first inspection within two (2) weeks after the completion of the installation of each 2,000 foot section of sewer.
 - 2. The first inspection shall consist of:
 - a. a visible and audible check of the sewers and manholes to ascertain that the manhole steps have been placed,
 - b. all lift holes plugged,
 - c. the channeling of the manhole bottoms completed,
 - d. all visible or audible leaks stopped,
 - e. all pipe has been placed straight and true to the proper grades and elevation,
 - f. the required adjusting rings and frame and cover properly installed,
 - g. all trenches and structures backfilled in a workmanlike manner
 - h. and that the system has been thoroughly cleaned.
 - 3. The first inspection shall be considered completed when all the repairs have been made and the system is ready for television inspection.
- G. Television Inspection:
 - 1. Contractor shall provide for television inspection of the various sanitary sewer lines installed under this Contract.
 - 2. Contractor shall arrange for, engage and pay all expenses involved for the services of a competent company to perform this television inspection.
 - 3. Television inspection shall be observed by representatives of the Owner, Engineer, and the Contractor. Any television viewing performed in the absence of the Engineer will not be considered as a part of the final inspection.

4. Inspection shall involve the visual observation by closed-circuit television of all sanitary sewer 8 to 30 inches in diameter inclusive, installed as a part of this Contract.
5. Prior to television inspection, the Contractor shall run water down the line to show any dips or high spots in the line. Water shall be run continuously during television inspection if necessary to determine changes in grade in the line.
6. Inspection shall be performed at a maximum rate of speed of 30 feet per minute, which will allow examination of all points of infiltration, cracked or crushed pipe, defective joints, misalignment in line or grade, location of all wye openings and any defects or items of poor workmanship which may appear.
7. Observations shall be documented per NASSCO current Pipeline Assessment Certification (PACP) requirements.
 - a. Items which, in the opinion of the Engineer, require repair shall be precisely located and photographed along with a detailed statement of the condition.
8. Contractor shall take immediate action to repair all such defects including excessive infiltration at any specific location, even though the infiltration limits as herein specified have not been exceeded for the entire length of sewer being inspected.
 - a. Following completion of the repair, the Owner or the Engineer, at their discretion, may require a second television inspection of any repaired areas. The Contractor shall arrange for and pay all costs involved in performing this re-inspection.
9. As a part of the television inspection, the precise location of each wye shall be noted in relation to the downstream manhole. These locations shall be entered on the Wye Location Sheet as supplied by the Engineer and verified by comparison with the locations as established at the time of construction.
 - a. Discrepancies in location between the field location record and the television inspection record shall be reconciled and the proper location of the wye determined as a part of the television inspection.
10. Two (2) copies of all notes, photographs, wye locations and other pertinent information shall be made as a part of the television inspection.
 - a. One (1) set of this information shall be turned over to the representative of the Engineer upon the completion of the inspection of each line.
 - b. The second copy of the information shall be held by the television inspection company until completion of the project, at which time it shall be neatly assembled and turned over to the Engineer as a complete, comprehensive report on the television inspection of the project.
11. Television inspection shall be recorded and shall be submitted in the format(s) as specified by the Engineer.
 - a. DVD Disk:
 - 1) Audio/video route survey submission shall be on DVD media meeting the following specifications:
 - (a) DVD-R or DVD+R, 4.7GB, single layer
 - (b) DVD – Video
 - (c) 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) 4x3 (720x480 pixels)

- 2) No Macrovision or other copy protection encoding. No region code or region code 1.
12. Television inspection shall be considered completed when the necessary construction repairs have been made and the installation retelevised when required, and the system is acceptable for the testing phase.

H. Testing:

1. Contractor shall provide the necessary supervision, labor, tools, equipment and the materials necessary for the tests which shall be conducted in the presence of the Engineer. Engineer shall be notified two (2) working days in advance of all testing. The following tests shall be performed and approved prior to placing any system in service:
 - a. Leakage tests shall be conducted on new sewer lines and existing lines which have not been previously approved. Sewers shall be subjected to air, exfiltration or infiltration tests, or a combination of same, prior to acceptance.
 - 1) Sewers over 24 inch diameter shall be subjected to infiltration tests.
 - 2) Sewers of 24 inch diameter or smaller, where the groundwater level above the top of the sewer is over 7 feet, shall be subjected to infiltration tests.
 - 3) Sewers of 24 inch diameter or less, where the groundwater level above the top of the sewer is 7 feet or less, shall be subjected to air tests or exfiltration tests.
 - b. Exfiltration/Infiltration Test:
 - 1) Exfiltration and Infiltration testing will be performed in accordance with ASTM C1091 for vitrified clay lines, C969 for precast concrete lines, F2487 for HDPE lines, or other appropriate standard except as specified herein.
 - 2) If an exfiltration test is performed, the maximum exfiltration rate shall be the same as the permitted from infiltration.
 - (a) For the purposes of exfiltration testing, the internal water level shall be equal to the external water level plus 7 feet as measured from the top of pipe, and the elevation must be at least as high as the highest house service.
 - 3) Maximum allowable infiltration shall not exceed 100 gallons per inch of diameter per mile of pipe between manholes per 24 hours for any section of the system and shall include the infiltration from all manholes and other appurtenances.
 - c. Air Test:
 - 1) The procedure for air testing of sewers shall be in accordance with ASTM C828 for Vitrified Clay Pipe, and ASTM F1417 for Plastic Pipe, except as follows:
 - (a) House leads shall be properly plugged and blocked to withstand the air pressure. The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole.
 - (1) Such plugs shall be designed to hold against the test pressure and shall provide an airtight seal. One (1) of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice.
 - (2) The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer.
 - (3) The pressure gauge shall have a minimum diameter of 3-1/2 inch and range of 0 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of ± 0.04 psi.

