SECTION 00 01 00
CONTRACT DOCUMENTS

2024 Infrastructure Improvement Program

City of Plymouth
201 S. Main Street
Plymouth, MI 48170

March 25, 2024

25251 Northline Road, Taylor MI. 48180

SECTION 00 01 10
TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 10 - Table of Contents

00 01 15 - List of Drawing Sheets

00 11 13 - Advertisement for Bids

00 21 13 - Instructions to Bidders

00 42 43 - Proposal

00 43 13 - Bid Bond Form

00 43 45 - Legal Status of Bidder

00 51 00 - Notice of Award

00 52 00 - Agreement

00 55 00 - Notice to Proceed

00 61 12.13 - Labor and Material Payment Bond Form

00 61 13.13 - Performance Bond Form

00 62 75 - Engineer's Certificate for Payment

00 62 76 - Contractor's Application for Payment

00 62 77 - Payment Schedule

00 63 25 - Substitution Request Form

00 65 16 - Certificate of Substantial Completion

00 65 20 - Sworn Statement

00 72 00 - General Conditions

00 73 00 - Supplementary Conditions

00 91 13 - Addendum

00 91 20 - Standard Specification Section Revisions

SPECIFICATIONS

DIVISION 01 - GENERAL REQUIREMENTS

01 11 00 - Summary of Work

01 22 00 - Unit Prices

01 31 19 - Project Meetings

01 33 00 - Submittal Procedures

01 45 00 - Quality Control

01 50 00 - Temporary Facilities and Controls

01 57 13 - Temporary Erosion and Sediment Control

01 60 00 - Product Requirements

01 71 23 - Construction Layout
01 77 00 - Closeout Procedures
01 89 00 - Site Construction Performance Requirements

DIVISION 04 - MASONRY

04 05 11 - Mortaring and Grouting

DIVISION 31 - EARTHWORK

31 23 13 - Subgrade Preparation
31 23 16 - Structural Excavation and Backfill
31 23 33 - Trenching and Backfilling

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 11 23 - Aggregate Base Courses
32 12 16 - Bituminous Paving
32 13 13 - Concrete Paving
32 13 15 - Sidewalks and Driveways
32 92 23 - Sodding

DIVISION 33 - UTILITIES

33 11 00 - Water Utility Distribution Piping
33 30 00 - Sanitary Utility Sewerage Piping

EXHIBITS

Geotechnical Engineering Report (SME)

City of Plymouth – 2024 Infrastructure Program

SECTION 00 01 15
LIST OF DRAWING SHEETS

The Plans bearing the general title of 2024 Infrastructure Program and dated March 25, 2024 are included with and form a part of the Contract Documents for this Project.

Title	Sheet Number
Cover	1
Notes	2
Legend	3
Church Street – Existing Conditions	4
Church Street - Removal	5
Church Street - Proposed Water Main Plan and Profile	6
Church Street – Traffic Signal Legend and Notes	7
Church Street – Traffic Signal Removal Plan	8
Church Street – Traffic Signal Construction Plan	9
Church Street – Traffic Signal Construction Plan	10
Church Street – Traffic Signal Construction Plan	11
Church Street – Reconstruction Plan and Storm Profile	12
Church Street – ADA Ramps NW and SW Quadrants	13
Church Street – ADA Ramps NE and SE Quadrants	14
Church Street – ADA Ramps West and East Median	15
Liberty Street – Existing Conditions	16
Liberty Street – Existing and Proposed Typicals	17
Liberty Street – Removal Plan	18
Liberty Street – Water Service Plan	19
Liberty Street – Resurfacing Plan	20
Liberty Street – Grading Plan	21
Liberty Street – ADA Ramps – Liberty And Davis	22
Liberty Street – Maintenance of Traffic – Liberty and Spring	23
S Main Street - Existing Conditions Sta 0+00 to Sta 7+50	24
S Main Street – Existing Conditions Sta 7+50 to 14+50	25
S Main Street – Existing Conditions Sta 14+50 to Sta 22+05	26
S Main Street – Existing and Proposed Typicals	27
S Main Street – Removal Plan Sta 0+00 to Sta 7+50	28
S Main Street – Removal Plan Sta 7+50 to 14+50	29
S Main Street – Removal Plan Sta 14+50 to Sta 22+05	30

S Main Street – Water Main Services	31
S Main Street – Resurfacing Plan Sta 0+00 to Sta 7+50	32
S Main Street – Resurfacing Plan Sta 7+50 to 14+50	33
S Main Street – Resurfacing Plan Sta 14+50 to Sta 22+05	34
S Main Street – Pavement Marking Plan Sta 0+00 to Sta 7+50	35
S Main Street – Pavement Marking Plan Sta 7+50 to 14+50	36
S Main Street – Pavement Marking Plan Sta 14+50 to Sta 22+05	37
S Main Street – ADA Ramps – S Main and Simpson and Ross	38
S Main Street – ADA Ramps – S Main and Palmer	39
Spring Street – Existing Conditions	40
Spring Street – Existing and Proposed Typicals	41
Spring Street Removal Plan	42
Spring Street – Resurfacing Plan and Storm Profile	43
Spring Street – Grading Plan	44
Spring Street – ADA Ramps - Spring and Starkweather	45
Water Valve Replacement	46-48
Bid Alternate No. 1	49
Miscellaneous Details	MD1
Soil Erosion and Sedimentation Controls	SE1
Standard Water Main Details	WM1
Paving Details	PD1 & PD2

SECTION 00 11 13
ADVERTISEMENT FOR BIDS

2024 Infrastructure Improvement Program

City of Plymouth has implemented online project bidding using the **Quest Construction Data Network (QuestCDN)**. Only electronic bids submitted through www.questcdn.com will be accepted for this project

Sealed Bids will be received by the City of Plymouth through QuestCDN until 11:00 am, Local Time, on April 23, 2024. Shortly after the bid closing time a bid tabulation will be prepared and posted online.

Bids will be received for the following Work:

Infrastructure improvements on S. Main, Church, Spring, and Liberty. The base project includes 1260 CYDs of Pavement Excavation, 14,500 SY of Cold Milling, 526 LFT of Water Main, 2500 TON of Bituminous Pavement, 400 SYDs of Concrete Pavement, 4000 SFT of Concrete Sidewalk, 16 Gate Valve WM Replacements, 15 new water services and other related work. An alternate bid is requested for approximately 25,000 SY of cold milling and 2800 TONs of Bituminous Pavement.

Contract Documents may be examined at the following locations:

1. City of Plymouth, 201 S. Main Street
2. Wade Trim Associates, Inc., 25251 Northline Road, Taylor MI. 48180
3. Plans and specifications 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.
4. The Contract Documents for bidding purposes are only available from QuestCDN starting on Ready for Bidders date. The Contract Documents can be viewed and downloaded by registering for free with QuestCDN online (www.questcdn.com) or by calling 952-233-1632. The QuestCDN Project Number for this project is 9049461 and may be used to look up the project.
    A. There is a Fifteen Dollars ($15.00) nonrefundable fee for downloading the Contract Documents in pdf format. You must download the Documents from QuestCDN to be included on the Plan Holders List and to receive any Addenda posted for the project.
    B. Bids will be received electronically through QuestCDN as outlined in the Supplemental Instructions to Bidders. There is a Twenty Five Dollars ($25.00) non-refundable fee for submitting a Bid.

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 Plymouth as security for the proper execution of the Agreement.

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

Bids may not be withdrawn for the period of 60 days after date of receiving bids.

Inquiries shall be directed to Shawn Keough (313) 363-1434, 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 Plymouth, 201 S. Main Street, a Municipal Corporation and being a party of the first part of this Contract.

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

1.02 BIDDERS QUALIFICATIONS

A. No Bid will be considered from any Bidder unless known to be skilled and regularly engaged in work of a character similar to that covered by the Contract Documents. In order to aid the Owner in determining the responsibility of any Bidder, the Bidder, within 48 hours after being requested in writing by the Owner to do so, must furnish evidence, satisfactory to the Owner, of the Bidder's experience and familiarity with Work of the character specified, and Bidder's financial ability to properly prosecute the proposed Work to completion within the specified time. The evidence requested may include the following:

1. Address and description of the Bidder's plant or permanent place of business.
2. Bidder's performance records for all Work awarded to or started by Bidder within the past three years.
3. An itemized list of the Bidder's equipment available for use on the proposed Contract.
4. Bidder's financial statement, including statement of ownership of equipment necessary to be used in executing Work under Contract.
5. Evidence that the Bidder is authorized to do business in the state in which the project is located, in case of a corporation organized under the laws of any other state; and,
6. Such additional information as will satisfy the Owner that the Bidder is adequately prepared to fulfill the Contract.

1.03 EXAMINATION OF CONTRACT DOCUMENTS AND SITE

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

1. Examine the Contract Documents thoroughly,
2. Visit the site to familiarize himself with local conditions that may in any manner affect cost, progress or performance of the Work,
3. Consider federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work; and
4. Study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and
5. Promptly notify the Engineer in writing of conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between Contract Documents and such related documents.

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

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

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

2. 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, mandatory pre-bid conference will be held, and representatives of the Owner and the Engineer will be present to discuss the Project.

B. Bidders are required to attend and participate in the conference to be considered responsive.

C. 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. 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.

F. The Legal Status of Bidder Form, located in Section 00 43 45 - Legal Status of Bidder, must be submitted with each Bid and must clearly state the legal position of a Bidder. In the case of a corporation, the home address, name and title of all officers must be given. In the case of a partnership, show names and home addresses of all partners. If an individual, so state. Any individual bid not signed by the individual must have attached, thereto, a power of attorney evidencing authority to sign.

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

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

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

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

1.10 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 60 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) 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.

SECTION 00 42 43
PROPOSAL

Owner: City of Plymouth

Project: 2024 Infrastructure Program

Project Location: 201 S. Main 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 Plymouth 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 Ready for Bidders date and Project Manual dated Ready for Bidders date) which Bidder understands and accepts as sufficient for the purpose, including any and all Addenda officially issued, the receipt of which has been acknowledged.
   A. Addendum _____ Acknowledged by: _____ Date: _____
   B. Addendum _____ Acknowledged by: _____ Date: _____
   C. Addendum _____ Acknowledged by: _____ Date: _____
2. Bidder has examined the surface and subsurface conditions where the Work is to be performed, the legal requirements and local conditions affecting cost, progress, furnishing or performance of the Work, and has made such independent investigations as Bidder deems necessary.
3. 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.
4. The Bidder agrees to complete the Work, in accordance with the Contract Documents, for the following Contract Price:

No.	Description	Est. Quantity	Unit	Bid Unit Price	Bid Price
	A. GENERAL				
1	Mobilization, Max. 5%	1	LS	$	$
2	Traffic Maintenance And Control	1	LS	$	$
3	Audio/Video Route Survey	1	LS	$	$
4	Minor Traffic Devices	1	LS	$	$
5	Inspector Days		DAY	$850.00	$
6	Sign, Type B, Temp, Prismatic, Special, Furn	78	SF	$	$
7	Sign, Type B, Temp, Prismatic, Special, Oper	78	SF	$	$
8	Barricade, Type III, High Intensity, Lighted, Furn	8	EA	$	$
9	Barricade, Type III, High Intensity, Lighted, Oper	8	EA	$	$
10	Plastic Drum	100	EA	$	$
	GENERAL SUBTOTAL			**$**	
	B. DEMO AND SESC				
11	Pavement Excavation	1300	CY	$	$
12	Remove Concrete Curb and Gutter	2400	LF	$	$
13	Concrete Pavement, Remove	425	SY	$	$
14	HMA Pavement, Remove	625	SY	$	$
15	Drainage Structure, Remove	5	EA	$	$
16	Cold Milling Bituminous Pavement, 1.5 inch	0	SY	$	$
17	Cold Milling Bituminous Pavement, 2 inch	14500	SY	$	$
18	Pavement for Butt Joint Remove	450	SY	$	$
19	Concrete Drives and Sidewalks, Remove	4500	SF	$	$
20	Storm Sewer, Remove	62	LF	$	$

21	Gate Valve and Well, Remove	17	EA	$	$
22	Fire Hydrant, Rem	2	EA	$	$
23	Inlet Filter	76	EA	$	$
	SESC AND DEMO SUBTOTAL			**$**	
	C. WATER MAIN				
24	Water Main, 8-inch, D.I., Trench "B"	526	LF	$	$
25	Water Main, Abandon with Flowable Fill	15	CY	$	$
26	Gate Valve and Well, 8-inch	17	EA	$	$
27	Connect Exist. Water Main w/ MJ Solid Sleeve	3	EA	$	$
28	Connect Exist. 8" Water Main	0	EA	$	$
29	Connect Existing GV&W	0	EA	$	$
30	Water Service, 1-inch, Type K Copper, Long	3	EA	$	$
31	Water Service, 1-inch, Type K Copper, Short	2	EA	$	$
32	Water Service, HDPE, 1-inch, Long	8	EA	$	$
33	Water Service, HDPE, 1.5-inch, Long	1	EA	$	$
34	Water Service, HDPE, 2-inch, Long	1	EA	$	$
35	8" X 6" Reducer	16	EA	$	$
36	8" X 8" X 8" Tee	3	EA	$	$
37	Fire Hydrant Assembly	1	EA	$	$
38	Curb Stop and Box, 1-Inch	13	EA	$	$
39	Curb Stop and Box, 1.5-Inch	1	EA	$	$
40	Curb Stop and Box, 2-Inch	1	EA	$	$
	WATER MAIN SUBTOTAL			**$**	

	D. STORM				
41	Remove CB Cover and Replace with Manhole Cover	1	EA	$	$
42	Adjust Structure	68	EA	$	$
43	Reconstruct Structure	136	VF	$	$
44	Remove and Replace Frame and Cover	23,595	LB	$	$
45	Connect to Existing Storm Structure	2	EA	$	$
46	12-Inch Storm Sewer, C-76. Cl IV RCP, Trench B	240	LF	$	$
47	Standard Storm Inlet	3	EA	$	$
48	Underdrain, 6-inch W/ Geotextile Fabric Wrap	520	LF	$	$
49	Standard Storm Catch Basin	2	EA	$	$
50	Standard Storm Manhole	0	EA	$	$
51	Build Standard CB Over Existing Sewer	2	EA	$	$
52	Build Standard MH Over Existing Sewer	1	EA	$	$
	STORM SUBTOTAL			**$**	
	E. PAVING AND RESTORATION				
53	Subgrade Undercut and 21AA Aggregate Backfill	200	CY	$	$
54	Aggregate Base Course, 21AA	1000	TON	$	$
55	Drive and Sidewalk, Concrete, 6-Inch	200	SF	$	$
56	Bituminous Pavement, Wearing Course, 1300T	1900	TON	$	$
57	Bituminous Pavement, Leveling Course, 3C	630	TON	$	$
58	8-Inch Plain Concrete Pavement	401	SY	$	$
59	Pavement Marking	6	LS	$	$
60	Remove and Salvage Parking Bumpers	13	EA	$	$
61	Concrete Collar	4	EA	$	$

62	Concrete Parking Bumper	12	EA	$	$
63	Concrete Curb, MDOT Detail E4	15	LF	$	$
64	Curb and Gutter, Concrete, Detail F4	2100	LF	$	$
65	Sidewalk, Concrete, 4-inch	4000	SF	$	$
66	Sidewalk Ramp, Concrete, 6-inch	1100	SF	$	$
67	Restoration with 3-inches Topsoil and Nursery Sod, and Mulch	170	SY	$	$
68	Sprinkler Allowance	1	LS	$	$
69	Maintenance Agg	30	TON	$	$
	PAVING AND RESTORATION SUBTOTAL			**$**	

	F. BID ALTERNATE 1				
70	Remove Concrete Curb and Gutter	200	LF	$	$
71	Cold Milling Bituminous Pavement, 2 Inch	25000	SY	$	$
72	Adjust Structure	100	EA	$	$
73	Reconstruct Structure	200	VF	$	$
74	Remove and Replace Frame and Cover	39200	LB	$	$
75	Bituminous Pavement, Wearing Course, 1300T	2800	TON	$	$
76	Bituminous Pavement, Leveling Course, 3C	200	TON	$	$
77	Pavement Markings	6	LS	$	$
78	Curb and Gutter, Concrete, Detail F4	200	LF	$	$
	BID ALTERNATE 1 (Items 70 to 78) SUBTOTAL			**$**	

Total Base Bid (Items 1 through 69) $_____

Total Bid Alternate 1 (Items 70 through 78) $_____

5. 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.
6. 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.
7. 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.
8. The Bidder will provide a bid bond, in the amount of at least **five (5)** percent of the amount Bid, drawn payable to City of Plymouth as security for the proper execution of the Agreement.
9. 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.
10. 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.
11. Liquidated damages, as specified in the General Conditions, Supplementary Conditions and Agreement, shall also apply to the Substantial Completion date.
12. 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.
13. Proposals may not be withdrawn for a period of 60 days after bid opening.
14. The following documents are made a condition of this Proposal:
    A. Required Bid Security
    B. Legal Status of Bidder
    C. Non-Collusion Affidavit

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 the 2024 Infrastructure 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)

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.

_____ _____

SECTION 00 51 00
NOTICE OF AWARD

Attention: _____ Date: _____

Project: PLY 2129 2024 Infrastructure 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: Project Description as delineated in your Bid submitted to City of Plymouth on 04-23-2024.

Please comply with the following conditions within15 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 Associates, Inc.