- (b) The sewer shall be pressurized to an initial test pressure of 4 psi greater than the greatest back pressure caused by groundwater over the top of the sewer pipe.
 - (1) At least two (2) minutes shall be allowed for the air pressure to stabilize.
 - (2) If necessary, air shall be added to the sewer to maintain a pressure within 1 psi of the initial test pressure.
 - (c) After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is not within 1 psi of the initial test pressure.
 - (d) The time required for the air pressure to decrease 1 psi during the Test shall not be less than the time calculated from Table 1 and the Appendices of the applicable ASTM standard as noted above.
 - (e) Manholes on sewers to be subjected to air tests shall be equipped with a capped pipe nipple extending through the manhole wall and at an elevation equal to the top of the sewer pipe. See Part 2 of this specification.
 - (1) Prior to the air test, the groundwater elevation shall be determined by blowing air through the pipe nipple to clear it and then connecting a clear plastic tube to the pipe nipple.
 - (2) The tube shall be suspended vertically in the manhole and the groundwater elevation determined by observing the water level in the tube.
 - (3) The air test pressure shall be adjusted to compensate for the maximum groundwater level above the top of the sewer pipe to be tested.
 - (4) After all tests are performed and the sewer is ready for final acceptance, the pipe nipple shall be removed and the hole in the manhole wall shall be plugged with hydraulic cement.
2. If a sewer fails to pass any of the previously described tests, the Contractor shall determine the location of the leaks, repair them and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

3.25 DEFLECTION TEST FOR PLASTIC PIPE

- A. Plastic pipe shall be tested for deflection, but no sooner than 30 days following the backfilling of the pipe.
- B. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.
- C. Optional devices for testing include a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. Mandrel shall have a minimum of nine (9) legs.

END OF SECTION 33 30 00

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 22 00 - Unit Prices
- B. Section 01 33 00 - Submittal Procedures
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 03 60 00 - Grouting
- E. Section 31 23 19 - Dewatering
- F. Section 31 23 16 - Structural Excavation and Backfill
- G. Section 31 23 33 - Trenching and Backfilling

1.03 REFERENCE STANDARDS

- A. Unless otherwise specified, the Work for this Section shall conform to the applicable portions of the following Standard Specifications:
 - 1. AASHTO M 36: Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
 - 2. AASHTO M 167/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. Complete Shop Drawings for all manhole tees shall be submitted to the Engineer.
- D. Submit shop drawings and design information for all precast concrete box sections.

1.06 STORAGE OF MATERIALS

- A. Piping material shall not be stacked higher than 4 feet or as recommended by the manufacturer, whichever is lowest. Suitable racks, chairs, and other supports shall be provided to protect preformed pipe mating surfaces from damage. Store bottom tiers off the ground, alternate tiers and chock tier ends.
- B. Jointing and sealing materials used in the storm sewer system shall be protected from sunlight and stored 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. Material shall not be dropped, bumped or allowed to impact against itself. Damaged material shall be rejected by the Engineer.
- B. Lifting devices shall be suited to the Work and shall 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. These Articles shall not be construed as allowing any alternate type of material to that which is indicated on the Plans or elsewhere in the Specifications.

2.02 CLAY PIPE

- A. Clay pipe shall conform to ASTM C700, extra strength vitrified clay pipe.
- B. Premium joints shall be compression type joints conforming to ASTM C425.
- C. When not specified, joints shall be made with cold applied pipe joint sealer. See Part 2 of this Section for requirements for cold applied pipe joint sealer.

2.03 NONREINFORCED CONCRETE PIPE SYSTEMS

- A. Pipe shall conform to ASTM C14, Class III nonreinforced concrete sewer pipe.
- B. When not specified, pipe joints shall be made with cold applied pipe joint sealer. Part 2 of this Section for requirements for joints.

2.04 REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe shall conform to ASTM C76. Pipe sizes 12 to 30 inch diameter shall be Class II thru V, Wall B or Wall C, circular reinforced. Pipe sizes 36 to 108 inch diameter shall be Class I through V, Wall B or Wall C, circular reinforced or elliptical reinforced.
- B. When elliptical reinforcement is used, the following method of indexing the steel and the pipe barrel shall be used.
 - 1. A dummy lift pin form shall be set in the outer pipe wall form projecting into the pipe wall a minimum of 1-3/4 inch and a maximum of . An additional spacer chair shall be welded to the elliptical steel cage at the proper location so as 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. Prior to shipment of the elliptically reinforced pipe, they shall be striped along the inside top with a minimum 1 inch wide indelible marker so that final inspection of the pipe orientation can be made following completion of the installation.
- C. For circular pipe 114 inch or larger in diameter, the design information in accordance with Section 6 of ASTM C76, shall be submitted to the Engineer for approval, prior to fabrication.
- D. The design of all pipes shall meet the d-load requirements for the class of pipe indicated on the Plans.
- E. When not specified, pipe joints shall be made with cold applied pipe joint sealer.

2.05 REINFORCED CONCRETE ELLIPTICAL PIPE

- A. Reinforced concrete elliptical pipe shall conform to ASTM C507.
- B. When not specified, pipe joints shall be made with cold applied pipe joint sealer.

2.06 PRECAST CONCRETE BOX SECTION

- A. Precast concrete box sections shall meet the requirements of ASTM C1433, ASTM C1577 or ACPA "Boxcar". Unless specified otherwise, CONTRACTOR shall use the same design conditions as exist at the time of construction or as planned for future development.

2.07 JOINTS FOR CONCRETE OR CLAY PIPE, BOX SECTIONS AND MANHOLES

- A. Sealed Joints (Cold Applied Pipe Joint Sealer):
 1. When not specified, pipe joints shall be made with cold applied pipe joint sealer.
 2. Cold-applied pipe joint sealer shall conform to MDOT Section 909.09. The bituminous material shall be of such consistency that it may be spread on the joints with a trowel when the temperature of the air is between 20 and 100 degrees F.
 3. The bituminous material shall adhere to the pipe so as to make a watertight seal and shall not flow, crack or become brittle when exposed to the atmosphere.
- B. Premium Joints:
 1. Premium joints for circular pipe shall conform to ASTM C443 limited as follows: Section 5.1 of ASTM C443, "Physical Requirements for Gaskets," shall be replaced with Section 6.9 of ASTM C361, "Rubber Gaskets." Also, Section 5 of ASTM C443 shall be limited to a modified grooved tongue to receive a rubber gasket.
 2. Premium joints for elliptical pipe shall conform to ASTM C877, external sealing bands for non-circular concrete pipe.
 - a. The width of the sealing bands shall be at least equal to twice the depth of the groove. For modified bell tongue and groove pipe, use the next larger gasket.
 - b. The length of the sealing bands shall be 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. Only lubricant, as supplied by the pipe manufacturer, shall be used on the groove and on the tongue in making up joints, and the joints shall be coupled in accordance with the pipe manufacturer's requirement.
- C. Preformed Flexible Joint Sealant:
 1. Butyl Rubber Sealant complying with ASTM C990.
- D. The inside annular space of all concrete pipe 36 inch diameter (or equivalent) and larger shall have the inside annular space filled with cement mortar and troweled flush. Mortar shall consist of 1-part Portland cement and two (2) parts of plaster sand. Mortar for inside joints shall be mixed with only enough water for "dry packing."

2.08 CORRUGATED METAL PIPE

- A. Galvanized Corrugated Metal Pipe:
 - 1. Corrugated galvanized steel pipe with circular cross section and corrugated galvanized steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M 36, and as specified in MDOT Section 909.05.
 - 2. Helical corrugated pipe shall have a minimum of two (2) circumferential corrugations rerolled on each end of each section of pipe.
- B. Polymeric Coated Corrugated Galvanized Steel Pipe:
 - 1. Polymeric coated corrugated galvanized steel pipe with circular cross section and polymeric coated corrugated galvanized steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M245, and as specified in MDOT Section 909.05.
 - 2. Helical corrugated pipe shall have a minimum of two (2) circumferential corrugations rerolled on each end of each section of pipe.
- C. Aluminized Type 2 Corrugated Metal Pipe:
 - 1. Type 2 aluminized corrugated steel pipe with circular cross section and corrugated steel pipe with pipe-arch shape shall conform to the requirements of AASHTO M 36, AASHTO M 274, Type 2 and as specified in MDOT Section 909.05.
 - 2. Helical corrugated pipe shall have a minimum of two (2) circumferential corrugations rerolled on each end of each section.
- D. Corrugated Aluminum Alloy Pipe:
 - 1. Corrugated aluminum alloy pipe with circular cross section and corrugated aluminum alloy pipe with arch-pipe shape shall conform to the requirements of AASHTO M196 and MDOT Section 909.05.
- E. Joints for Corrugated Metal Pipe:
 - 1. The joints for corrugated metal pipe shall be made by use of coupling bands. The coupling bands shall be of the same material as specified for the pipe and shall prevent infiltration of the side fill material.
 - a. Coupling bands shall be corrugated to match the corrugations of the pipe to be jointed, and shall include two (2) "O" ring neoprene gaskets for each joint. Dimple bands shall not be used.
 - b. All joints shall be wrapped with a 3 foot wide geotextile filter fabric centered on the joint.
 - 2. When called for in the Contract Documents, joints shall have bell and spigot coupling system and rubber gasketed joint.