SECTION 00 52 00
AGREEMENT

This Agreement, made and entered into this _____ day of _____ in the year 20___, by and between City of Plymouth 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:

Project Description

The Work will be substantially completed in the work areas on Liberty, Spring, South Main Street, and the valve replacement areas on or before August 30, 2024 and on Main Street/Church Street intersection on or before **10-31-2024**, and completed and ready for final payment in accordance with paragraph 14.11 of Section 00 72 00 - General Conditions on or before **November 15, 2024**.

If the alternate bid is accepted, the resurfacing work will be substantially completed prior to September 1, 2024.

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 Seven Hundred Fifty Dollars ($750.00) 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: _____
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 Ready for Bidders date
8. Plans bearing the following general title: PLY 2129 2024 Infrastructure 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 Plymouth

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: 2024 Infrastructure 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 Associates, Inc.

SECTION 00 61 12.13
LABOR AND MATERIAL PAYMENT BOND FORM

Bond No. _____

KNOW ALL BY THESE PRESENT, That we, _____, a corporation organized and existing under the laws of the State of, and duly authorized to transact business in the State of Michigan, hereinafter called the "Principal," and _____, a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business in the State of 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 13.13
PERFORMANCE BOND FORM

Bond No. _____

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

THE CONDITIONS OF THIS OBLIGATION is such that, WHEREAS, the above Principal has entered into a contract with the said Obligee, dated the day of _____, 20_____, for _____

_____.

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

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

AND THE SAID SURETY, for value received, hereby stipulates and agrees that no change, extension of time, or any other forbearance, alteration or addition to the terms of the contract or to the work to be performed thereunder or the Contract Documents accompanying the same 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 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 65 16
CERTIFICATE OF SUBSTANTIAL COMPLETION

Project: 2024 Infrastructure Project

Owner: City of Plymouth

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 relay on this Sworn Statement to avoid claim of a subcontractor, supplier or laborer who has provided a Notice of Furnishing pursuant to Section 109 of the Construction Lien Act to the Designee or to the Owner or Lessee if the Designee is not named or has died.

Warning to Deponent: A person, who with intent to defraud, gives a false Sworn Statement, is subject to criminal penalties as provided in Section 110 of the Construction Lien Act, Act No. 497 of the Public Acts of 1980, as amended, being Section 570.1110 of the Michigan Complied Laws.

_____ day of _____, 20____.

Notary Public: _____

_____ County, Michigan

My Commission Expires: _____

INSTRUCTIONS

A Sworn Statement in the preceding form must be provided before any Contractor or Subcontractor can file a Complaint, Cross-Claim, or Counter-Claim to enforce a construction lien.

An Owner or lessee may withhold payment to a Contractor or Subcontractor who has not provided a Sworn Statement. Owner or lessee may withhold from a Contractor or Subcontractor who has provided a Sworn Statement the amount sufficient to pay all sums shown on the statement as owing Subcontractors, Suppliers, and laborers, or the amount shown to be due to lien claimants who have provided Notices of Furnishing pursuant to the Construction Lien Act of 1980.

Owner or lessee may rely on a Sworn Statement to avoid a lien claim unless the lien claimant has provided the Owner or lessee with a Notice of Furnishing pursuant to the Construction Lien Act of 1980.

If the contract provides for payments by the Owner to the Contractor, if any, in the normal course of construction, but the Owner elects to pay lien claimants directly, the first time the Owner elects to make payment directly to a lien claimant 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 Oder or Work Change Directive.

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

parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers.

ARTICLE 6 CONTRACTOR'S RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

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

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

6.02 LABOR AND WORKING HOURS

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

6.03 SERVICES, MATERIALS AND EQUIPMENT

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

B. All materials and equipment shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Contract Documents shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence, (including reports of required tests) as to the kind and quality of materials and equipment to be incorporated in the Work. 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, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 12.01.B.1 or specifically covered by paragraph 12.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 12.01.B.

D. Contractor's Fee: When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee 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 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.

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:

2. Copies of the following reports and/or tests are attached as Exhibits:

   Geotechnical Engineering Report (Prepared by SME)
   City of Plymouth – 2024 Infrastructure Program
   SME Project Number: 094712.00
   February 21, 2024

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:

   Wade Trim Associates, Inc.

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: $500,000

   Disease – Policy Limit: $500,000

Disease – Each Employee: $500,000

SGC-5.04.B Comprehensive General Liability

General Aggregate: $3,000,000 **

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

Personal and Advertising Injury: $1,000,000

Each Occurrence: $1,000,000

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

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

SGC-5.04.C Comprehensive Automobile Liability

Bodily Injury: $500,000

Property Damage: $200,000

or combined single limit: $3,000,000 **

SGC-5.04.D Owner's Protective - Coverage shall be Occurrence Form

Policy to be written with City of Plymouth as the insured

General Aggregate:$3,000,000

Each Occurrence: $3,000,000

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

Cost to Replace at Time of Loss

SGC-5.04.F Umbrella or Excess Liability:

** CONTRACTOR is granted the option of arranging coverage under a single policy for the full limits required or by a combination of underlying policies with the balance provided by an Excess Liability of umbrella liability policy, with he Each Occurrence and the Aggregate limits equal to the total limits requested.

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.

SECTION 00 91 13
ADDENDUM

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

Section	Description of Change

Sheet	Description of Change

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

Section 00 9120
Standard Specification Section Revisions

Part 1 General

The following paragraphs amend or supplement the Standard Specification Sections as indicated below. All Standard Specification provisions which are not amended or supplemented remain in full force and effect.

Section 33 1100: "WATER UTILITY DISTRIBUTION PIPING"

Amend the first sentence of paragraph one, Article 2.07.B, "Gate Valves," to read as follows:

Gate valves, sizes four inches through 16 inches, shall be Mueller 2360 Series; American Cast Iron Pipe Company, Waterous Series 2500; or Clow, F-6104, Resilient Wedge type, conforming to AWWA C509. Valves shall be designed for 200 psi working pressure and 400 psi test pressure. Valve body shall be cast iron, with a smooth, unobstructed waterway. Valve body, bonnet, and thrust collar shall be coated inside and out with fusion bonded epoxy. Valves shall have a 2-inch square-operating nut with cast-in directional arrow, and shall open clockwise. Gate valve shall have a cast bronze, non-rising stem with double "O" ring seals. Two low torque thrust bearings shall be located above and below the thrust collar to reduce friction and minimize operating torques. The stem nut shall be solid bronze and independent of the wedge. The wedge shall be cast iron, replaceable and completely encapsulated in permanently bonded urethane rubber per ASTM D429. Valve inlet and outlet connections shall be mechanical joint.

Section 33 1100: "WATER UTILITY DISTRIBUTION PIPING"

Amend the first sentence of paragraph one, Article 2.07.C, "Fire Hydrants," to read as follows:

Hydrants shall be East Jordan Iron Works 5BR250 Traffic Model, dry barrel compression type conforming to AWWA C502. Unit shall have a seat valve and double operating stem "O" ring seals. Hydrant shall have a 5-1/4 inch diameter valve opening and 6-inch Mechanical Joint connection. Two, 4-inch diameter pumper nozzles shall be provided. Nozzle threads shall be to City of Detroit Fire Department standards. Hydrant shall have a 1-1/8-inch pentagon operating nut and be designed to open in a counterclockwise direction with an arrow cast into the top of the hydrant in a clearly visible location indicating the opening direction. The unit shall be designed for 250 pound working pressure and 500 pound test pressure when tested in accordance with approved AWWA methods. Hydrants shall have nozzles on a removable head or upper section so nozzles may be rotated without removing the lower barrel section.

The bonnet, nozzle housing, lower barrel, and elbow must all be made of the same material (cast iron or ductile). The traffic safety device of the hydrant must consist of a two piece frangible section and a cast iron break coupling. The lower barrel must be flanged at both ends and have a reinforced traffic flange area. The lower barrel must also be designed to accept a one piece flanged spool extension at the traffic area of the hydrant.

The hydrant must be designed for removal of the stem, main valve, drain valve, and seat ring through the top of the hydrant without removing the nozzle housing. A short design wrench is required which does not place excessive force on the stem traffic coupling.

Hydrants shall be suitable for a bury of 6-feet from bottom of hub to grade line unless otherwise indicated on the Plans. Hydrants' exterior surfaces shall be painted using suitably approved weatherproof paint. Hydrant shall be painted black below grade line and red above the grade line.

Section 33 1100: “WATER UTILITY DISTRIBUTION PIPING”

Delete Article 2.10, Corporation Stops, of Section 33 1100 and insert the following in its place.

2.10 Corporation Stops

Corporation stops shall be Mueller 300, ball type corporation stops, 1-inch minimum size, AWWA taper thread inlet and Copper Flare outlet.

Section 33 1100: “WATER UTILITY DISTRIBUTION PIPING”

Delete Article 2.12, Curb Stops, of Section 33 1100 and insert the following in its place.

2.12 Curb Stops and Curb Box

Curb boxes shall be Mueller Company, extension type with arch pattern base, model H-10334, 1-inch inside diameter, combination lid with pentagon plug.

Section 33 1100: “WATER UTILITY DISTRIBUTION PIPING”

Delete Article 2.22.D., Acceptable Manufacturers-Corporation Stops, and 2.22.F., Acceptable Manufacturers-Curb Stops, in their entirety.

Part 2 Products (Not Used)

Part 3 Execution (Not Used)

End of Section

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The Base Project includes the resurfacing of Main Street from Ann Arbor Road to Burroughs, including the installation of new water services to several businesses on the east side of Main Street. This Base Project also includes the reconstruction of Spring Street, including new storm sewer and drainage structures, the resurfacing of Liberty Street between N. Mill Street and Amelia, including some minor water service upgrades, and potentially the reconstruction of the Main Street/Church Street Intersection, as well as several water system valve replacements at multiple locations throughout the City.

B. The work on Liberty, Spring, South Main Street and in each of the water valve replacement areas can begin immediately following the Notice to Proceed and a coordinated pre-construction meeting. It is desired by the City to complete the work on Liberty, Spring, South Main Street and the water valve replacement areas prior to August 31, 2024.

C. The work at the Main Street/Church Street Intersection has been included in the base bid, however, the City may or may not complete this intersection work in 2024 due to various City related coordination issues. The City reserves the right to delete this portion of the work. If this intersection work is awarded, work at the Main/Church intersection cannot begin until September 10, 2024 (after the completion of the Fall Festival) and must be completed prior to November 8, 2024.

D. The City has also requested bids for an Alternate Set of Resurfacing Projects located throughout the City. The City reserves the right to award a portion of, all or none of the alternate resurfacing project work.

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. The City of Plymouth intends to retain Rauhorn Electric to complete traffic signal and pedestrian crossing signal upgrades at the intersection of Main Street and Church Street. Rauhorn Electric's work shall include the removal of all existing traffic signal components and include the installation of new conduit, wiring, cabinets, foundations, support poles, mast arms and pedestrian crosswalk signals to replace the existing infrastructure. If the City The contractor shall coordinate their work on the 2024 Infrastructure Improvement Program Project with Rauhorn Electric. The Contractor shall coordinate with the contractor for the Traffic Signal Upgrades Project to ensure the orderly completion of the work and the timely completion of both projects.

1.04 RIGHT-OF-WAY JURISDICTION/PERMITS

A. North Mill Street and Sheldon Road are under the jurisdiction of the Wayne County Department of Public Services.

B. Ann Arbor road is under the jurisdiction of the Michigan Department of Transportation.

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

D. The Tonquish Creek/Byron Drain is under the jurisdiction of Wayne County Department of Public Services.

E. 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. 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 Plymouth Water Department shall be notified. Valves shall be opened or closed only by the City of Plymouth 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 Plymouth 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.

1.08 AUDIO/VIDEO ROUTE SURVEY

A. An audio/video route survey as specified in Section01 33 00 - Submittal Procedures shall be required for this Project. Complete coverage shall include the project areas and 50 feet beyond the project limits shown on the plans.

B. The audio/video route survey shall be on USB Flash Drive.

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

Item 1

Mobilization will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment necessary for preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site; for the establishment of Contractor's, Engineer's, and Owner's field offices, and other facilities necessary to undertake the work on the project; and for other work and operations which must be performed, or for expenses incurred, prior to beginning work on the various contract items on the project site. It shall also include preconstruction costs, including insurance and bonds, exclusive of bidding costs, which are necessary direct costs to the project and are of a general nature rather than directly attributable to other pay items under the contract. Payment for mobilization will be based upon the following schedule:

Partial Payment Schedule	
Percentage of Original Contract Amount Earned	Percentage of Bid Price for Mobilization Allowed
5	50
10	75
25	100

Item 2

Traffic Maintenance and Control will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for labor, material, and equipment required for maintaining traffic, and shall include, but is not limited to, furnishing, installing, operating, and maintaining barricades, lighted arrow boards, drums, traffic control devices, signs, channeling devices, cones, flagmen, flag control, pavement markings, warning flashers, concrete barriers, minor traffic devices, and other items necessary to complete the job, whether specifically mentioned or implied.

Item 3

Audio-Video Route Survey will be paid for at the Contract Unit Price on a Lump Sum basis. Price paid shall be payment in full for 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.

Item 4

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

markings, and other items necessary to complete the Work, whether specifically mentioned or implied.

Item 5

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

a. An Inspector Day 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.

b. 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 Engineer. Cost of Inspector Days will be deducted from the monthly payments to the Contractor and paid to Engineer by the 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.

Item 6, 7

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.

Item 8, 9, 10

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, 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.

Item 11

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

Measurement for pavement excavation will be determined by one of the following methods:

a. For full width pavement: By a neat rectangle, the width equal to the proposed pavement plus two (2) feet on each side, and the height of the rectangle determined by the difference in elevation, from the elevation of the existing right-of-way centerline down to the average subgrade elevation or the average bottom of the proposed pavement, whichever is lower. The average subgrade or bottom of pavement elevation being determined by averaging the elevation of each as measured at the back of curbs or edges of pavement and the centerline of the pavement.

b. For pavement widening: By a neat rectangle, the width equal to the proposed pavement widening plus two (2) feet, and the height of the rectangle determined by the difference in elevation from the surface or gutter of the existing pavement down to the subgrade elevation or the bottom of the proposed pavement, whichever is lower. The average subgrade or bottom of pavement elevation being determined by averaging the elevation of each, as measured at the back of curb and the edge of pavement. Unless otherwise specified in the Proposal, the subbase material required to fill the void between the subgrade and the bottom of proposed pavement shall be provided and compacted in place and shall be considered incidental to the price paid for pavement excavation.

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

Item 12, 70

Concrete Curb and Gutter, Remove will be paid for at the Contract Unit Price per Linear Foot (LFT). Price paid shall be payment in full for labor, material, and equipment necessary for the removal of concrete curb and gutter, as shown on the Plans or as determined by Engineer, and 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 other items necessary to complete the job, whether specifically mentioned or implied.

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

Item 13

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

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

Item 14

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. Measurement for removal of bituminous pavement will be by field measure of removed pavement is square yards.

Item 15

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; also 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. Removing structures will be measured on an each unit basis for each structure removed.

Item 16, 17, 18, 71

Pavement, Bituminous, Cold Milling up to 1.5, and 2 inches in depth, will be paid for at the Contract Unit Price per Square Yard (SYD). Price paid shall be payment in full for labor, material, and equipment required for cold milling bituminous pavement as shown on the plans, and shall include, but is not limited to, construction, protection of existing improvements, hand chipping around structures, removal and disposal of debris, traffic control, barricading, dust control, wedging driveways and streets, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for cold milling bituminous pavement will be determined by field measure.

Item 19

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; also furnishing, placing and compacting backfill; protection of existing improvements; barricading; and for all items necessary to complete the job, whether specifically mentioned or implied.

Measurement for removal of concrete sidewalks or driveways six (6) inches or less in thickness will be in square feet, determined by field measurement.

Item 20

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; also 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. Removing storm sewers and culverts will be field measured in linear feet.

Item 21

Remove existing gate valve and well structure will be paid for at the Contract Unit Price per each. Price paid shall be payment in full for all labor, materials, and equipment required for removing existing gate valve and well, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, draining, and dewatering; backfilling (including backfill with special materials where specified); disposal of excess excavated material; protection of existing improvements; removing and salvaging gate valve and well frame and cover; removing valve well; cleanup; restoration; and all other items necessary to complete the job, whether specifically mentioned or implied. Removing gate valve and well structures will be measured as units removed.

Item 22

Removing fire hydrants 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 removing fire hydrant, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; thrust blocks; restoration; cleanup; removal of fire hydrant, valve, valve boxes, and connecting piping; capping of existing water main; delivering hydrant, gate valve and valve box to the OWNER; cleanup; restoration; and all other items necessary to complete the job, whether specifically mentioned or implied. Removing fire hydrant will be measured as units removed.

Item 23

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, install and maintain soil erosion and sedimentation control devices, and shall include, but is not limited to, 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.

Item 24, 27, 28, 29, 35, 36

Water main, of the type, diameter and class specified, in open cut trench, will be paid for at the Contract Unit Price per linear foot. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and installing water main, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, draining, dewatering, laying, jointing, bedding, testing and disinfecting; backfilling (including backfill with special materials where specified); disposal of excess excavated material; protection of existing improvements; temporary blow-offs; thrust blocks; fittings; encasement; barricading; restoration; final cleanup; connections to existing mains; and all other items necessary to complete the job, whether specifically mentioned or implied. Measurement for water main will be in linear feet along the centerline of the pipe taken from end-to-end with no reduction for fittings and valves except for special structures, sections or connections for which either lump sum or unit prices have been taken will be deducted from the total length of water main and will be paid for at the prices bid therefor.

Item 25

Abandoning water main will be paid for at the Contract Unit Price per cubic yard of flowable fill pumped into the existing mains. Price paid shall be payment in full for all labor, material, and equipment necessary for abandoning water main, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; all specials

and fittings; capping ends of existing water main; thrust blocks; filling with flowable fill; cleanup; restoration; and all other items necessary to complete the job, whether specifically mentioned or implied. Measurement for abandoning water main shall be by certified batch plant delivery tickets of flowable fill submitted to the ENGINEER at time of placement.

Item 26

Gate Valve and Well, 8 Inches, will be paid for at the Contract Unit Price per Each. Price paid shall be payment in full for labor, material, and equipment necessary for furnishing and installing valve and well, and shall include, but is not limited to, valve, valve well foundation, steel reinforcing, bricks, blocks, valve well sections, adjusting rings, well frame and cover, cement mortar plaster coat, necessary excavation, sheeting and bracing, shoring, dewatering, connection to water main, backfilling, restraints, disposal of excess excavated material, thrust blocks, restoration, cleanup, and other items necessary to complete the job, whether specifically mentioned or implied.

Valve and well will be measured as units installed.

Item 30, 31, 32, 33

Water service lines, of the length and type specified, bored under the pavement from the new water main to the existing curb stop, will be paid for at the Contract Unit Price per each. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and installing bored water service lines, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; all water service pipe, curb stops, curb box, corporation stops, and special fittings; connection to new water main (including service clamps where specified); restoration; cleanup; and all other items necessary to complete the job, whether specifically mentioned or implied. Water service lines bored under the pavement from new water main to the existing curb stop will be measured as units installed.

Item 37

Fire hydrant assemblies will be paid for at the Contract Unit Price per each. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and installing fire hydrant assemblies, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; protection of existing improvements; also valves, valve boxes, fittings, thrust blocks, and connecting piping; connection to water main; disposal of excess excavated material; restoration; cleanup; and all other items necessary to complete the job, whether specifically mentioned or implied. Hydrants will be measured as units installed.

Item 38, 39, 40

Curb stop and box will be paid for at the Contract Unit Price per each with the sizes shown on the plans. Price paid shall be payment in full for all labor, material, and equipment required for installation of new curb stop and new curb box on existing and/or new water service line, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; connection to existing water service line; restoration; cleanup; and all other items necessary to complete the job, whether specifically mentioned or implied. This item will be used at the discretion of the ENGINEER when an existing water service line cannot be connected to the existing curb stop or whenever determined by the ENGINEER.

Item 41, 44, 74

Remove and replace structure frame and cover will be paid for at the Contract Unit Price per pound. Price paid shall be payment in full for all labor, material and equipment

necessary for removing the existing frame and cover and replacing with a new frame and cover, and shall include, but is not limited to, all excavation, removing and salvaging existing frame and cover, furnishing and installing new frame and cover, sand backfill, cleanout of structure, removal and disposal of unsuitable or excess material, and all other items necessary to complete the Work, whether specifically mentioned or implied.

Measurement for remove and replace structure cover will be in pounds determined by the scale weight of the new frame and cover.

Item 42, 72

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

Item 43, 73

Structure, Reconstruct of the size, type, and material specified will be paid for at the Contract Unit Price on a Vertical Foot (VFT) basis. Price paid shall be payment in full for labor, material, and equipment required to either raise the frame and cover in excess of 12 inches, lower them in excess of six (6) inches, or to rebuild portions of the existing structure which need to be reconstructed due to deterioration; and shall include, but is not limited to, sawcutting, excavation, removal and disposal of pavement, construction, bricks, blocks, precast cone section, riser sections, top section, adjustment rings, joints, masonry plaster coat, steps, sand backfill, concrete pavement, installation of frame and cover, cleanout of structure, and other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for reconstruction of structures will be in vertical feet, measured from the new elevation of the masonry below the casting down to the point where the structure has been reconstructed. A structure which has been paid for as "Structure, Reconstruct" will not be paid for as "Structure, Adjust".

Item 44, 45

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 furnishing and installing storm sewer pipe and culvert pipe in open cut trench, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; sand backfill; stone 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.

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

the end of the special bid item nearest the adjoining drainage structure and the adjoining drainage structure.

Item 47, 49, 50

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. 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, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; also frame, cover, bricks, blocks, cone section, riser sections, top section, bottom section, masonry plaster coat, and steps; barricading; restoration; and all other items necessary to complete the job, whether specifically mentioned or implied. Additional depth of drainage structures, more than eight (8) feet, of the type and diameter specified will be measured by 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.

Item 48

Edge drain, of the diameter 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 furnishing and installing the edge drain, and shall include, but is not limited to, all excavation, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; stone bedding; geotextile fabric wrap; placing of stoppers or bulkheads; connection to drainage structures; and all other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for edge drain will be in linear feet, determined by field measurement of edge drain in place.

Item 51, 52

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, sheeting, bracing, shoring, dewatering, and backfilling; disposal of excess excavated material; protection of existing improvements; also frame, cover, bricks, blocks, cone section, riser sections, top section, bottom section, masonry plaster coat, and steps; connection to sewer; barricading; restoration; and all other items necessary to complete the job, whether specifically mentioned or implied. Additional depth of drainage structures, more than eight (8) feet, of the type and diameter specified will be measured by 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.

Item 53

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.

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

Item 54

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 required for furnishing, placing and compacting the aggregate base course; and shall include, but is not limited to, all excavation, construction, and protection of existing improvements; also furnishing, placing, and compacting backfill and subbase; compacting and fine grading subgrade; furnishing and applying chemical additives and water; barricading; and for all items necessary to complete the job, whether specifically mentioned or implied.

Measurement for aggregate base course will be in tons, with the installed tonnage determined by certified delivery tickets submitted to 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.

Item 55, 65, 66

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 construction of sidewalks, sidewalk ramps and driveway approaches; and shall include, but is not limited to, all excavation, construction, and protection of existing improvements; also 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 all other items necessary to complete the job, whether specifically mentioned or implied. 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.

Item 56, 57, 75, 76

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, construction, protection of existing improvements; also compacting and fine grading subgrade; furnishing, placing and compacting backfill and subbase; furnishing, placing, rolling and compacting the various bituminous lifts or courses; furnishing and applying of prime and bond coats; barricading; restoration; and for all items necessary to complete the job, whether specifically mentioned or implied.

Measurement for bituminous pavement will be in tons, with the installed tonnage determined by certified batch plant delivery tickets submitted to the ENGINEER or his duly authorized representative, at the time of placement.

Item 58

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 construction of concrete pavement; and shall include, but is not limited to, all excavation, construction, and protection of existing improvements; also 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, fillers, hot-poured elastic joint compound, mesh reinforcement, and bar mat reinforcement; also forming, placing, jointing, finishing, texturing and curing the concrete; also providing protection against rain and cold weather; barricading; pavement gapping; part width construction; miscellaneous restoration; and all other items necessary to complete the job, whether specifically mentioned or implied. Measurement for concrete pavement will be in square yards, determined by field measurement of the concrete in place.

Item 59, 77

Pavement markings of the type, width and color specified on the Plans, will be paid for at the Contract Unit Price of Lump Sum. Price paid shall be payment in full for all labor, material, and equipment necessary for linear pavement markings, pavement word and/or symbol markings, and shall include, but is not limited to, all preparation of surface, layout, removing any old markings; applying proposed pavement markings, pavement word marking, pavement symbol markings, and glass beads; providing temporary barricading; cleanup; and all items necessary to complete the job, whether specifically mentioned or implied.

Item 60

Remove and re-install parking bumpers 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 remove, store, and re-install the existing parking bumpers, and shall include, but is not limited to, removing, stacking and protecting the parking bumpers; removing and reinstalling anchoring pins; furnishing and installing new anchor pins as required; and all other items necessary to complete the Work, whether specifically mentioned or implied.

Item 61

Concrete collar 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 construction of a concrete collar around the drainage structure, and shall include, but is not limited to, all sawcutting, removal and disposal of existing pavement, excavation, construction of concrete collar, sand backfill, cleanout of structure, removal and disposal of unsuitable or excess material, and all other items necessary to complete the Work whether specifically mentioned or implied.

Item 62

Parking bumpers, of the type and length specified, will be paid for at the Contract Unit Price per each, in place. Price paid shall be payment in full for all labor, material, and equipment necessary for furnishing and installing precast, reinforced concrete parking bumpers and anchoring with pins as shown on the plans or specified.

Item 63, 64, 78

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; also furnishing, placing, and compacting backfill and subbase; compacting and fine grading subgrade; providing and installing hook bolt assemblies, tie

bar assemblies, and reinforcing steel; also forming, placing, jointing, finishing, texturing and curing the concrete; providing protection against rain and cold weather, backfilling; barricading; restoration; gapping; and all items necessary to complete the job, whether specifically mentioned or implied.

Measurement for concrete curb and gutter will be in linear feet, determined by field measurement of curb and gutter in place.

Item 67

Restoration with topsoil (of the depth specified), and sod 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 furnishing and installing topsoil and sod to the cross section shown on the Plans or as determined by the ENGINEER, and shall include, but is not limited to, all excavation, subgrade preparation; filling, shaping, grading, plowing, discing, and raking subgrade; disposing of unsuitable material and excess material; furnishing fill and topsoil; placing sod; also pegging, rolling, and tamping sod; protection of existing improvements; miscellaneous cleanup and restoration; maintenance and care; and all items necessary to complete the job, whether specifically mentioned or implied. The CONTRACTOR shall restore all areas disturbed by his operations.

Measurement for restoration with topsoil and sod will be determined by taking the length along the property line, field measured in linear feet, on each side of the proposed pavement, less the driveway width or the pavement width at the intersections. The limits of right-of-way restoration shall be as follows:

For rights-of-way with ditches, the limits of right-of-way restoration will be between a line located 1-foot from the top of ditch back slope nearest the right-of-way line, to the right-of-way line.

For rights-of-way without ditches, the limits of right-of-way restoration will be between the back of curb and the right-of-way line.

Areas disturbed outside of the limits indicated shall be restored at the CONTRACTOR’s expense.

Item 68

Sprinkler Allowance, 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 to restore all damaged sprinkler systems that occur from normal construction activities or determined by the Engineer. Any broken or damaged sprinklers outside of the construction zone will be repaired at the contractors expense.

Item 69

Maintenance Aggregate will be paid for at the Contract Unit Price per Ton. Price paid shall be payment in full for 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, 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 other items necessary to complete the job, whether specifically mentioned or implied.

Measurement for maintenance aggregate will be determined by certified delivery tickets submitted to Engineer or Engineer's 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 Engineer will be paid for at the tonnage basis specified. If the width of the maintenance aggregate is increased to accommodate Contractor’s operation, the additional material installed beyond the width specified on the Plans or as determined by Engineer, will be at Contractor's expense.

---------- Miscellaneous ----------

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.

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)

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)

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 install1-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 then original, and adequate for normal travel.

1.05 WORK WITHIN RAILROAD COMPANY RIGHT-OF-WAY

A. Contractor shall be responsible for complying with the requirements of the Railroad Company for 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)

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.

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)

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)

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 startup 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)

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.

SECTION 04 05 11
MORTARING AND GROUTING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the preparation and installation of mortar and grout used for bond or primer coats, laying and grouting masonry units, filling the inside annular space of pipe joints, general patching, grout for riprap and flagstone slope protection, joints in precast structural members, spaces under leveling plates and equipment bases, supporting structures, grouting dowels and anchor bolts.

1.02 DEFINITIONS

A. Mortar is a plastic mixture of cementitious materials, admixtures where specified, fine aggregate and water.

B. Grout is a mixture of sand, water, and fine aggregate mixed to a fluid consistency.

1.03 REFERENCE STANDARDS

A. ACI - 530.1: Specification for Masonry Structures

B. ACI 304R: Guide for Measuring, Mixing, Transporting, and Placing Concrete

C. ASTM C91/C91M: Standard Specification for Masonry Cement

D. ASTM C150/C150M: Standard Specification for Portland Cement

E. ASTM C207: Standard Specification for Hydrated Lime for Masonry Purposes

F. ASTM C270: Standard Specification for Mortar for Unit Masonry

G. MDOT - Michigan Department of Transportation Standard Specifications for Construction, latest edition

1.04 REFERENCE SPECIFICATIONS

A. The latest or current ACI Standards, and the “Specifications for Masonry Structures," ACI-530.1, shall govern all mortar and grout work except where otherwise specified herein.

1.05 SUBMITTALS

A. Manufacturer's literature shall be submitted for premixed materials.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials shall be stored and handled as recommended in ACI 304R .

B. When cement is stored 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. At the time of its use the cement shall be free from lumps. Cement sacks shall be thoroughly shaken when emptying sacks into the batch. Cement salvaged by the Contractor by cleaning sacks mechanically or otherwise, or from discarded sacks of cement shall not be used.

C. The aggregates are to be furnished, stocked and handled so that uniformity of grading will be obtained at the time of batching. The area on which stockpiles are to be built shall be thoroughly cleaned of all foreign materials and shall be firm, reasonably level, and well drained. No aggregates which have become intermixed prior to proportioning shall be used.

D. The premixed mortar or grout shall be stored and handled in strict accordance with the manufacturer's recommendations.

1.07 JOB CONDITIONS

A. Environmental requirements relative to temperature for mixing and placing mortar or grout shall be in accordance with Part 2 of this Section.

PART 2 PRODUCTS

2.01 PREMIXED MORTAR OR GROUT

A. Premixed mortar or grout shall be a complete packaged mixture to which water is to be added at the job site. Mortar and grout shall be nonshrink, nonstaining.

2.02 CEMENT

A. The type of cement to be used shall be as indicated on the Plans or as specified below:

1. Portland cement: Types I, IA or III: ASTM C150/C150M.
2. Masonry cement: Type N, S, or M: ASTM C91/C91M.
3. Mortar: Type M or S: ASTM C270.
4. Hydrated lime: Type S: ASTM C207.

2.03 AGGREGATE

A. Fine aggregate: Type 2MS, per MDOT Section 902.08

2.04 ADMIXTURES

A. Integral waterproofing compounds, accelerators, retarders or other admixtures not definitely mentioned in the Specifications shall not be used in mortar or grout without the approval of the Engineer. Use no admixtures containing calcium chloride.

2.05 WATER

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

2.06 MIXES

A. General:

1. Water shall be added to premixed mortar or grout in strict accordance with manufacturer's recommendations to prepare a stiff or plastic mix, depending on workability needed for application.
2. For job mixed mortar or grout, a mixture of cement, aggregate, water and admixtures, if required, shall be combined in proportions meeting the requirements of MDOT Section 702 to produce mortar or grout for the use indicated on the Plans and as specified herein.
3. For job mixed mortar and grout the cement and aggregate shall be proportioned by weight for cubic yard (or cubic meter) batches or by volume for small batches. Shovel method of volume measuring will not be permitted. When materials are measured by volume, water shall be added in amounts necessary for the consistency required for the Work.

B. Standard Mortar and Grout

MDOT Designation	General Use
R-1 (Grout)	Bond or Primer Coat
R-2 (Mortar)	Laying masonry units, caulking pipe joints, general patching
R-3 (Mortar)	Filler between slope protection and riprap

C. Non-Shrinking Mortar and Grout

1. Unless otherwise indicated on the Plans or Specifications, the cement shall be Portland Type I. The materials shall be proportioned by weight, with water added in amounts to obtain necessary consistency required for the Work.

MDOT Designation	General Use
Type H-1	Joints in precast structural members, spaces under leveling plates, supporting structures, grouting dowels, and anchor bolts

2.07 MIXING

A. The minimum mixing time shall be five (5) minutes. Consistency of mortar shall be adjusted to provide the best workability. If the mortar begins to stiffen from evaporation or absorption of a part of the mixing water, the mortar shall be retempered by adding water and remixing. Consistency of the grout shall be such that at the time of placement, it will completely fill all spaces intended to receive grout.

2.08 MIX TEMPERATURE

A. The temperature of the mix shall be between 40 to 120 degrees Fahrenheit.

2.09 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers of premixed, nonshrink, nonmetallic grout include:

1. Sonneborn "Sonogrout"
2. L&M Construction Chemicals "Duragrout"
3. Masters Builders "Masterflow 713"
4. Five Star Products "Five Star Grout"
5. Engineer-approved equal.

PART 3 EXECUTION

3.01 VERIFICATION

A. Contractor shall verify the elevation of structural member or equipment bases to be grouted, and/or location of anchoring devices as indicated on the Plans or approved Shop Drawings.

3.02 PREPARATION

A. Surfaces to receive mortar or grout shall be prepared as follows, unless otherwise specified:

1. Remove laitance down to sound concrete.
2. Surface shall be properly wet cured, being free of chemical curing compound, oil, grease, dirt and loose particles.
3. Clean bolt and/or tie holes, anchor bolts and underside of bearing plates.
4. Saturate concrete including holes prior to grouting.

B. When a premixed mortar or grout is used, preparation of surfaces shall be in strict accordance with manufacturer's recommendations.

3.03 INSTALLATION - GENERAL

A. Mortar and grout shall be used within 2-1/2 hours of initial mixing. No mortar or grout shall be used after it has begun to set.