2.09 DUAL WALL CORRUGATED PVC PIPE – SMOOTH INTERIOR

- A. Pipe shall be a single extrusion of PVC with smooth interior and corrugated outer walls. Corrugated outer profile shall be annular and seamless.
- B. Pipe and fittings shall be in accordance with ASTM F949. Joints shall be bell and spigot type with a elastomeric gasket meeting the requirements of ASTM F477 and be suitable for storm sewer service.
- C. Wyes or tees shall be a molded wye or tee fitting per ASTM F949, with gasketed joints on each end suitable for directly inserting in the mainline pipe. Branch connection fitting shall be a gasketed joint suitable for the house lead pipe specified. Saddle connections are not allowed.
- 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. Smooth lined corrugated polyethylene pipe shall meet the requirements of MDOT section 909.06 and AASHTO M 252, Type S for sizes 4 to 10 inch diameter, and AASHTO M 294, Type S for 12 to 48 inch diameter.
 - 2. Fittings shall conform to the corresponding pipe specification and be constructed of the same material classification as the pipe. Fittings shall be welded on the interior and exterior at all junctions.
 - 3. Joints shall be bell & spigot type with rubber gaskets on both sides of the joint conforming to MDOT section 909.03 and ASTM F477. Split collar couplers are not allowed. Joints shall be watertight meeting the performance requirements of ASTM D3212.
- B. Corrugated Plastic Edge Drain / Underdrains.
 - 1. Corrugated plastic tubing for edge drains or underdrains shall meet the requirements of AASHTO M 252 for polyethylene tubing. Pipe shall be wrapped in a Geotextile Pipe Wrap per MDOT Section 910.03.A.

2.11 SMOOTH PLASTIC PIPE

- A. Smooth plastic pipe for underdrains shall be polyvinyl chloride PVC meeting the requirements of AASHTO M 278. Pipe shall be wrapped in a Geotextile Pipe Wrap per MDOT Section 910.03.A.

2.12 DUAL WALL CORRUGATE POLYPROPYLENE PIPING

- A. Dual Wall Corrugate Polypropylene Pipe shall have a smooth interior and annular exterior corrugations. Pipe 12 through 60 inch diameter shall meet the requirements of ASTM F2881/F2881M or AASHTO M 330.
- B. Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M 330, Section 6.1.
- C. Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881/F2881M or AASHTO M 330. The joint shall be watertight according to the requirements of ASTM D3212.
- D. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A manufacturer approved joint lubricant shall be used on the gasket and bell during assembly.
- E. Fittings
 - 1. Fittings shall conform to ASTM F2881/F2881M or AASHTO M 330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

2.13 STRUCTURAL PLATES FOR FIELD ASSEMBLY OF PIPE, PIPE-ARCHES, AND ARCHES

- A. The plates, bolts and nuts to be used in field assembled circular pipe, pipe-arches and arches shall meet all applicable requirements of AASHTO M 167/M 167 and as specified in MDOT Section 909.

2.14 END SECTIONS

- A. The precast concrete end section shall conform to ASTM C76, Class II and as specified in MDOT Section 909.04. The joint for connection to pipe shall be by means of a standard tongue and groove with cold-applied pipe joint sealer. See Part 2 of this Section for requirements for the cold-applied pipe joint sealer.

- B. Metal end sections shall conform to MDOT 909.05. See Part 2 "Corrugated Metal Pipe" for requirement for joints for end sections.

2.15 STORM STRUCTURES

- A. Materials for storm sewer structures shall conform to the requirements indicated on the Plans and as specified below.
- B. Concrete Brick:
 - 1. Concrete brick shall be ASTM C55, Grade S-II, solid units of nominal 3 inch thickness.
- C. Concrete Block:
 - 1. Block shall conform to ASTM C139, manufactured of Portland cement conforming to ASTM C150/C150M, Type II. Blocks shall be solid curved blocks with the inside and outside surfaces parallel and curved to the required radii. The blocks shall have a groove or other approved type of joint at the ends.
 - a. Blocks intended for use in the cones or tops of manholes shall have such shape as may be required to form the structure as indicated on the Plans.
- D. Precast Concrete:
 - 1. Precast concrete manhole, flat top slabs, risers, cone, bases, grade rings, transition sections and bottom sections shall conform to ASTM C478/C478M, and shall be circular with circular reinforcement.
 - a. For depths greater than 32 feet, the manhole shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
 - 2. Base slab shall be minimum 8 inches thick for depths up to 25 feet and minimum 12 inches thick for depths greater than 25 feet.
 - 3. Transition sections, reducers and flat top slabs shall be designed for the earth loading at the design depth of bury with a factor of safety of 1.5.
 - 4. Precast concrete manhole tee units shall conform to ASTM C76, Class IV and shall be circular with circular reinforcement. Shop Drawings shall be provided for all manhole tees.
 - 5. The joints on the precast manhole tee shall be the same as the joints on the storm sewer section.
- E. Manhole Steps:
 - 1. Cast iron manhole steps shall conform to ASTM A48/A48M, Class 30, gray iron with a minimum cross section dimension of 1 inch in any direction.
 - 2. Steel reinforced plastic steps shall be 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. Manhole steps shall be of the type and size indicated on the Plans and shall comply with applicable occupational safety and health standards. Manhole steps shall be installed at locations indicated on the Plans.
- F. Frames and Covers:
 - 1. Frames and covers for manholes, catch basins, and inlets shall conform to ASTM A48/A48M, Class 30, gray iron and shall be of the types and sizes as indicated on the Plans. The castings shall be neatly made and free from cracks, holes and other defects.
 - 2. Surfaces of casting shall be ground to assure proper fit and to prevent rocking.