B. Premixed mortar or grout shall be used in strict accordance with the manufacturer's recommendations.

3.04 INSTALLATION OF MASONRY UNITS

A. Mortar joints to bond brick or block shall be no less than 3/8 inch and no greater than 1/2 inch thick. The surface of the joint shall be struck to be flush with the masonry units.

3.05 SURFACE FINISHING APPLICATIONS

A. Nonshrink mortar shall be thoroughly compacted into all voids, holes, honeycombs, or other defects in the finish surface of concrete. The mortar shall be flush with the surrounding concrete and matching in color and texture.

3.06 GROUTING ANCHORING DEVICES

A. Nonshrink, nonstaining mortar or grout shall be placed in the hole provided, then the anchoring device or dowel shall be set into the grout filled hole. The surface shall be flush with the surrounding concrete. No pressures or loads shall be applied to the anchoring device until the mortar or grout has attained its ultimate strength.

3.07 GROUTING PLATES AND STRUCTURAL MEMBERS

A. Thoroughly fill the area between the foundation and plate or member with nonshrink, nonmetallic grout. If required, immediately set shims and align plate or member as required. After the grout has set hard remove forms or shims and finish with a capping mortar.

3.08 COLD WEATHER WORK

A. General:

1. No masonry units, mortar or grout Work shall be placed in contact with frozen surfaces. No mortar or grout Work shall be performed when the mean air temperature is below 40 degrees Fahrenheit unless the materials are heated and/or the Contractor provides adequate protection of the Work. All Work shall be protected against freezing for no less than 48 hours after placement.

2. Application of heat to the materials shall be made in a manner which will keep these materials clean and free from injurious substances.

B. Air Temperature 40 to 32 degrees Fahrenheit:

1. Sand or mixing water shall be heated to produce mortar temperatures between 40 to 120 degrees Fahrenheit. Heating of either of the ingredients shall be to a minimum 70 to 160 degrees Fahrenheit. The ideal mortar temperature should be 70 to 80 degrees Fahrenheit.

C. Air Temperature 32 to 25 degrees Fahrenheit:

1. Sand and mixing water shall be heated to produce mortar temperatures between 40 to 120 degrees Fahrenheit. Maintain temperatures of mortar on boards above freezing. Heat sand and water to a minimum 70 to 160 degrees Fahrenheit.

D. Air Temperature 25 to 20 degrees Fahrenheit:

1. Sand and mixing water shall be heated to produce mortar temperatures between 40 to 120 degrees Fahrenheit. Maintain mortar temperatures on boards above freezing. Salamanders or other sources of heat shall be used on both sides of interior bearing walls under construction and on the inside of all exterior walls. Windbreaks shall be employed when wind is in excess of 15 mph.

E. Air Temperature 20 degrees Fahrenheit and Below:

1. Sand and mixing water shall be heated to provide mortar temperatures between 40 to 120 degrees Fahrenheit. Enclosure and auxiliary heat shall be provided to maintain air temperature above 40 to 120 degrees Fahrenheit. Temperature of units when laid shall be not less than 20 degrees Fahrenheit.

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 the requirements 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 ± 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.

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.

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.

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.

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 501except 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						
			Percentage Passing Designated Sieves			
Type of Course	Range (a)	(b)	No. 8	No. 30	No. 200	Asphalt Binder Content
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 dray or compressive action necessary to produce the desired surface texture.
3. Paver shall be equipped with a hopper and an automatic material-depth control device so that each distributing auger and corresponding feeder shall respond automatically to provide for a constant level of mix ahead of the screed unit to the full width of the lane being paved.
4. In order to ensure that adequate material shall be fed to the center portion of the lane being paved, reverse pitch augers or paddles shall be installed at the inside of one or both ends of the auger shafts to force the mix to the middle portion of the lane. If necessary to

prevent segregation of the mix as it drops off the feed conveyor, baffle plates shall be installed at the required location.

5. When extensions are added to the paver, they shall be provided with the same vibrating screed or tamper action as the main unit of the paver, except for paving variable width areas. 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 between0 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 Overlayed	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.

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 tube2 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 last 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.

l. 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 ± 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 \'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 overlayed 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**
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.

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 or 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 milpolyethylene 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
o to 150 psi	None
more than 150 but not exceeding 300 psi	20
more than 300 but not exceeding 500 psi	50
more than 500 psi	Remove & Replace

E. The area of the deficient core 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.

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 comple 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 affect 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.

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.

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.

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. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
16. ASTM C150/C150M: Standard Specification for Portland Cement
17. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
18. ASTM C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
19. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
20. ASTM C595/C595M: Standard Specification for Blended Hydraulic Cements
21. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
22. ASTM C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
23. ASTM C828: Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
24. ASTM C969: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
25. ASTM C1091: Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines
26. ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
27. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
28. ASTM D2680: Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
29. ASTM D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
30. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
31. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
32. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
33. ASTM F679: Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
34. ASTM F949: Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
35. ASTM F1417: Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air
36. ASTM F1803: Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter
37. ASTM F2487: Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines

38. MDOT - Michigan Department of Transportation, Standard Specifications for Construction, latest edition
39. NASSCO - National Association of Sewer Service Companies
40. 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 within0.2 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 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.

2.03 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 ± 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.

2.04 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.

2.05 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.

2.06 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.

2.07 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.

2.08 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.

2.09 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.

2.10 STEEL PIPE

A. Pipe shall conform to ASTM A53/A53M, black and hot-dipped galvanized welded and seamless pipe of standard weight.

2.11 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.

2.12 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.

2.13 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.

2.14 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 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.

3.10 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.

3.11 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.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 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.

3.18 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.

3.19 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.

3.20 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.

3.21 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 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.

3.22 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.

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 167M/M 167: Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
3. AASHTO M 196: Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
4. AASHTO M 245: Standard Specification for Corrugated Steel Pipe, Polymer- Precoated, for Sewers and Drains
5. AASHTO M 252: Standard Specification for Corrugated Polyethylene Drainage Pipe
6. AASHTO M 274: Standard Specification for Steel Sheet, Aluminum-Coated (Type 2), for Corrugated Steel Pipe
7. AASHTO M 278: Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
8. AASHTO M 330: Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter
9. ASTM A48/A48M: Standard Specification for Gray Iron Castings
10. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
11. ASTM A1064/A1064M: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
12. ASTM C12: Standard Practice for Installing Vitrified Clay Pipe Lines
13. ASTM C14: Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
14. ASTM C55: Standard Specification for Concrete Building Brick

15. ASTM C76: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
16. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
17. ASTM C150/C150M: Standard Specification for Portland Cement
18. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
19. ASTM C425: Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
20. ASTM C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
21. ASTM C478/C478M: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
22. ASTM C507: Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
23. ASTM C700: Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
24. ASTM C877: Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
25. ASTM C990: Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
26. ASTM C1433: Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
27. ASTM C1577: Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
28. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
29. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
30. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
31. ASTM F949: Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
32. ASTM F2881/F2881M: Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications
33. American Concrete Pipe Association (ACPA)
34. Michigan Department of Transportation, Standard Specifications for Construction, latest edition (MDOT)

1.04 SOURCE QUALITY CONTROL

A. Laboratory test not less than one (1) percent, with a minimum of three (3) pieces each size, material and class of gravity pipe required in the Work.

1.05 SUBMITTALS

A. Submit a complete field report of the location of all wye openings and sump pump discharge leads to the Engineer at the end of each sewer section of the Project or on the last day of each week, whichever occurs first.

B. Submit two (2) copies of the laboratory test reports required per Part 1, Source Quality Control, of this Section to the Engineer.

C. 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 re-rolled 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 re-rolled 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 167M/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 ± five degrees.

L. Type VE elliptical pipe shall be installed with the longer axis placed vertically within a tolerance of ± 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 psi 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.

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.

1.05 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.

1.06 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.

1.07 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.

1.08 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.

1.09 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.

1.10 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.

1.11 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.

1.12 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.

1.13 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.

1.14 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.

1.15 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.

1.16 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.

1.17 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.

GEOTECHNICAL ENGINEERING REPORT

CITY OF PLYMOUTH – 2024 INFRASTRUCTURE PROGRAM
CITY OF PLYMOUTH, MICHIGAN

SME Project Number: 094712.00
February 21, 2024

SME

SME

The Kramer Building
43980 Plymouth Oaks Blvd.
Plymouth, MI 48170-2584

T (734) 454-9900

www.sme-usa.com

February 21, 2024

Mr. Shawn Keough, PE
Senior Vice President
Wade Trim, Inc.
25251 Northline Road
P.O. Box 10
Taylor, Michigan 48108

Via E-mail: skeough@wadetrim.com

RE: Pavement and Geotechnical Evaluation
City of Plymouth – 2024 Infrastructure Improvement Program
Plymouth, Michigan
Wade Trim Project Number: PLY2129-01T
SME Project No. 094712.00

Dear Mr. Keough:

We have completed our pavement and geotechnical investigation for the City of Plymouth – 2024 Infrastructure Improvement Program project in Plymouth, Michigan. This report summarizes our exploratory and laboratory testing and provides design and construction recommendations for the proposed drilled shaft signal foundations and the proposed pavement rehabilitation.

We appreciate the opportunity to serve you on this project. Please contact us if you have any questions or require additional information.

Very truly yours,

SME

Jeremy S. Friedley, PE
Senior Project Engineer

Enclosure: SME Geotechnical Engineering Report; Dated (February 21, 2024)

TABLE OF CONTENT

1. INTRODUCTION 1
1.1 EXISTING CONDITIONS AND PROJECT DESCRIPTION 1
2. FIELD EXPLORATION 2
2.1 OVERVIEW 2
2.2 PAVEMENT BORINGS 3
2.3 MAST ARM BORINGS 4
3. LABORATORY TESTING 4
4. PAVEMENT BORINGS 5
4.1 PAVEMENT THICKNESS & SUBSURFACE CONDITIONS 5
4.1.1 LIBERTY STREET (STARKWEATHER STREET TO N. MILL STREET) 5
4.1.2 INTERSECTION OF CHURCH STREET AND MAIN STREET 5
4.1.3 S. MAIN STREET (ANN ARBOR ROAD TO BURROUGHS STREET) 6
4.1.4 LIBERTY STREET (AMELIA STREET TO STARKWEATHER STREET) 6
4.1.5 SPRING STREET (STARKWEATHER STREET TO MILL STREET) 7
4.2 RECOMMENDATIONS FOR SUBGRADE PREPARATION 7
4.3 COMMENTS ON PROPOSED PAVEMENT REPAIRS 7
4.4 DRAINAGE CONSIDERATIONS 8
4.5 ENGINEERED FILL REQUIREMENTS 8
4.6 UTILITY CONSTRUCTION CONSIDERATIONS 8
5. MAST ARM TRAFFIC SIGNAL POLES 9
5.1 SUBSURFACE CONDITIONS AND FOUNDATION ANALYSIS 9
5.2 CONSTRUCTION CONSIDERATIONS 10
5.3 LIMITATIONS 12
6. GENERAL COMMENTS 12
7. SIGNATURES 12

APPENDIX A
BORING LOCATION DIAGRAM

APPENDIX B
LABORATORY TESTING PROCEDURES
BORING LOG TERMINOLOGY
BORING LOG AND USACE DATA SHEETS (B1 – B4 & C1-C7)
BORING LOGS (D1 – D2)

APPENDIX C
MDOT SIG-DESIGN-284-A

APPENDIX D
GENERAL COMMENTS
IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

1. INTRODUCTION

This report summarizes our exploratory and laboratory testing and provides design and construction recommendations for the proposed drilled shaft, traffic signal, foundations and the proposed pavement rehabilitation. This investigation was conducted in general accordance with the scope of services outlined in SME Proposal No. P03999.23 dated October 30, 2023. Our services for this evaluation were authorized by Wade Trim, Inc.

To assist with our evaluation, Wade Trim, Inc. provided SME with a PDF file containing a single page of a site plan drawing titled "Traffic Signal Construction Plan," Sheet: EXHIBIT 2, dated December 28, 2023, and prepared by Wade Trim, Inc. for the "2024 Infrastructure Improvements Program" project. The site plan included the locations of existing utilities, existing conditions, and the locations of the two proposed traffic signal mast arms.

1.1 EXISTING CONDITIONS AND PROJECT DESCRIPTION

We understand the City of Plymouth is planning on various improvements at five separate locations within the downtown area of Plymouth, Michigan. The locations of the various sites are detailed below and are depicted on the Location Map inset on the attached Boring Location Diagram (Appendix A).

Liberty Street from Amelia Street to Starkweather Street: The length of this project is approximately 670 feet. Water main improvements are planned for this project.

Liberty Street from Starkweather Street to N. Mill Street: The length of this project is approximately 325 feet. This road is proposed to be resurfaced with minor water main improvements.

Spring Street from Starkweather Street to N. Mill Street: The length of this project is approximately 325 feet. This road is proposed to be resurfaced with minor drainage improvements.

S. Main Street between Ann Arbor Road and Burroughs/Sutherland Street: The length of this project is approximately 1,900 feet. This road is proposed to be resurfaced.

Main Street/Church Street Intersection: This intersection is proposed to be reconstructed and the water main through this intersection will likely be replaced. Two new mast arm, traffic signal poles are planned to be constructed in the pedestrian refuge islands in the median of Church Street to the northwest and southeast of South Main Street. The two proposed traffic signal poles are planned to be double arm, mast arm poles with cantilevered mast arm lengths ranging between 25 and 50 feet. Refer to Image No. 1 below for proposed traffic signal pole locations.

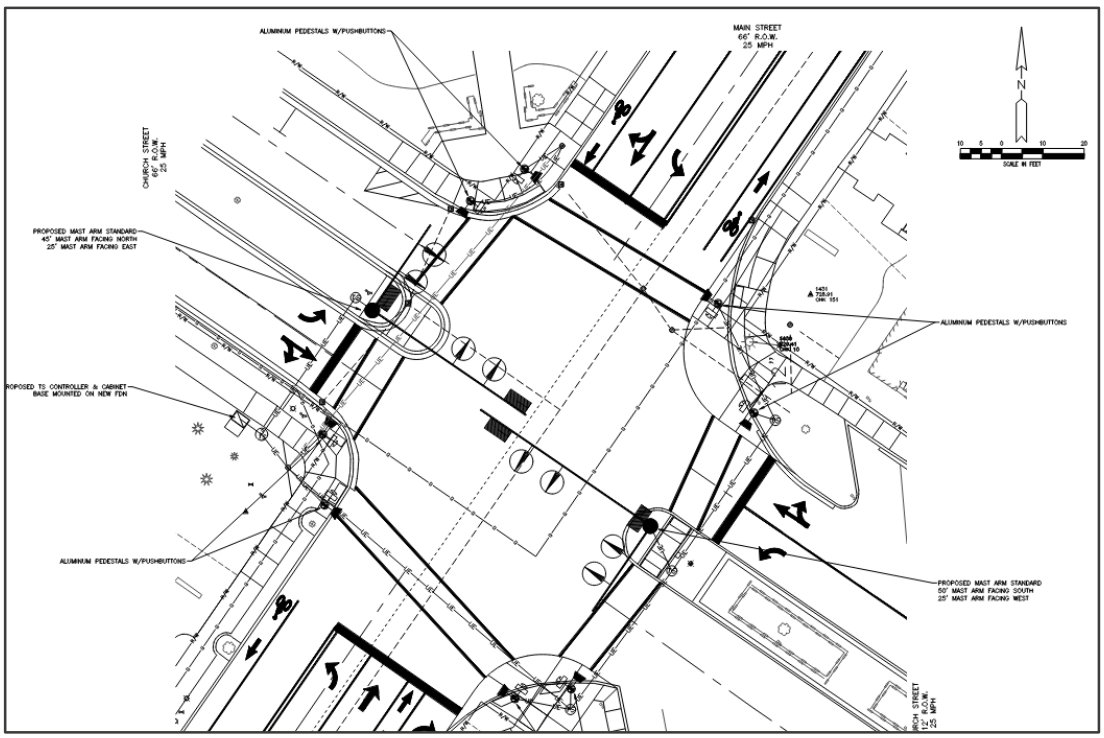


IMAGE NO. 1: Section of a site plan drawing titled "Traffic Signal Construction Plan," dated December 28, 2023, and prepared by Wade Trim for the "2024 Infrastructure Improvement Program" project.

2. FIELD EXPLORATION

2.1 OVERVIEW

SME performed a total of thirteen (13) borings at the various streets and intersections on January 5 and 10, 2024. The planned number, locations, and depths of the roadway borings were jointly determined by SME and Wade Trim. The planned number, locations, and depths of the mast arm traffic signal pole borings were determined by SME based on the exploration guidelines detailed in Section 6, titled "Subsurface Investigation Guidelines," of the Michigan Department of Transportation (MDOT) Geotechnical Manual, dated November 2019. Prior to commencing the field exploration, SME visited the various sites on December 22, 2023, and staked the boring locations by referencing existing site features. Public underground utilities were located and marked by the MISS DIG utility clearance system. The following notations were used for the boring locations:

1. Locations for performing pavement borings in areas where the existing pavement is to be resurfaced: These locations are designated as C1 through C7.
2. Locations for performing pavement borings in areas where the existing pavement is to be resurfaced and water main improvements are planned: These locations are designated as B1 through B4.
3. Locations for performing soil borings where mast arms for traffic signals were to be installed: These locations are designated as D1 through D2.