2.16 CONCRETE

- A. The concrete shall 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.

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 to which the new Work is to be connected and notify the Engineer of same. Engineer will verify the vertical and horizontal locations of the existing system and shall inform the Contractor as to the necessary adjustments required to align the new storm sewer Work with the existing system.

3.03 PREPARATION

- A. The outside surface of the spigot end and the inside surface of the bell end of the pipe shall be cleaned and free of any foreign materials, other than the sealant recommended by the manufacturer, prior to installation.
- B. Pipe, frames, covers, accessories, and appurtenances shall be examined carefully for damage and other defects immediately prior to installation. Defective or damaged material shall be rejected and removed from the Project by the Contractor.

3.04 INSTALLATION - GENERAL

- A. Each section of pipe, when placed to grade and line, shall have firm bearing on the trench bedding throughout its length.
- B. Cutting of pipe shall be done with approved tools and by approved methods suitable for the pipe material. Pipe cutting methods that produce a smooth, square-cut end without damage to the pipe and that minimize air-borne particles, shall be employed.
 - 1. Pipe cutting shall be performed using the recommendations of the manufacturer of the type of the pipe materials being cut and according to the best trade practices.
 - 2. When cutting pipe, care shall be taken to prevent damage to the interior and exterior surfaces. Damage to either shall be cause for rejection of a complete section of pipe.
- C. During the preparation of the pipe bedding and until the trench has been satisfactorily backfilled, the trench shall be kept free of water. A dewatering system, in accordance with Section 31 23 19 shall be provided and maintained by the Contractor. The dewatering system shall remain in operation until the trench is backfilled.
- D. Backfill shall be as indicated on the Plans and as specified in Section 31 23 33.

3.05 PIPE LAYING

- A. Installation of pipe shall conform to ASTM C12, and as recommended by the pipe manufacturer.

- B. The pipe shall be protected during handling against impact shocks and free fall. Hooks shall not be permitted to come in contact with premolded joint surfaces.
- C. Pipes having premolded joint rings or attached couplings shall be handled so that no weight, including the weight of the pipe itself, will bear on or be supported by the jointing material.
- D. Care shall be taken to avoid dragging any pipe on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.
- E. Pipe shall be laid to the line and grade called for on the Plans. Each pipe as laid, shall be checked by the Contractor with line and grade pole or laser system to insure that this result is obtained. When employing a laser system, the Contractor shall have an independent and alternate means of checking the line and grade.
- F. Construction shall begin at the outlet end and proceed upgrade with spigot ends pointing in direction of flow. Bell holes shall be excavated so that the full length of the barrel will bear uniformly on the bedding material.
- G. Lubricants, primers or adhesives as recommended by the pipe or joint manufacturer shall be used immediately prior to jointing.
- H. The pipe shall be centered in the bells or grooves and pushed tight together to form a smooth and continuous invert. After laying of pipe, care shall be taken so as not to disturb its line and grade. Pipe found off grade or out of line shall be re-laid properly by the Contractor.
- I. Mechanical means shall be used for pulling home all pipe where manual means will not result in pushing and holding the pipe home. Mechanical means shall consist of a cable placed inside of the pipe with a suitable winch, jack, or come along for pulling the pipe home and holding the pipe in position.
- J. Circular concrete pipe with elliptical reinforcement shall be installed with the lift holes to the top of the pipe. The manufacturer's marks designating the top and bottom of the pipe shall not be more than five degrees from the vertical plane through the longitudinal axis of the pipe. After the pipe is installed, the lift holes shall be sealed with suitable concrete plugs.
- K. Type HE elliptical pipe shall be installed with the longer axis placed horizontally within a tolerance of \pm five degrees.
- L. Type VE elliptical pipe shall be installed with the longer axis placed vertically within a tolerance of \pm five degrees.
- M. The finished work shall be straight and shall be sighted through between manholes.

3.06 PIPE BEDDING

- A. After the bottom of trench has been excavated the pipe bedding material will be installed in accordance with Section 31 23 33. The pipe shall then be installed strictly in accordance with the manufacturer's recommendations.
- B. After the pipe is laid, the bedding shall be continued above the pipe as specified in Section 31 23 33. Particular care shall be taken to assure filling and tamping all spaces under, around and above the top of the pipe.
- C. A continuous and uniform bedding as specified in Section 31 23 33, shall be provided in the trench for all buried pipe.

3.07 UNDERDRAINS

- A. The pipe shall be laid in close conformity with the lines or grades shown on the Plans or established by the Engineer.
- B. The upgrade ends of all underdrains shall be closed with suitable plugs to prevent entry of soil or other foreign material.
- C. Perforated pipe shall be laid with the perforations down.

- D. Underdrains shall be bedded in MDOT open graded drainage course material. The bedding shall have a minimum thickness beneath the pipe of 6 inches, a minimum width of 6 inches on each side of the pipe and extend to a level not less than 12 inches above the top of the pipe.
- E. The bedding shall be placed equally on both sides of the underdrain at the same time. Staking or other methods to restrain the pipe may be necessary during the backfilling operation to maintain the line and grade of the underdrain.
- 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. Structures shall be complete with concrete bases, reinforcing, frames, covers, adjustment bricks, etc., as shown and as required for a complete installation.
- B. Storm sewer structures shall conform to the type of material and dimensions indicated on the Plans.
- C. Cast-in-place structures shall be constructed in accordance with Section 03 30 00.
- D. Block Structures:
 - 1. Construct concrete block structures in the locations and according to the details on the Plans. The first course of concrete blocks shall be placed on the prepared base or footings in a full bed of mortar.
 - 2. Mortar joints shall be full and close in all courses. Courses shall be level throughout. Stagger joints in adjoining courses by one-half the length of the block as nearly as practicable. Joints shall be uniform in thickness throughout the structures.
 - 3. Strike all joints and properly point to provide true, smooth surfaces.
 - 4. A cement mortar plaster coat shall be applied to the exterior surfaces of the brick and block sections of all storm structures as indicated on the Plans. Plaster coat shall be 1/2 inch thick.
- E. 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.
- F. Provide and install all frames and covers to the elevations indicated on the Plans. Castings shall be set in a full bed of cement mortar 1/2 inch thick, minimum. Mortar joints shall be struck smooth.
- G. Steps shall be installed at the plant by the manufacturer of precast units. Field install steps for brick, block, or cast in place structures of the types and in the locations indicated on the Plans.
- H. Pipe up to 42 inches in diameter, shall be connected to storm structures using a grouted joint, as indicated on the Plans. The pipe shall be properly supported, so that any settlement will not disturb the connection.
- I. For pipe, in diameter or larger, the pipe shall be installed as an integral part of the manhole (manhole tees) which shall be constructed of 3500 pdi concrete and reinforcing, as indicated on the Plans.
- J. Manhole tees, as indicated on the Plans, may be used for pipe 42 inches in diameter or larger. Connection to manhole tees shall be made using tees and pipe having the same type of joint. The pipe and tee shall be properly supported with concrete as indicated on the Plans.
- K. Sump shall be provided, as indicated on the Plans, in all catch basins and storm manholes having outlets of 18 inches in diameter or less.

- L. Flow channels shall be constructed in all structures not requiring a sump and shall be constructed as indicated on the Plans.

3.09 FIELD QUALITY CONTROL

- A. After all the pipe and structures have been laid, constructed and backfilled, the system shall be final inspected. The sewer system shall be ready for the final inspection within two (2) weeks after the completion of each 2,000 feet section of sewer installed.
- B. The final inspection shall consist of a visible and audible check of the sewers and structures to ascertain that the steps have been placed, all lift holes filled, the channeling of the manhole bottoms completed, all visible or audible leaks stopped, all pipe has been placed straight and true to the proper slopes and elevations, the required brick courses for adjustment have been placed, the frame and cover properly installed, the required end section installed, all trenches and structures backfilled in a workmanlike manner, and that the system has been thoroughly cleaned.
- C. The final inspection shall be considered complete when all the repairs have been made.

3.10 DEFLECTION TEST FOR PLASTIC PIPE

- A. Plastic pipe shall be tested for deflection; but no sooner than 30 days following the backfilling of the pipe.
- B. Maximum allowable deflection (reduction in vertical inside diameter) shall be five (5) percent.
- C. Locations with excessive deflection shall be excavated and repaired by re-bedding and/or replacement of the pipe.
- D. Optional devices for testing include a deflectometer, calibrated television or photography, or a properly sized "go, no-go" mandrel or sewer ball. Mandrel shall have 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 replace storm sewer shall consist of the complete removal and disposal of the existing sewer and replacement with the size and type of sewer as called for on the plans or specified.
- B. Materials and installation shall be in accordance with the requirements of this section and Section 31 23 33, as applicable.

3.15 REMOVE AND REPLACE STORM STRUCTURE

- A. Remove and replace storm structure shall consist of the complete removal and disposal of the existing structure and replacement with the size and type of structure as called for on the plans or specified.
- B. Materials and installation shall be in accordance with the requirements of this section and Section 31 23 33, as applicable.

END OF SECTION 33 41 00

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 22 00 - Grading
- F. Section 31 23 16 - Structural Excavation and Backfill
- G. Section 31 23 19 - Dewatering
- H. Section 31 35 00 - Slope Protection
- I. Section 32 92 19 - Seeding
- J. Section 32 92 23 - Sodding
- K. Section 33 41 00 - Storm Utility Drainage Piping

1.03 ALLOWABLE TOLERANCES

- A. All areas to be excavated shall be trimmed and dressed to conform to the lines, grades and cross sections shown on the Plans within the following tolerances:
 - 1. The finished surface elevation of all channel bottoms shall be within ± 1 inch of Plan elevation.
 - 2. The finished surface elevation of all channel areas, other than the channel bottoms, shall be within ± 2 inches of Plan elevation.