Table 1, below, shows the depth of each boring from the pavement surface. C1 through C7 is shown in inches and B1 through B4 and D1 through D2 are shown in feet.

TABLE NO. 1: DEPTH OF EACH BORING

BORING	DEPTH (INCH)	BORING	DEPTH (FEET)
C1	36	B1	8[1]
C2	36	B2	10
C3	36	B3	10
C4	20	B4	10
C5	20	D1	25
C6	20	D2	25
C7	20		

NOTES: 1. Boring depth of 10 feet was planned, refusal at 8 feet.

Site topographic information was not available at the time of sampling and existing ground surface elevations at the boring locations were not estimated by SME.

The boring location diagram included in Appendix A shows the boring locations.

2.2 PAVEMENT BORINGS

The pavement borings (C1 through C7 and B1 through B4) were performed on January 5, 2024 using our truck mounted Geoprobe®. See Table 1 above for the boring depths at each location. The pavement surface was cored with a 4-inch-diameter core barrel. After coring and prior to performing soil sampling, the existing base and subgrade soils were evaluated with a dynamic cone penetrometer (DCP) at C1 and C3 and B1 through B4. The DCP was designed by the U.S. Army Corps of Engineers (USACE). The USACE DCP test was performed to a depth of approximately 3 feet from the existing pavement surface. The USACE DCP consists of a 5/8-inch diameter steel rod with a steel cone attached to one end that is driven into the base/subgrade by means of a sliding dual-mass hammer. The number of blows to drive the cone was recorded at selected penetration intervals. The USACE has developed relationships to estimate the in-situ California Bearing Ratio (CBR) value of the subsurface material from the results of the DCP test. CBR is an index commonly used in pavement design that gives an indication of base and subgrade support characteristics. Table No. 2 below shows our opinion of the aggregate base and subgrade support conditions for various ranges of estimated in-situ CBR values from USACE DCP test results.

TABLE NO. 2: AGGREGATE BASE AND SUBGRADE SUPPORT CONDITIONS

SUPPORT CONDITION	CBR RANGE FOR AGGREGATE BASE MATERIAL (%)	CBR RANGE FOR SUBGRADE SOILS (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

After completion of the USACE DCP test, the thickness of the aggregate base, if encountered, was estimated by probing and a sample of the aggregate base was obtained. Soil sampling was performed using a truck mounted Geoprobe® rig. The Geoprobe® uses a pneumatic hammer device to obtain continuous liner samples at a boring using acetate-lined piston samplers. Groundwater measurements were obtained, if present, after completion of probing operations at each location. After completion of sampling, the bore holes were backfilled with sand and gravel and capped with asphalt cold patch. Therefore, long-term groundwater levels were not available from this evaluation.

2.3 MAST ARM BORINGS

Per the guidelines in Sub-Sections 6.2.3.8 and 6.3.1.7 of the MDOT Geotechnical Manual, each of the mast arm borings (D1 and D2) were drilled within 10 feet of the proposed traffic signal foundations and each boring extended to a depth of 25 feet below the existing ground surface.

Borings D1 and D2 were drilled using a rotary-type drill rig and were advanced using continuous-flight augers. The borings included soil sampling based upon the Split-Barrel Sampling procedure. Samples were collected at 2-1/2-foot intervals to the final explored boring depth of each boring. Recovered split-barrel samples were sealed in glass jars by the driller.

Groundwater observations were recorded during and immediately after completion of each boring. Each borehole was backfilled using auger cuttings, and the surface was patched with an EPCO hole plug, after completion and collection of groundwater observations. Therefore, long-term groundwater levels are not available from the borings.

3. LABORATORY TESTING

Soil samples recovered from the field exploration were returned to the SME laboratory for further observation and testing. The laboratory testing program consisted of performing visual soil classifications on recovered samples in general accordance with ASTM D-2488. Moisture content and hand penetrometer and/or Torvane shear strength tests were performed on portions of cohesive soil samples recovered from the borings. The Laboratory Testing Procedures document included in Appendix B provide descriptions of the laboratory tests. Based on the laboratory testing, we assigned a Unified Soil Classification System (USCS) group symbol to the each of the various soil strata encountered. For the pavement borings, the thickness of the pavement cores were measured to the nearest 1/4 inch in our laboratory, and the pavement cores were photographed.

Upon completion of the laboratory testing, we prepared a boring log and USACE data sheet for each boring performed using the Geoprobe that shows a photograph of the pavement core, the materials encountered in the boring, the estimated in-situ CBR values of aggregate base and subgrade (for borings where a DCP test was performed), and the results of laboratory tests. The boring log and USACE data sheet for each boring is included in Appendix B.

For borings D1 and D2, performed at the proposed mast arm locations, boring logs were prepared that include soil descriptions, penetration resistances, pertinent field observations made during the drilling operations, and the results of the laboratory tests. Explanations of symbols and terms used on the boring logs (D1 and D2) are provided in the Boring Log Terminology sheet included in Appendix B. Boring logs for D1 and D2 are included in Appendix B.

The Standard Penetration Test (SPT) resistances (N-values) plotted on the boring logs (D1 and D2), and on Table Nos. 5 and 6, represent a modified N-value based on the correlation between the recorded SPT value and the measured hammer efficiency of the testing equipment (also shown on the boring logs). Specifically, the plotted N-values have been normalized to a 60 percent hammer efficiency (N_{60}).

Soil samples retained over a long time, even sealed in jars, are subject to moisture loss and are no longer representative of the conditions initially encountered in the field. Therefore, we retain soil samples in our laboratory for 60 days unless instructed otherwise.

4. PAVEMENT BORINGS

4.1 PAVEMENT THICKNESS & SUBSURFACE CONDITIONS

Table No. 3 shows the pavement layer thicknesses encountered at the pavement borings.

TABLE NO. 3: PAVEMENT THICKNESS

BORING	ROAD	THICKNESS (IN)			BASE MATERIAL
		ASPHALT	CONCRETE	BASE	
C1	Liberty	3.5	6.25	N/E[1]	N/E[1]
C2	Liberty	3.75	7	N/E[1]	N/E[1]
C3	Church/Main	5.25	N/E[1]	8.75	Steel Furnace Slag
C4	Main	5.5	7.75	N/E[1]	N/E[1]
C5	Main	5.25	9	N/E[1]	N/E[1]
C6	Main	4.5	9	N/E[1]	N/E[1]
C7	Main	7	8	N/E[1]	N/E[1]
B1	Liberty	4.75	N/E[1]	6.25	Crushed Limestone
B2	Liberty	4.25	N/E[1]	9.75	Steel Furnace Slag
B3	Spring	5	N/E[1]	N/E[1]	N/E[1]
B4	Spring	3.25	N/E[1]	8.75	Crushed Concrete

NOTES: 1. Not Encountered.

4.1.1 LIBERTY STREET (STARKWEATHER STREET TO N. MILL STREET)

C1 and C2 were performed on Liberty Street between Starkweather Street and Mill Street. The asphalt thickness ranged from 3.5 to 3.75 inches. The concrete thickness ranged from 6.25 to 7 inches. No aggregate base was encountered.

The asphalt cores were intact. The concrete core was mostly deteriorated at C1 and completely deteriorated at C2.

At C1 and C2, clayey to silty sand was encountered beneath the concrete pavement. Beneath the sand, silty clay was encountered to the explored depth. The clay was stiff, with moisture contents ranging from 14 to 15 percent. Refer to the boring log and USACE data sheet for the borings that are included in Appendix B for a detailed description of the encountered subgrade.

The USACE DCP test results indicated poor to very poor subgrade support conditions were encountered from 14 to 37 inches at C1. C2 was not evaluated with the DCP.

Groundwater was not encountered.

4.1.2 INTERSECTION OF CHURCH STREET AND MAIN STREET

C3 was performed at the intersection of Main Street and Church Street. The asphalt thickness was 5.25 inches. No concrete pavement was encountered underlying the asphalt pavement. The aggregate base thickness was 8.75 inches and consisted of steel furnace slag.

The asphalt core was partially deteriorated in the bottom 2 inches.

At C3, clayey to silty sand was encountered beneath the aggregate base. Beneath the sand, silty clay was encountered to the explored depth. The clay was stiff, with a moisture content of 19 percent. Refer to the boring log and USACE data sheet for the borings that are included in Appendix B for a detailed description of the encountered subgrade.

The USACE DCP test results indicated the aggregate base encountered at C3 generally had marginal to good support conditions with an overall in-situ CBR value of 69 percent. The DCP test indicated poor to very poor subgrade support conditions were encountered from 18 to 39 inches at C3.

Groundwater was not encountered.

4.1.3 S. MAIN STREET (ANN ARBOR ROAD TO BURROUGHS STREET)

C4 through C7 were performed on S. Main Street between Ann Arbor Road and Burroughs/Sutherland Street. The asphalt thickness ranged from 4.5 to 7 inches and averaged 5.6 inches. The thickness of the concrete underlying the asphalt pavement ranged from 7.75 to 9 inches and averaged 8.4 inches. No aggregate base was encountered at any of the S. Main Street sampling locations.

The asphalt cores were intact at all locations except C7 where it was partially deteriorated. The concrete cores were intact at all locations except C7, where the concrete was completely deteriorated. The deteriorated concrete encountered at C7 may instead be crushed concrete aggregate base. The boring was performed on the east edge of the street, and there is not another core location closer to Ann Arbor Road for comparison.

At borings C4 through C6, sand with silt was encountered to the explored depth. At boring C7, clayey sand with gravel was encountered to the explored depth. Refer to the boring log and USACE data sheet for the borings that are included in Appendix B for a detailed description of the encountered subgrade.

C4 through C7 were not evaluated with the DCP.

Groundwater was not encountered at C4 through C7.

4.1.4 LIBERTY STREET (AMELIA STREET TO STARKWEATHER STREET)

B1 and B2 were performed on Liberty Street between Amelia Street and Starkweather Street. The asphalt thickness ranged from 4.25 to 4.75 inches. No concrete pavement was encountered underlying the asphalt pavement. The aggregate base thickness ranged from 6.25 to 9.75 inches and consisted of crushed limestone at B1 and steel furnace slag at B2.

The asphalt cores at B1 and B2 were intact.

At B1, alternating layers of sand and clayey sand were encountered beneath the aggregate base to the explored depth. At B2, alternating layers of sand, clayey sand, and silty clay were encountered beneath the aggregate base to the explored depth. The clay was very stiff, with a moisture content of 17 percent. Refer to the boring log and USACE data sheet for the borings that are included in Appendix B for a detailed description of the encountered subgrade.

The USACE DCP test results indicated the aggregate base encountered at B2 generally had poor support conditions with an overall in-situ CBR value of 35 percent. The DCP test indicated good subgrade support conditions at both borings.

Groundwater was encountered at a depth of 7 feet from the pavement surface at both B1 and B2.

4.1.5 SPRING STREET (STARKWEATHER STREET TO MILL STREET)

B3 and B4 were performed on Spring Street between Starkweather Street and Mill Street. The asphalt thickness ranged from 3.25 to 5 inches. No concrete pavement was encountered underlying the asphalt pavement. The aggregate base thickness was 8.75 inches and consisted of crushed concrete at B4. No aggregate base was encountered at B3.

The asphalt core was cracked and deteriorated at B3 and intact at B4.

At B3 and B4, alternating layers of sand and clayey sand were encountered beneath the asphalt pavement to a depth of approximately 9 feet with a lean clay layer underlying the clayey sand to the explored depth. The lean clay was very stiff, with a moisture content of 20 percent. Refer to the boring log and USACE data sheet for the borings that are included in Appendix B for a detailed description of the encountered subgrade.

The USACE DCP test results indicated the aggregate base encountered at B4 generally had marginal support conditions with an overall in-situ CBR value of 67 percent. The DCP test indicated poor to very poor subgrade support conditions were encountered from 13 to 38 and 24 to 39 inches at B3 and B4, respectively.

Groundwater was encountered at a depth of 8 feet from the pavement surface at both B3 and B4.

4.2 RECOMMENDATIONS FOR SUBGRADE PREPARATION

In areas where existing pavements are being reconstructed, remove the existing asphalt, aggregate base and subgrade material to a sufficient depth as required for the installation of the desired pavement cross-section. The upper 12 inches of the exposed subgrade should be compacted to at least 95 percent of the maximum modified Proctor dry density (ASTM D1557). Subgrade and aggregate base preparation shall extend to at least 12 inches beyond the edge of pavement or curbs to provide support for the outer edges of pavement. The prepared subgrade should be proof rolled using a loaded tandem axle dump truck in the presence of a geotechnical/pavement engineer. Any yielding or loose areas (deflections greater than 1/4 inch) should be stabilized by additional compaction, conditioning, or undercutting and replacing with salvaged base material from the existing pavements, engineered fill, or crushed aggregate (MDOT 21AA crushed limestone) as dictated by site conditions at time of construction.

Aggregate base was not encountered at most of the borings. As a result, the subgrade primarily exhibited poor or very poor support conditions. Expect undercutting on all streets.

4.3 COMMENTS ON PROPOSED PAVEMENT REPAIRS

We recommend Wade Trim should consult with SME after a decision has been made regarding the proposed pavement repair strategy to discuss its feasibility.

A mill and overlay strategy is not recommended on any street with water main improvements. This will create a dissimilar pavement section around the utility trench that will potentially settle relative to the pavement section overtop of the utility trench. A uniform pavement cross section should be placed on the streets with water main improvements.

For Main Street, a mill and overlay strategy is also not recommended. Reflective cracking would likely appear on the asphalt surface within a year. The entire asphalt pavement section should be removed to allow for repairs to the underlying concrete surface prior to asphalt resurfacing. As mentioned above, it is possible that the deteriorated concrete at B7 is crushed concrete aggregate base. This would indicate the concrete beneath the roadway may not extend the entire width of Main Street, or a different cross section was used closer to Ann Arbor Road.

4.4 DRAINAGE CONSIDERATIONS

The pavement system must be properly drained to reduce the potential for frost heaving and softening of the subgrade due to water infiltrating through cracks. Provision of drainage will also extend the life of the pavements by preventing premature pavement failures. The infiltrated water, if not properly drained will adversely affect the long-term pavement performance.

We recommend installing edgedrains along the curbs in the areas where pavement and curbs are reconstructed. The edgedrains should consist of a 6-inch diameter perforated pipe that is placed in a 1-foot-wide trench extending a minimum of 18 inches below the final subgrade elevation. The trench should be encased with a non-woven geotextile fabric and backfilled with aggregate meeting MDOT 34R requirements.

4.5 ENGINEERED FILL REQUIREMENTS

Any fill placed within roadway areas to adjust site grades or as utility trench backfill should be an approved material, free of frozen soil, organics, or other deleterious materials. If the proposed fill contains more than 4 percent organics, we recommend such materials not be used for engineered fill. The fill should be spread in level layers not exceeding 12 inches in loose thickness (depending on compaction equipment utilized) and be compacted to a minimum of 95 percent of the maximum dry density per ASTM D1557.

We recommend utility trenches within the roadways be backfilled with clean granular (SP or SP-SM) excavation spoils or imported MDOT Class II sand. Sands with high silt contents and clays (designated as “SM”, “SC”, “CL”, and “CH” soils) encountered at the soil borings will likely require moisture conditioning prior to reuse. Additionally, silty sands will become unstable due to the repeated loading of compaction equipment and are frost susceptible. Due to the effort required for drying these soils and the size of the working area for trench backfill required to effectively aerate and compact these cohesive soils with large or specialized compaction equipment, these soils are generally not recommended for reuse as engineered fill in trenches below pavements with exception to the upper 12 inches to provide a uniform subgrade.

Most of the subgrade encountered in borings B1 through B4 had either high silt content (SM) or high clay content (SC or CL), this soil should be treated as described above. There are pockets of sands that may be suitable to reuse. This includes the fine sand with gravel from B2 (encountered from approximately 35 to 70 inches), the fine to coarse sand with gravel from B3 (encountered from approximately 58 to 76 inches), and the fine to coarse sand with gravel from B4 (encountered from approximately 67 to 106 inches). Each of these sands may need to be conditioned before reuse.

4.6 UTILITY CONSTRUCTION CONSIDERATIONS

This section provides general considerations for utility construction.

Ground water was encountered at 7 to 8 feet at boring locations B1 through B4. Therefore, deeper excavations (greater than 5 feet), may require aggressive dewatering to temporarily lower the ground water within the vicinity of the excavation, if ground water is encountered.

The contractor must provide a safely sloped excavation or an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground. Shoring must be used to resist the extra pressure due to the imposed static or dynamic loads from the adjacent streets, as well as where material is to be stored or equipment operated near the excavation.

The contractor should be aware of the locations of existing utilities in the area before excavating and should be prepared to underpin or brace any such excavations near the utilities, as required. Shoring, bracing or underpinning should be properly designed by a qualified professional engineer, and should be installed by a contractor experienced with this type of construction.

Only the amount of trench which can be backfilled on any given day should be excavated. Excavations should not be left open overnight due to the possibility of disturbance of the exposed subgrade and side slopes (for open cut excavations) by inclement weather and/or groundwater.

We recommend that the existing pavement remain in place during utility construction to minimize disturbing the existing subgrade. The pavement should be saw cut and removed only over the working excavation. This will minimize the potential for damage to the underlying base and subgrade from construction traffic loading and environmental factors, and provide a more stable platform for construction.