1.04 JOB CONDITIONS

- A. Trees, shrubs and other types of vegetation not within the Work limits designated on the Plans or by the Engineer, shall be carefully protected from damage or injury during the entire drain construction operation.
- B. Trees, shrubs, or other types of vegetation not designated to be removed but which are damaged by the Contractor's operation shall be replaced by the Contractor. Costs incurred shall be incidental to the open drain construction operation.
- C. Existing buildings, fences, culverts, drain tile, utility poles, overhead lines, underground conduits, underground cables, sewers, structures, or other types of improvements within the drain right-of-way limits not designated on the Plans to be removed, shall be carefully protected from damage during the drain construction operation.
- D. Any type of existing structure or improvement not designated to be removed but which is damaged by the Contractor's operation, shall be repaired or replaced by the Contractor. Costs incurred shall be incidental to the drain construction operation.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PERFORMANCE – GENERAL

- A. The construction shall begin at the outlet end of the open drain and proceed upstream, unless otherwise authorized by the Engineer.
- B. Prior to the commencing of excavation or cleanout of the open drain and until the satisfactory completion of the open drain construction operation, the drain shall be kept free of water. A dewatering system shall be provided and maintained by the Contractor as specified in Section 31 23 19 - Dewatering.

3.02 DISPOSAL AREAS

- A. If disposal areas for unsuitable materials are not specified on the Plans, the Contractor, at his expense, shall furnish and maintain a disposal area. Spoil disposal areas that may be designated on the Plans are not for disposal of unsuitable materials unless otherwise specified on the Plans or as determined by the Engineer.

3.03 CLEARING AND GRUBBING

- A. The drain right-of-way and spoil deposit areas, designated on the Plans or as determined by the Engineer, shall be cleared and grubbed prior to actual excavation of the open drain as provided for in Section 31 11 00 - Clearing and Grubbing.
- B. Along the open drain, the clearing and grubbing Work shall precede the excavation operation by at least a 1/2 mile.
- C. Clearing and grubbing shall consist of preparing an area for excavation or fill by removing unsuitable materials and vegetation which interferes with the proposed Work, and shall include the preservation from injury or defacement of all material ground cover, trees, and other vegetation and improvements designated to remain.
- D. The clearing and grubbing operations, including removal and disposal of unsuitable materials, shall be considered incidental to the Project and shall be considered part of the excavation pay item.

3.04 REMOVING AND SALVAGING TOPSOIL

- A. Topsoil shall be salvaged 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, the Contractor, at his expense, shall furnish, place, and spread the additional topsoil.
- D. The all vegetation shall be cut to a height of approximately 2 inches, and the topsoil shall be free of foreign materials prior to removal. Topsoil shall be removed in such a manner as to avoid the lifting of subsoils.
- E. Topsoil shall be removed within the grading limits for cuts, and shall be removed to width and depth as specified on the Plans or as directed by the Engineer.
- F. Topsoil shall be stockpiled within the drain right-of- way, outside of the construction area. The topsoil shall be stockpiled separate from other excavated materials to be used for embankments or subject to disposal. The topsoil shall be located as near the original location as possible, as no payment will be made for overhauls. The topsoil shall be stockpiled at locations so as to avoid placing the material around tree trunks or over root systems of trees to be preserved.
- G. The cost of topsoil removal, stockpiling, hauling, spreading and grading shall be considered incidental to the Project.

3.05 EXCAVATION

- A. The open drain shall be excavated to the lines, grades, dimensions and cross sections specified on the Plans.
- B. Excavation shall consist of the removal and disposal of all materials necessary to construct the open drain. The material removed shall be placed in suitably prepared spoil disposal areas. If spoil disposal areas are not specified on the Plans, the Contractor, at his expense, shall provide and maintain a disposal area.
- C. Construction, excavation and disposal operations shall be performed in such a manner and sequence that adequate drainage will be maintained at all times.
- D. When wet or unstable soil conditions are encountered during the excavation operation, the Contractor shall immediately cease operations and notify the Engineer. With the approval of the Engineer, the Contractor, in addition to dewatering, may make changes in the Work to facilitate the dewatering and stabilizing of the soils. Cost incurred for dewatering and stabilizing the soils shall be at the Contractor's expense.
- E. When indicated on the Plans or when wet or unstable soils are encountered, the initial construction of the drain shall be the excavation of a pilot channel no less than 30 days in advance of completing final drain side slopes. The Engineer will determine when drain slopes have stabilized sufficiently to allow for final slope shaping.
 - 1. The pilot channel excavation shall have a bottom width of approximately one-half the proposed final width with 1:1 side slopes and shall be excavated to the elevations indicated on the Plans. Unless otherwise approved by the Engineer, the pilot channel shall not be excavated upstream from any bridge requiring bridge protection work or replacement until the scheduled work for such bridge has been completed.
- F. When stones, boulders, or rocks are encountered during the excavation, they shall be removed and disposed of as unsuitable material. Any holes or voids created below plan grade after the stones, boulders, or rocks have been removed, shall be backfilled with approved materials, and compacted, to the satisfaction of the Engineer.
- G. Costs incurred for removal and disposal of stones, boulders, and rocks in addition to backfilling and compaction shall be at the Contractor's expense.
- H. When ledge rock is encountered, the Contractor shall immediately cease operations and notify the Engineer of his findings.
- I. Blasting will not be permitted unless otherwise specified on the Plans or approved by the Engineer.