5. MAST ARM TRAFFIC SIGNAL POLES

5.1 SUBSURFACE CONDITIONS AND FOUNDATION ANALYSIS

Design and construction of the new traffic signal mast arm pole foundations will be in accordance with the Standard Plan Details issued by MDOT for drilled shaft foundations. The drilled shaft diameters and depths are a function of the subsurface conditions, if the mast arm type is a single or double arm pole, and the mast arm pole's arm(s) lengths. MDOT Standard Plan "TRAFFIC SIGNAL MAST ARM POLE FOUNDATION DESIGN TABLE," Detail "SIG-DESIGN-284-A," (dated July 27, 2023) will be used for design and construction of the drilled shafts and is included in Appendix C. The MDOT Standard Plan Detail use soil strength classes defined as LOW, MED, or HIGH CLAY and LOW, MED, or HIGH SAND.

Tables Nos. 5 and 6 below summarize the subsurface conditions including the modified SPT blows per foot (bpf) recorded at the boring locations, the estimated undrained shear strengths based on the results of hand penetrometer-type tests performed on disturbed, cohesive samples, and the measured moisture contents of cohesive samples collected during drilling operations. Following Table Nos. 5 and 6 is a brief summary of groundwater observations and the recommended design soil strength class for the drilled shaft locations. We also provided discussion regarding the need for steel casing, wet or dry excavation methods to construct the drilled shafts, and foundation shaft lengths and diameters designated by MDOT in the standard foundation details.

TABLE NO. 5: SUMMARY OF SUBSURFACE CONDITIONS: NORTHWEST QUADRANT OF INTERSECTION OF SOUTH MAIN STREET AND CHURCH STREET – BORING D1

DEPTH[1] (FEET)	SOIL TYPE[2]	N_{60}-VALUE (BPF)	UNDRAINED SHEAR STRENGTH[3] (PSF)	WATER CONTENT[4] (PERCENT MOISTURE)
0 – 2	SAND & GRAVEL FILL (GP & SC)	5	—–	—–
2 – 8	SAND FILL (SP)	12 – 29	—–	—–
8 – 14	SAND WITH SILT (SP-SM)	22 – 25	—–	—–
14 – 25	LEAN CLAY (CL)	14 – 26	1,500 – 4,500+	18 – 26

NOTES: 1. Depth is measured from the existing ground surface at boring D1.
2. Soil types have corresponding USCS symbols next to soil description.
3. 4,500+ indicates an estimated undrained shear strength greater than the hand penetrometer's test capability.
4. Water contents were obtained from oven drying cohesive samples collected from the field exploration.

Groundwater was first observed during drilling activities at boring D1 at a depth of about 8 feet below the existing ground surface. Upon completion of drilling, groundwater was observed at a depth of about 12 feet below the existing ground surface.

The existing fill encountered in the upper 8 feet of boring D1 is considered to be undocumented because we have not been provided records of the fill material being placed and compacted as engineered fill, and thus the existing fill should be considered uncontrolled. Therefore, in our opinion, the subsurface conditions that will impact performance of the foundation for a double arm, mast arm pole with arm lengths of 25 feet and 45 feet most closely resembles **MED CLAY**, which will result in a 42-inch-diameter drilled shaft extending to a depth of 15.5 feet below the ground surface.

Based on the information at the borehole location, the drilled shaft will generally penetrate through about 8 feet of loose to medium dense granular fill overlying medium dense, natural sands and stiff to very stiff, natural clays and will bear on very stiff, natural clay. The sands encountered are considered caving soils, and groundwater was first observed during drilling activities about 7.5 feet above the anticipated bearing depth. Therefore, a full-length casing sealed into the clay, and dry construction methods, will be necessary to construct the shaft.

TABLE NO. 6: SUMMARY OF SUBSURFACE CONDITIONS: SOUTHEAST QUADRANT OF INTERSECTION OF SOUTH MAIN STREET AND CHURCH STREET– BORING D2

DEPTH[1] (FEET)	SOIL TYPE[2]	N_{60}-VALUE (BPF)	UNDRAINED SHEAR STRENGTH[3] (PSF)	WATER CONTENT[4] (PERCENT MOISTURE)
0 – 3	SAND & GRAVEL FILL (GP & SC)	33	—–	—–
3 – 8	SAND FILL (SP)	29 – 30	—–	—–
8 – 14	SAND WITH SILT (SP-SM)	24 – 26	—–	—–
14 – 25	LEAN CLAY (CL/ML)	12 – 26	2,500 – 4,500+	15 – 21

NOTES: 1. Depth is measured from the existing ground surface at boring D2.
2. Soil types have corresponding USCS symbols next to soil description.
3. 4,500+ indicates an estimated undrained shear strength greater than the hand penetrometer's test capability.
4. Water contents were obtained from oven drying cohesive samples collected from the field exploration.

Groundwater was first observed during drilling activities at boring D2 at a depth of about 8 feet below the existing ground surface. Upon completion of drilling, groundwater was observed at a depth of about 12 feet below the existing ground surface.

The existing fill encountered in the upper 8 feet of boring D2 is considered to be undocumented because we have not been provided records of the fill material being placed and compacted as engineered fill, and thus the existing fill should be considered uncontrolled. Therefore, in our opinion, the subsurface conditions that will impact performance of the foundation for a double arm, mast arm pole with arm lengths of 25 feet and 50 feet most closely resembles **MED CLAY**, which will result in a 42-inch-diameter drilled shaft extending to a depth of 15.5 feet below the ground surface.

Based on the information at the borehole location, the drilled shaft will generally penetrate through about 8 feet of medium dense to dense granular fill overlying medium dense, natural sands and very stiff to hard, natural clays and will bear on very stiff to hard, natural clay. The sands encountered are considered caving soils, and groundwater was first observed during drilling activities about 7.5 feet above the anticipated bearing depth. Therefore, a full-length casing sealed into the clay and dry construction methods will be necessary to construct the shaft.

5.2 CONSTRUCTION CONSIDERATIONS

The previous discussion provides the recommended design soil strength classes (i.e., LOW SAND, MED SAND, etc.) for the drilled shaft locations. The required drilled shaft foundation lengths have been selected from the MDOT Standard Plan "TRAFFIC SIGNAL MAST ARM POLE FOUNDATION DESIGN TABLE," Detail "SIG-DESIGN-284-A." These foundation shaft lengths and installation recommendations have been detailed in Table No. 7 below. The foundation design tables are attached to this report.

TABLE NO. 7: SUMMARY OF MAST ARM POLE FOUNDATION DIMENSIONS AND INSTALLATION RECOMMENDATIONS

QUADRANT OF INTERSECTION (CORRESPONDING BORING)	SOIL STRENGTH CLASS	DRILLED SHAFT LENGTH (FEET)	GROUND WATER DEPTH (FEET)	INSTALLATION RECOMMENDATIONS	
				CASINGS	CONSTRUCTION METHOD
NORTHWEST (D1)	MED CLAY	15.5	8	FULL-LENGTH CASING	DRY CONSTRUCTION METHODS
SOUTHEAST (D2)	MED CLAY	15.5	8	FULL-LENGTH CASING	DRY CONSTRUCTION METHODS

The drilled shafts should be constructed in accordance with Section 718, “Drilled Shafts,” in the 2020 MDOT Standard Specifications for Construction. The bottom of the drilled shaft excavations should be cleared of loose or disturbed soils prior to placement of the concrete. Cleaning of the shaft bottom surface may be done mechanically with a bucket but should be verified in the field prior to placing concrete. The bottom of the excavations should also be checked before concrete placement to verify that loose or caved soil material is removed so a relatively “clean” bottom is achieved.

Groundwater was encountered during and upon completion of drilling activities at each mast arm boring location, and if the casing can be sealed into the clay, the Dry Construction Method is expected to be necessary to construct each drilled shaft. For drilled shafts constructed through wet sands we recommend advancing the casings ahead of the excavations to reduce the risk of soil loss adjacent to the shafts. If the casings are able to seal off groundwater infiltration and/or groundwater infiltration rates are low (i.e., less than 12 inches in one hour) into the drilled shaft excavations at the time of concrete placement and there is less than 3 inches of water in the bottom of the drilled shaft excavations, the shaft concrete can be placed using the free-fall placement method. At drilled shaft locations where groundwater is rapidly infiltrating into the excavation once final excavation elevations have been reached, the concrete placement for the drilled shafts would require use of tremie-placement techniques as described in the Wet Construction Method as outlined in the MDOT Standard Specifications for Construction. Dewatering of wet shafts is not allowed.

The casings should be permanent. The recommended casings should be driven, drilled (i.e., “twisted”), or vibrated into position prior to excavation, such that the soils providing the drilled shaft lateral load resistances are not excessively disturbed. Care should be exercised so that installing the casings do not cause settlement of and/or damage to adjacent structures. If the drilled shafts will be installed adjacent to existing structures, the contractor should twist the casings in (i.e., not drive or vibrate as the excavation proceeds). Concrete placement should begin as soon as possible after the shafts are excavated, the bottom cleaned, and the conduits, anchor bolts, and reinforcing steel are placed.

Any required excavations should be sloped, shored, or braced according to MI-OSHA requirements. The contractor should provide an adequately constructed and braced shoring system for employees working in an excavation that may expose employees to the danger of moving ground. If material is stored, or heavy equipment is operated near an excavation, stronger shoring must be used to resist the increased pressure due to the superimposed loads. The contractor should take precautions to protect adjacent utilities, roadways, and structures during construction.

Any excavation backfill needed for the drilled shaft foundations and present below 3 feet from the top of shaft, should be placed as STRUCTURE BACKFILL and placed prior to attempting removal of any adjacent temporary sheeting or shoring. The upper 3 feet of material surrounding the drilled shaft can be “suitable material” backfill in accordance with MDOT specifications.

5.3 LIMITATIONS

The subsurface profiles and groundwater observations included on the attached boring logs are generalized descriptions of the conditions encountered at the borehole locations. The stratification depths shown on the boring logs are intended to indicate a zone of transition from one soil type to another. They are not intended to show exact depths of change from one soil type to another. The soil descriptions are based on visual classification and laboratory analyses of the soils encountered. Soil conditions and pavement layers may vary between or away from the borehole locations. Please refer to the boring logs for the subsurface conditions at each borehole location.

6. GENERAL COMMENTS

This report has been prepared in accordance with generally accepted geotechnical engineering and pavement engineering practices to aid in the evaluation of this project and to assist the Engineer in the design of this project. Our General Comments on this report are included in Appendix D. Appendix D also includes the document "Important Information about this Geotechnical Engineering Report" prepared by Geoprofessional Business Association that addresses interpretation of Geotechnical Reports.

7. SIGNATURES

PREPARED BY:

Max W. Reed, EIT
Senior Staff Engineer

PREPARED BY:

Michael W. Bay, PE
Senior Staff Engineer

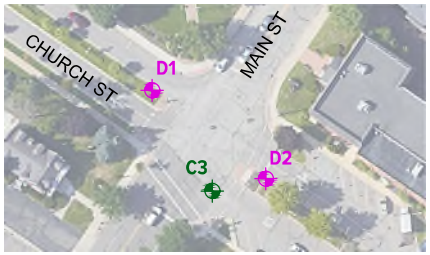
REVIEWED BY:

Jeremy S. Friedley, PE
Senior Project Engineer

REVIEWED BY:

Melinda L. Bacon, PE
Senior Project Engineer

APPENDIX A
BORING LOCATION DIAGRAM



LOCATION MAP
NOT TO SCALE

LEGEND

- APPROXIMATE BORING LOCATION
- APPROXIMATE BORING LOCATION
- APPROXIMATE BORING LOCATION

NOTE:
1. AERIAL IMAGE TAKEN FROM GOOGLE EARTH PRO WITH AN IMAGE DATE OF 6-22-2022.

SME
www.sme-usa.com

Project
CITY OF PLYMOUTH - 2024 INFRASTRUCTURE IMPROVEMENT PROGRAM

Project Location
PLYMOUTH, MICHIGAN

Sheet Name
BORING LOCATION DIAGRAM

No.	Revision Date

Date 1-22-2024
CADD MNR
Designer MWR
Scale AS NOTED
Project 094712.00
Figure No. 1

APPENDIX B

LABORATORY TESTING PROCEDURES
BORING LOG TERMINOLOGY
BORING LOG AND USACE DATA SHEETS (B1 – B4 & C1-C7)
BORING LOGS (D1 – D2)

LABORATORY TESTING PROCEDURES

VISUAL ENGINEERING CLASSIFICATION

Visual classification was performed on recovered samples. The appended General Notes and Unified Soil Classification System (USCS) sheets include a brief summary of the general method used visually classify the soil and assign an appropriate USCS group symbol. The estimated group symbol, according to the USCS, is shown in parentheses following the textural description of the various strata on the boring logs appended to this report. The soil descriptions developed from visual classifications are sometimes modified to reflect the results of laboratory testing.

MOISTURE CONTENT

Moisture content tests were performed by weighing samples from the field at their in-situ moisture condition. These samples were then dried at a constant temperature (approximately 110º C) overnight in an oven. After drying, the samples were weighed to determine the dry weight of the sample and the weight of the water that was expelled during drying. The moisture content of the specimen is expressed as a percent and is the weight of the water compared to the dry weight of the specimen.

HAND PENETROMETER TESTS

In the hand penetrometer test, the unconfined compressive strength of a cohesive soil sample is estimated by measuring the resistance of the sample to the penetration of a small calibrated, spring-loaded cylinder. The maximum capacity of the penetrometer is 4.5 tons per square-foot (tsf). Theoretically, the undrained shear strength of the cohesive sample is one-half the unconfined compressive strength. The undrained shear strength (based on the hand penetrometer test) presented on the boring logs is reported in units of kips per square-foot (ksf).

TORVANE SHEAR TESTS

In the Torvane test, the shear strength of a low strength, cohesive soil sample is estimated by measuring the resistance of the sample to a torque applied through vanes inserted into the sample. The undrained shear strength of the samples is measured from the maximum torque required to shear the sample and is reported in units of kips per square-foot (ksf).

LOSS-ON-IGNITION (ORGANIC CONTENT) TESTS

Loss-on-ignition (LOI) tests are conducted by first weighing the sample and then heating the sample to dry the moisture from the sample (in the same manner as determining the moisture content of the soil). The sample is then re-weighed to determine the dry weight and then heated for 4 hours in a muffle furnace at a high temperature (approximately 440º C). After cooling, the sample is re-weighed to calculate the amount of ash remaining, which in turn is used to determine the amount of organic matter burned from the original dry sample. The organic matter content of the specimen is expressed as a percent compared to the dry weight of the sample.

ATTERBERG LIMITS TESTS

Atterberg limits tests consist of two components. The plastic limit of a cohesive sample is determined by rolling the sample into a thread and the plastic limit is the moisture content where a 1/8-inch thread begins to crumble. The liquid limit is determined by placing a ½-inch thick soil pat into the liquid limits cup and using a grooving tool to divide the soil pat in half. The cup is then tapped on the base of the liquid limits device using a crank handle. The number of drops of the cup to close the gap formed by the grooving tool ½ inch is recorded along with the corresponding moisture content of the sample. This procedure is repeated several times at different moisture contents and a graph of moisture content and the corresponding number of blows is plotted. The liquid limit is defined as the moisture content at a nominal 25 drops of the cup. From this test, the plasticity index can be determined by subtracting the plastic limit from the liquid limit.