3.06 GRADING REQUIREMENTS

- A. Channel areas receiving slope protection shall be excavated to a depth sufficient to provide for installation of the protective materials and meet the finished surface grade tolerances.
- B. The additional excavation necessary to provide for slope protection shall be considered incidental to the cost of the Project.
- C. In areas where the Contractor over excavates, the over excavation area shall be backfilled with approved materials and compacted at the Contractor's expense.
- D. Grades shall be finished in a condition satisfactory to the Engineer immediately prior to the placement of 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. The Contractor, at his expense, shall provide, maintain and remove such temporary and/or permanent soil erosion and sedimentation control measures as specified on the Plans or as determined by the Engineer.

- B. The measures shall prevent surface runoff from carrying excavated materials into the drain, shall reduce erosion of the slopes, and shall prevent silting in of drain downstream of the Work.
- 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 completion of the grading operation and prior to the placing any protective covering, the Engineer shall inspect the slopes for any signs of internal water movement as indicated by seepage and soil slippage, and for the existence of unstable slope conditions.
- B. The Contractor shall take the necessary measures to stabilize the slopes including removal and disposal of unsuitable or unstable materials, backfilling with approved material, and compaction. The cost incurred for slope stabilization shall be considered incidental to the excavation.

3.09 SPOIL DISPOSAL AREAS

- A. Excavation, free from unsuitable materials shall be deposited in approved spoil disposal areas, as specified in Section 01 89 00 - Site Construction Performance Requirements.
- B. Depositing of spoil materials in existing watercourses or drains shall be prohibited unless otherwise specified on the Plans. The spoil material shall be deposited, compacted, and graded to provide drainage. Swales shall be constructed when necessary to provide positive drainage to drain.

3.10 CULVERTS

- A. New culverts or culverts to be relayed as indicated on the Plans shall be installed as required in Section 33 41 00 - Storm Utility Drainage Piping. Special care will be taken in removing, salvaging, storing, handling or placing culverts so that they are not damaged.
- B. Only culverts meeting the approval of the Engineer may be relayed.
- C. Any culverts having the protective coating scraped or otherwise damaged, shall be repaired by the Contractor, at his expense, to the satisfaction of the Engineer.
- 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. When existing culverts are to be relayed, the inverts shall be rotated 180 degrees.
- F. The Contractor shall make arrangements with the land owner and/or land user for the removal of culverts. The Contractor shall provide the Engineer with a copy of the arrangements made, bearing the signature of the landowner and/or land user.
- G. Any culvert removed and not relayed, shall be disposed of by the Contractor, at his expense.
- H. Culverts which are specified to be removed and relayed, shall be relayed at the culvert crossing from which they were removed. Salvaged culverts shall not be used at any other location, unless otherwise authorized by the Engineer.

3.11 TILE OUTLETS

- A. The Contractor shall contact existing landowners and land users to locate and flag the location of all field tile outlets to be protected during the excavating operation. The Contractor shall not proceed with the Work until the tile outlet locations have been so marked.
- B. The Contractor will be responsible for leaving the tile outlets in good repair and in working order.
- C. It may become necessary to shorten the length of existing field tile outlets and recess them back into the newly shaped slope. This Work shall be considered incidental to the Project.

- D. When called for on the Plans new outlets shall be installed and shall conform to the materials specified. A suitable rodent guard shall be furnished and placed on the end of new outlet, at the Contractor's expense. Existing rodent guards shall be relocated by the Contractor 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. Existing bridges shall be removed and disposed of or shall be removed, salvaged and reinstalled, as specified on the Plans. Care shall be taken when removing, salvaging, storing, handling and re-installing the existing bridge.
- B. The Contractor shall make arrangements with the landowner and/or land user for the removal of the bridge. The Contractor shall 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. Cleanout of the existing drain shall include the clearing and grubbing of all trees, brush, stumps and other vegetation in accordance with Section 31 11 00 - Clearing and Grubbing. Excavation shall be in accordance with Part 3 of this Section.
- B. Enclosed drain cleanout shall include the complete removal and disposal of all sediment, silt, dirt, debris and other miscellaneous items to the bottom of the culvert or to the elevation shown on the plans, or as determined by the Engineer.
- C. At the completion of the cleanout the Contractor shall restore all areas disturbed with topsoil, seed, fertilizer and mulch; or topsoil and sod.

END OF SECTION 33 44 00