BORING LOG TERMINOLOGY

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOIL (more than 50% of material is larger than No. 200 sieve size.)			
GRAVEL More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravel (Less than 5% fines)	GW	Well-graded gravel; gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravel; gravel-sand mixtures, little or no fines
	Gravel with fines (More than 12% fines)	GM	Silty gravel; gravel-sand-silt mixtures
		GC	Clayey gravel; gravel-sand-clay mixtures
SAND 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sand (Less than 5% fines)	SW	Well-graded sand; sand-gravel mixtures, little or no fines
		SP	Poorly graded sand; sand-gravel mixtures, little or no fines
	Sand with fines (More than 12% fines)	SM	Silty sand; sand-silt-gravel mixtures
		SC	Clayey sand; sand–clay-gravel mixtures
FINE-GRAINED SOIL (50% or more of material is smaller than No. 200 sieve size)			
SILT AND CLAY Liquid limit less than 50%		ML	Inorganic silt; sandy silt or gravelly silt with slight plasticity
		CL	Inorganic clay of low plasticity; lean clay, sandy clay, gravelly clay
		OL	Organic silt and organic clay of low plasticity
SILT AND CLAY Liquid limit 50% or greater		MH	Inorganic silt of high plasticity, elastic silt
		CH	Inorganic clay of high plasticity, fat clay
		OH	Organic silt and organic clay of high plasticity
HIGHLY ORGANIC SOIL		PT	Peat and other highly organic soil

OTHER MATERIAL SYMBOLS

Topsoil, Void, Sandstone, Asphalt, Glacial Till, Siltstone, Aggregate Base, Coal, Limestone, Concrete, Shale, Fill

LABORATORY CLASSIFICATION CRITERIA

GW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with PI greater than 7	
SW	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with PI greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent……GW, GP, SW, SP
More than 12 percent……GM, GC, SM, SC
5 to 12 percent……Cases requiring dual symbols

- SP-SM or SW-SM (SAND with Silt or SAND with Silt and Gravel)
- SP-SC or SW-SC (SAND with Clay or SAND with Clay and Gravel)
- GP-GM or GW-GM (GRAVEL with Silt or GRAVEL with Silt and Sand)
- GP-GC or GW-GC (GRAVEL with Clay or GRAVEL with Clay and Sand)

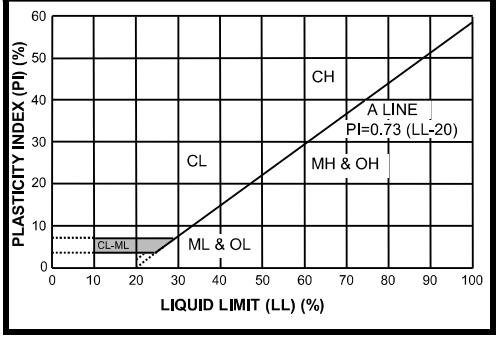
If the fines are CL-ML:

- SC-SM (SILTY CLAYEY SAND or SILTY CLAYEY SAND with Gravel)
- SM-SC (CLAYEY SILTY SAND or CLAYEY SILTY SAND with Gravel)
- GC-GM (SILTY CLAYEY GRAVEL or SILTY CLAYEY GRAVEL with Sand)

PARTICLE SIZES

Boulders	-	Greater than 12 inches
Cobbles	-	3 inches to 12 inches
Gravel- Coarse	-	3/4 inches to 3 inches
Fine	-	No. 4 to 3/4 inches
Sand- Coarse	-	No. 10 to No. 4
Medium	-	No. 40 to No. 10
Fine	-	No. 200 to No. 40
Silt and Clay	-	Less than (0.0074 mm)

PLASTICITY CHART



VISUAL MANUAL PROCEDURE

When laboratory tests are not performed to confirm the classification of soils exhibiting borderline classifications, the two possible classifications would be separated with a slash, as follows:

For soils where it is difficult to distinguish if it is a coarse or fine-grained soil:

- SC/CL (CLAYEY SAND to Sandy LEAN CLAY)
- SM/ML (SILTY SAND to SANDY SILT)
- GC/CL (CLAYEY GRAVEL to Gravelly LEAN CLAY)
- GM/ML (SILTY GRAVEL to Gravelly SILT)

For soils where it is difficult to distinguish if it is sand or gravel, poorly or well-graded sand or gravel; silt or clay; or plastic or non-plastic silt or clay:

- SP/GP or SW/GW (SAND with Gravel to GRAVEL with Sand)
- SC/GC (CLAYEY SAND with Gravel to CLAYEY GRAVEL with Sand)
- SM/GM (SILTY SAND with Gravel to SILTY GRAVEL with Sand)
- SW/SP (SAND or SAND with Gravel)
- GP/GW (GRAVEL or GRAVEL with Sand)
- SC/SM (CLAYEY to SILTY SAND)
- GM/GC (SILTY to CLAYEY GRAVEL)
- CL/ML (SILTY CLAY)
- ML/CL (CLAYEY SILT)
- CH/MH (FAT CLAY to ELASTIC SILT)
- CL/CH (LEAN to FAT CLAY)
- MH/ML (ELASTIC SILT to SILT)

DRILLING AND SAMPLING ABBREVIATIONS

2ST	–	Shelby Tube – 2" O.D.
3ST	–	Shelby Tube – 3" O.D.
AS	–	Auger Sample
GS	–	Grab Sample
LS	–	Liner Sample
NR	–	No Recovery
PM	–	Pressure Meter
RC	–	Rock Core diamond bit. NX size, except where noted
SB	–	Split Barrel Sample 1-3/8" I.D., 2" O.D., except where noted
VS	–	Vane Shear
WS	–	Wash Sample

OTHER ABBREVIATIONS

WOH	–	Weight of Hammer
WOR	–	Weight of Rods
SP	–	Soil Probe
PID	–	Photo Ionization Device
FID	–	Flame Ionization Device

DEPOSITIONAL FEATURES

Parting	–	as much as 1/16 inch thick
Seam	–	1/16 inch to 1/2 inch thick
Layer	–	1/2 inch to 12 inches thick
Stratum	–	greater than 12 inches thick
Pocket	–	deposit of limited lateral extent
Lens	–	lenticular deposit
Hardpan/Till	–	an unstratified, consolidated or cemented mixture of clay, silt, sand and/or gravel, the size/shape of the constituents vary widely
Lacustrine	–	soil deposited by lake water
Mottled	–	soil irregularly marked with spots of different colors that vary in number and size
Varved	–	alternating partings or seams of silt and/or clay
Occasional	–	one or less per foot of thickness
Frequent	–	more than one per foot of thickness
Interbedded	–	strata of soil or beds of rock lying between or alternating with other strata of a different nature

DESCRIPTION OF RELATIVE QUANTITIES

The visual-manual procedure uses the following terms to describe the relative quantities of notable foreign materials, gravel, sand or fines:

Trace	–	particles are present but estimated to be less than 5%
Few	–	5 to 10%
Little	–	15 to 25%
Some	–	30 to 45%
Mostly	–	50 to 100%

CLASSIFICATION TERMINOLOGY AND CORRELATIONS

Cohesionless Soils

Relative Density	N_{60} (N-Value) (Blows per foot)
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	Over 81

Cohesive Soils

Consistency	N_{60} (N-Value) (Blows per foot)	Undrained Shear Strength (kips/ft^2)
Very Soft	<2	0.25 or less
Soft	2 - 4	> 0.25 to 0.50
Medium	5 - 8	> 0.50 to 1.0
Stiff	9 - 15	> 1.0 to 2.0
Very Stiff	16 - 30	> 2.0 to 4.0
Hard	> 30	> 4.0 or greater

Standard Penetration 'N-Value' = Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch O.D. split barrel sampler, except where noted. N60 values as reported on boring logs represent raw N-values corrected for hammer efficiency only.

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: B1
STREET: Liberty Street
LANE: East Bound
OFFSET: 6' North of South Curbline
STATION: 140' East of Amelia Street

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	2.25	2.25	Asphalt Pavement Wearing Course	Intact - Slight Voids
2.25	4.75	2.5	Asphalt Pavement Leveling Course	Intact - Slight Voids
4.75	11	6.25	Crushed Limestone	(GP/ Agg Base)
11	84	73	Fine SAND with Clay - Brown - Moist	(SP-SC)
84	96	12	CLAYEY SAND - Brown/Gray - Wet	(SC)
			End of Boring at 96" Below Pavement Surface	

Depth to Groundwater From Ground Surface Upon Completion: 7'

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) Refusal of the probe at approximately 8 feet.

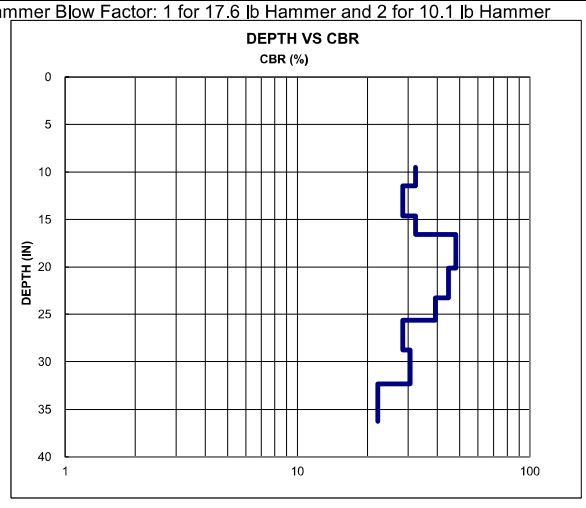
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 9.5 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	370								
7	420	50	7	1	11.5	32.3	Good	Subgrade	
10	500	80	8	1	14.6	28.4	Good	Subgrade	
7	550	50	7	1	16.6	32.3	Good	Subgrade	
8	590	40	5	1	18.2	48.1	Good	Subgrade	
10	640	50	5	1	20.1	48.1	Good	Subgrade	
15	720	80	5	1	23.3	44.8	Good	Subgrade	
10	780	60	6	1	25.6	39.3	Good	Subgrade	
10	860	80	8	1	28.8	28.4	Good	Subgrade	
12	950	90	8	1	32.3	30.6	Good	Subgrade	
10	1050	100	10	1	36.3	22.2	Good	Subgrade	33.8

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: B2
STREET: Liberty Street
LANE: West Bound
OFFSET: 22' North of South Curbline
STATION: 530' East of Amelia Street

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	2	2	Asphalt Pavement Wearing Course	Intact - Slight Voids
2	4.25	2.25	Asphalt Pavement Leveling Course	Intact - Slight Voids
4.25	14	9.75	Steel Furnace Slag	(GP/ Agg Base)
14	35	21	CLAYEY SAND - Brown - Moist	(SC)
35	70	35	Fine SAND with Gravel - Brown - Moist	(SP)
70	108	38	SILTY CLAY with Sand - Brown - Very Stiff	(CL-ML) At 71" Qp= 3.0 ksf; MC= 17%
108	120	12	Fine SAND with Silt - Brown - Wet	(SP-SM)
			End of Boring at 120" Below Pavement Surface	

Depth to Groundwater From Ground Surface Upon Completion: 7'

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) Qp = Estimated shear strength from hand penetrometer; MC = Moisture content.

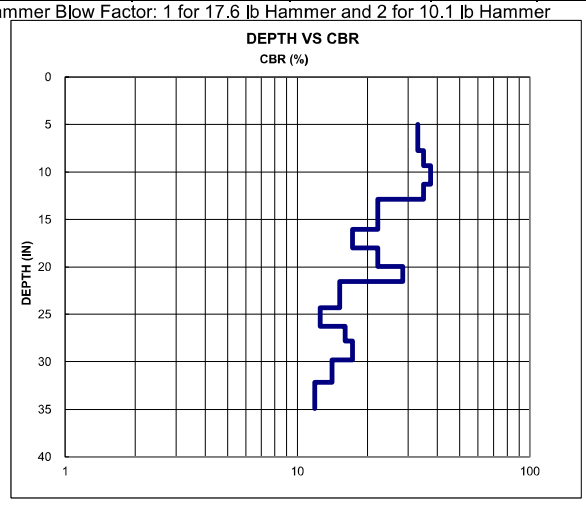
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 5 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	260	0							
10	330	70	7	1	7.8	33.0	Poor	Agg Base	
6	370	40	7	1	9.3	34.9	Poor	Agg Base	
8	420	50	6	1	11.3	37.5	Poor	Agg Base	
6	460	40	7	1	12.9	34.9	Poor	Agg Base	34.9
4	500	40	10	1	14.4	22.2	Good	Subgrade	
4	540	40	10	1	16.0	22.2	Good	Subgrade	
4	590	50	13	1	18.0	17.3	Good	Subgrade	
5	640	50	10	1	20.0	22.2	Good	Subgrade	
5	680	40	8	1	21.5	28.4	Good	Subgrade	
5	750	70	14	1	24.3	15.2	Good	Subgrade	
3	800	50	17	1	26.3	12.5	Good	Subgrade	
3	840	40	13	1	27.8	16.0	Good	Subgrade	
4	890	50	13	1	29.8	17.3	Good	Subgrade	
4	950	60	15	1	32.2	14.1	Good	Subgrade	
4	1020	70	18	1	34.9	11.8	Good	Subgrade	17.4

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: B3
STREET: Spring Street
LANE: East Bound
OFFSET: 40' South of North Sidewalk
STATION: 55' East of Starkweather Street

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	2.75	2.75	Asphalt Pavement Wearing Course	Vertical Crack Through
2.75	5	2.25	Asphalt Pavement Leveling Course	Deteriorated
5	13	8	Fine SAND with Silt - Brown - Moist	(SP-SM)
13	36	23	SILTY SAND - Brown/Black - Moist	(SM)
36	58	22	CLAYEY SAND - Brown - Moist	(SC)
58	76	18	Fine to Coarse SAND with Gravel - Brown - Moist	(SP)
76	110	34	CLAYEY SAND - Brown/Gray - Moist to Wet	(SC)
110	120	10	LEAN CLAY with Sand - Gray - Very Stiff	(CL) At 112" Qp= 3.0 ksf; MC= 20%

Depth to Groundwater From Ground Surface
Upon Completion: 8'

NOTES:
1) End of Boring at 120" Below Pavement Surface 2) No aggregate base encountered.
3) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
4) Qp = Estimated shear strength from hand penetrometer; MC = Moisture content.

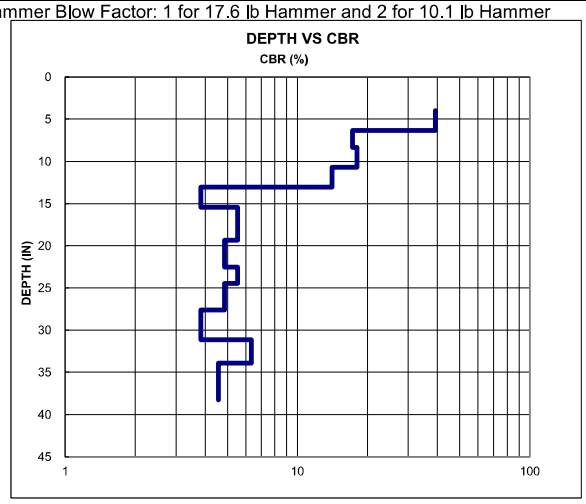
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 4 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	210	0							
10	270	60	6	1	6.4	39.3	Good	Subgrade	
4	320	50	13	1	8.3	17.3	Good	Subgrade	
5	380	60	12	1	10.7	18.1	Good	Subgrade	
4	440	60	15	1	13.1	14.1	Good	Subgrade	22.4
2	500	60	30	1	15.4	3.8	Poor	Subgrade	
2	550	50	25	1	17.4	5.5	Marginal	Subgrade	
2	600	50	25	1	19.4	5.5	Marginal	Subgrade	
3	680	80	27	1	22.5	4.9	Poor	Subgrade	
2	730	50	25	1	24.5	5.5	Marginal	Subgrade	
3	810	80	27	1	27.6	4.9	Poor	Subgrade	
3	900	90	30	1	31.2	3.8	Poor	Subgrade	
3	970	70	23	1	33.9	6.3	Marginal	Subgrade	
4	1080	110	28	1	38.3	4.6	Poor	Subgrade	4.9

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: B4
STREET: Spring Street
LANE: West Bound
OFFSET: 21' South of North Sidewalk
STATION: 215' East of Starkweather Street

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	1.5	1.5	Asphalt Pavement Wearing Course	Intact - Slight Voids
1.5	3.25	1.75	Asphalt Pavement Leveling Course	Intact - Slight Voids
3.25	12	8.75	Crushed Concrete	(GP/ Agg Base)
12	67	55	SILTY SAND with Gravel - Brown - Moist	(SM)
67	106	39	Fine to Coarse SAND with Gravel - Brown - Moist to Wet	(SP)
106	120	14	LEAN CLAY with Sand - Brown/Gray - Very Stiff	(CL-ML) At 108" Qp= 2.5 ksf; MC= 20%
			End of Boring at 120" Below Pavement Surface	

Depth to Groundwater From Ground Surface Upon Completion: 8'

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) Qp = Estimated shear strength from hand penetrometer; MC = Moisture content.

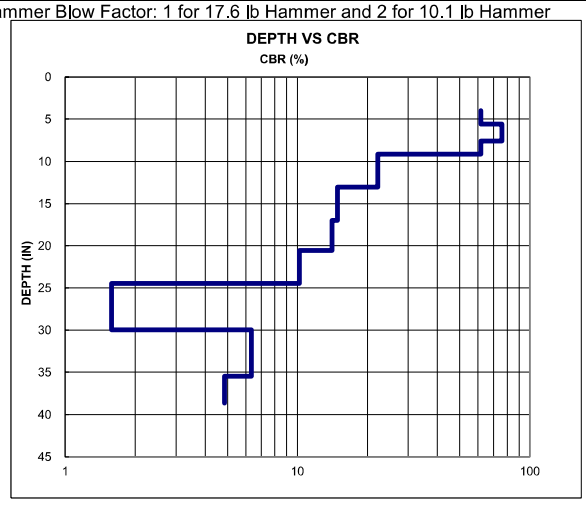
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 4 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	230	0							
10	270	40	4	1	5.6	61.8	Marginal	Agg Base	
15	320	50	3	1	7.5	75.8	Marginal	Agg Base	
10	360	40	4	1	9.1	61.8	Marginal	Agg Base	67.2
10	460	100	10	1	13.1	22.2	Good	Subgrade	
7	560	100	14	1	17.0	14.9	Good	Subgrade	
6	650	90	15	1	20.5	14.1	Good	Subgrade	
5	750	100	20	1	24.5	10.2	Good	Subgrade	15.3
3	890	140	47	1	30.0	1.6	Very Poor	Subgrade	
3	960	70	23	1	32.7	6.3	Marginal	Subgrade	
3	1030	70	23	1	35.5	6.3	Marginal	Subgrade	
3	1110	80	27	1	38.6	4.9	Poor	Subgrade	4.2

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C1
STREET: Liberty Street
LANE: Right Lane
OFFSET: 29' North of South Curbline
STATION: 50' East of Starkweather Street

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	1.75	1.75	Asphalt Pavement Wearing Course	Intact
1.75	3.5	1.75	Asphalt Pavement Leveling Course	Intact
3.5	9.75	6.25	Portland Cement Concrete	Mostly Deteriorated
9.75	16	6.25	Fine to Coarse SAND with Silt - Brown - Moist	(SP-SM)
16	27	11	CLAYEY to SILTY SAND - Brown - Moist	(SC-SM)
27	36	9	SILTY CLAY with Sand - Brown - Stiff	(CL-ML) At 28" Qp= 1.5 ksf; MC= 14%
			End of Boring at 36" Below Pavement Surface	

Depth to Groundwater From Ground Surface Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) Qp = Estimated shear strength from hand penetrometer; MC = Moisture content.
3) No aggregate base was encountered.

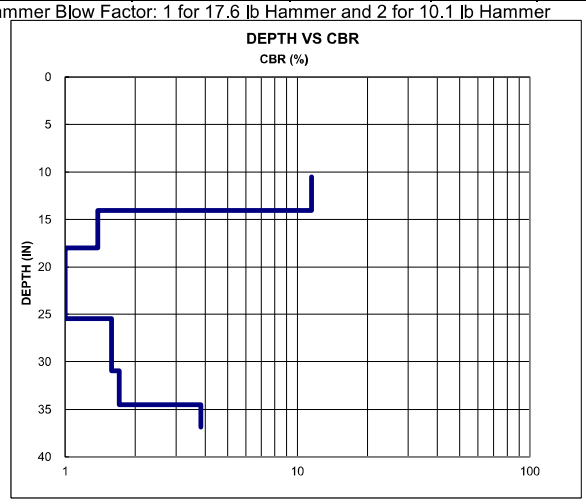
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 10.5 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	410	0							
5	500	90	18	1	14.0	11.5	Good	Subgrade	11.5
2	600	100	50	1	18.0	1.4	Very Poor	Subgrade	
1	700	100	100	1	21.9	0.3	Very Poor	Subgrade	
1	790	90	90	1	25.5	0.4	Very Poor	Subgrade	
3	930	140	47	1	31.0	1.6	Very Poor	Subgrade	
2	1020	90	45	1	34.5	1.7	Very Poor	Subgrade	
2	1080	60	30	1	36.9	3.8	Poor	Subgrade	1.4

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C2
STREET: Liberty Street
LANE: Left Lane
OFFSET: 19' North of South Curbline
STATION: 230' East of Starkweather Street

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	1.75	1.75	Asphalt Pavement Wearing Course	Intact
1.75	3.75	2	Asphalt Pavement Leveling Course	Intact
3.75	10.75	7	Portland Cement Concrete	Deteriorated
10.75	22	11.25	CLAYEY to SILTY SAND - Brown - Moist	(SC-SM)
22	36	14	SILTY CLAY with Sand - Brown - Stiff	(CL-ML) At 23" Qp= 1.5 ksf; MC= 15%
			End of Boring at 36" Below Pavement Surface	

Depth to Groundwater From Ground Surface
Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) Qp = Estimated shear strength from hand penetrometer; MC = Moisture content.
3) No aggregate base was encountered. 4) No DCP test performed.

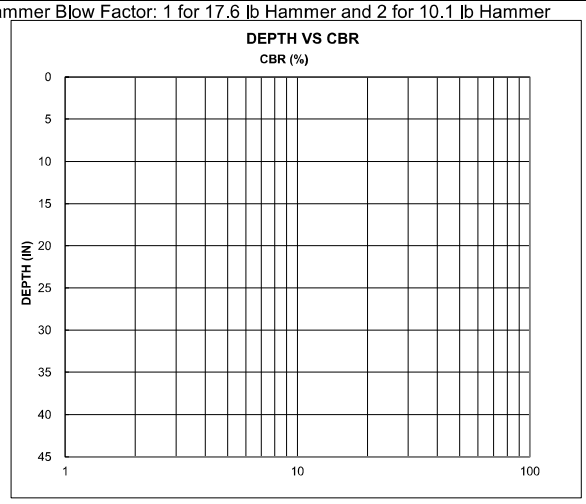
DCP TEST RESULTS

Depth to start of test from ex. ground surface: inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
		0							

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C3
STREET: Intersection of Church Street and Main Street
LANE: North Bound

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	1.5	1.5	Asphalt Pavement Wearing Course	Intact - Slight Voids
1.5	3.5	2	Asphalt Pavement Leveling Course	Intact - Slight Voids - Delaminated From Layer Below
3.5	5.25	1.75	Asphalt Pavement Leveling Course	Partially Deteriorated
5.25	14	8.75	Steel Furnace Slag	(GP/ Agg Base)
14	22	8	CLAYEY to SILTY SAND - Brown - Moist	(SC-SM)
22	36	14	SILTY CLAY with Sand - Brown - Stiff	(CL-ML) At 24" Qp= 1.5 ksf; MC= 19%
			End of Boring at 36" Below Pavement Surface	

Depth to Groundwater From Ground Surface
Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) Qp = Estimated shear strength from hand penetrometer; MC = Moisture content.

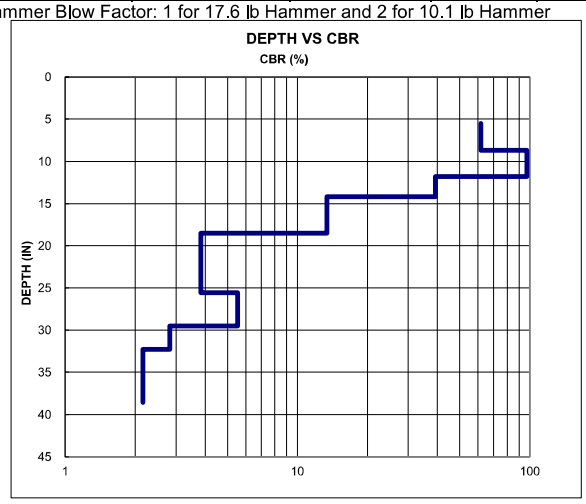
DCP TEST RESULTS

Depth to start of test from ex. ground surface: 5.5 inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0	250	0							
10	290	40	4	1	7.1	61.8	Marginal	Agg Base	
10	330	40	4	1	8.6	61.8	Marginal	Agg Base	
15	370	40	3	1	10.2	97.3	Good	Agg Base	
15	410	40	3	1	11.8	97.3	Good	Agg Base	
10	470	60	6	1	14.2	39.3	Poor	Agg Base	68.6
7	580	110	16	1	18.5	13.4	Good	Subgrade	
3	670	90	30	1	22.0	3.8	Poor	Subgrade	
3	760	90	30	1	25.6	3.8	Poor	Subgrade	
4	860	100	25	1	29.5	5.5	Marginal	Subgrade	
2	930	70	35	1	32.3	2.8	Very Poor	Subgrade	
2	1010	80	40	1	35.4	2.2	Very Poor	Subgrade	
2	1090	80	40	1	38.6	2.2	Very Poor	Subgrade	5.2

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C4
STREET: Main Street
LANE: South Bound
OFFSET: 33' West of East Curbline
STATION: 1,720' North of Ann Arbor Road

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	2	2	Asphalt Pavement Wearing Course	Intact
2	3.75	1.75	Asphalt Pavement Leveling Course	Intact
3.75	5.5	1.75	Asphalt Pavement Leveling Course	Intact - Delaminated From Layer Below
5.5	13.25	7.75	Portland Cement Concrete	Intact
13.25	20	6.75	SILTY SAND with Gravel - Brown - Moist	(SM)
			End of Boring at 20" Below Pavement Surface	

Depth to Groundwater From Ground Surface
Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) No DCP test performed.

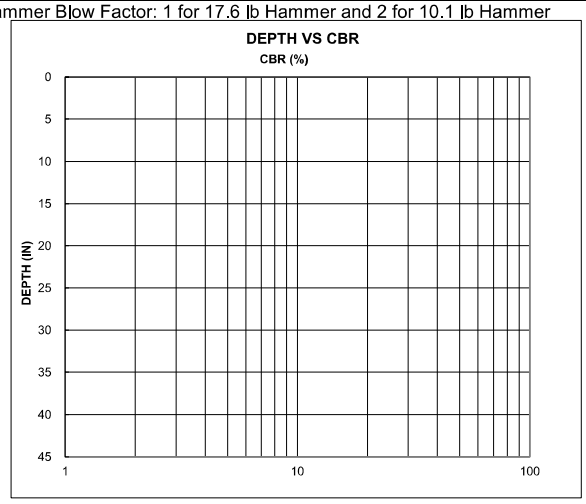
DCP TEST RESULTS

Depth to start of test from ex. ground surface: inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0		0							

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C5
STREET: Main Street
LANE: Center Lane
OFFSET: 20' West of East Curbline
STATION: 1,380' North of Ann Arbor Road

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	1.5	1.5	Asphalt Pavement Wearing Course	Intact
1.5	3.25	1.75	Asphalt Pavement Leveling Course	Intact
3.25	5.25	2	Asphalt Pavement Leveling Course	Intact - Delaminated From Layer Below
5.25	14.25	9	Portland Cement Concrete	Intact
14.25	20	5.75	Fine SAND with Silt - Brown - Moist	(SP-SM)
			End of Boring at 20" Below Pavement Surface	

Depth to Groundwater From Ground Surface
Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) No DCP test performed.

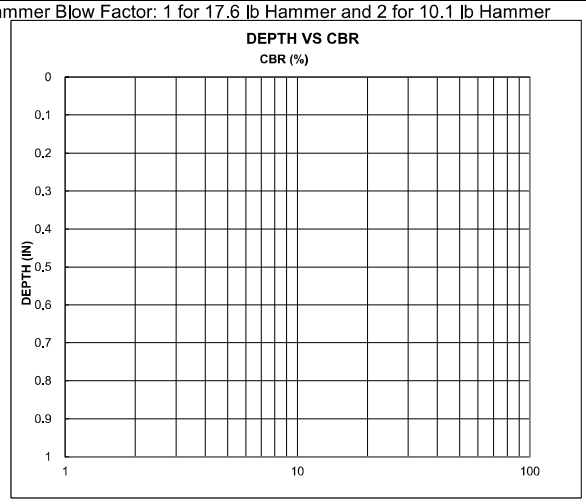
DCP TEST RESULTS

Depth to start of test from ex. ground surface: inches

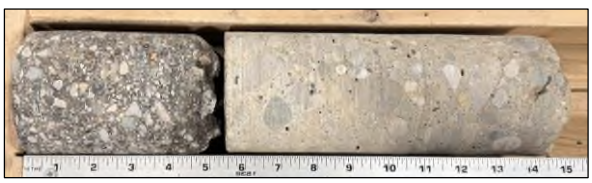
No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0		0							

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3



**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C6
STREET: Main Street
LANE: Center Lane
OFFSET: 24' West of East Curbline
STATION: 945' North of Ann Arbor Road

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	1.5	1.5	Asphalt Pavement Wearing Course	Intact - Slight Voids
1.5	4.5	3	Asphalt Pavement Leveling Course	Intact - Slight Voids - Delaminated From Layer Below
4.5	13.5	9	Portland Cement Concrete	Intact
13.5	20	6.5	Fine to Coarse SAND with Silt - Brown - Moist	(SP-SM)
			End of Boring at 20" Below Pavement Surface	

Depth to Groundwater From Ground Surface
Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) No DCP test performed.

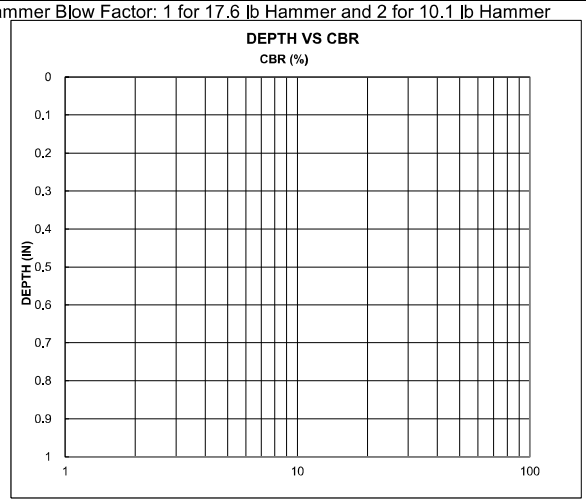
DCP TEST RESULTS

Depth to start of test from ex. ground surface: inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0		0							

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING LOG AND USACE DCP DATA

PROJECT NAME: City of Plymouth 2024 Soil Borings
PROJECT NO.: 94712.00
LOCATION: Plymouth, MI
CLIENT: Wade Trim
DATE: 1/5/24
DRILLED BY: ZAH/MIS
LOGGED BY: MIS/MWR

PROBE/CORE: C7
STREET: Main Street
LANE: North Bound
OFFSET: 3' West of East Curbline
STATION: 290' North of Ann Arbor Road

PAVEMENT AND SUBSURFACE CONDITIONS

Layer, in. From	Layer, in. To	Layer Thickness, in.	Description	Comment
0	2.25	2.25	Asphalt Pavement Wearing Course	Vertical Crack Through
2.25	5	2.75	Asphalt Pavement Leveling Course	Vertical Crack Through
5	7	2	Asphalt Pavement Leveling Course	Patially Deteriorated
7	15	8	Portland Cement Concrete	Deteriorated
15	20	5	CLAYEY SAND with Gravel - Brown - Moist	(SC)
			End of Boring at 20" Below Pavement Surface	

Depth to Groundwater From Ground Surface
Upon Completion: Not Encountered

NOTES:
1) The indicated stratification lines are approximate and in situ transition between materials may be gradual.
2) No DCP test performed.

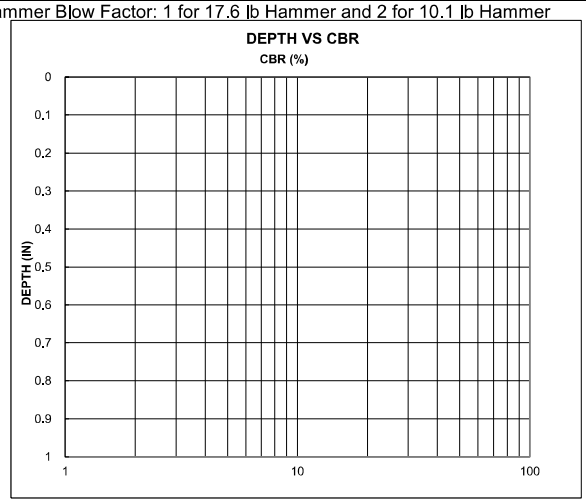
DCP TEST RESULTS

Depth to start of test from ex. ground surface: inches

No. of Blows	Pen. (mm)	Blow Set (mm)	Pen./Blow (mm)	Blow Factor	Depth from Surface (inches)	CBR (%)	Comment	Soil Type	Average CBR (%)
0		0							

Hammer Blow Factor: 1 for 17.6 lb Hammer and 2 for 10.1 lb Hammer

*CBR breaklines are based on blow counts performed prior to sampling. Depths are approximate.



Support Conditions	CBR Range for Aggregate Base Materials (%)	CBR Range for Subgrade Soils (%)
Good	>80	>10
Marginal	60 to 80	5 to 10
Poor	30 to 60	3 to 5
Very Poor	<30	<3

**Core picture shows approximate thickness

SME

BORING D 1

BORING DEPTH: 25 FEET

PROJECT NAME: City of Plymouth 2024 Infrastructure Program
PROJECT NUMBER: 094712.00
CLIENT: Wade Trim, Inc.
PROJECT LOCATION: Plymouth, Michigan
DATE STARTED: 1/10/24 **COMPLETED:** 1/10/24 **BORING METHOD:** Solid-stem Augers
DRILLER: JR **RIG NO.:** 281 (CME 45B) **LOGGED BY:** KT **CHECKED BY:** MR

LATITUDE: 42.37269
LONGITUDE: -83.46749
LOCATION: NORTHWEST QUADRANT

DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
0	0.5 FILL- GRAVEL with Sand- Brown- Moist (GP)			
	2.0 FILL- CLAYEY SAND with Gravel- Brown- Moist- Loose (SC)	SB1	13	2 2 5
5	FILL- Fine to Coarse SAND with Gravel- Brown- Moist- Medium Dense (SP)	SB2	12	6 9 10
		SB3	16	9 8 14
	8.0	SB4	13	8 8 11
10	Fine SAND with Silt- Brown- Wet- Medium Dense (SP-SM)	SB5	18	6 7 10
	14.0	SB6	16	5 7 8
15		SB7	14	8 8 11
	LEAN CLAY with Sand- Gray- Stiff to Hard (CL)	SB8	18	9 8 10
20		SB9	15	8 10 10
	25.0	SB10	14	5 6 5
25	END OF BORING AT 25.0 FEET.			
30				

HAMMER EFFICIENCY: 79%
DATE: 11/11/2021
N_{60} – ○

DRY DENSITY (pcf) – ■
MOISTURE & ATTERBERG LIMITS (%)
PL MC LL

▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)
SHEAR STRENGTH (KSF)

REMARKS

GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)
▽ DURING BORING:	8.0
▼ AT END OF BORING:	12.0

BACKFILL METHOD: Auger Cuttings & EPCO Hole Plug

NOTES: 1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

SME

BORING D 2

BORING DEPTH: 25 FEET

PROJECT NAME: City of Plymouth 2024 Infrastructure Program
PROJECT NUMBER: 094712.00
CLIENT: Wade Trim, Inc.
PROJECT LOCATION: Plymouth, Michigan
DATE STARTED: 1/10/24 **COMPLETED:** 1/10/24 **BORING METHOD:** Solid-stem Augers
DRILLER: JR **RIG NO.:** 281 (CME 45B) **LOGGED BY:** KT **CHECKED BY:** MR

LATITUDE: 42.37250
LONGITUDE: -83.46716
LOCATION: SOUTHEAST QUADRANT

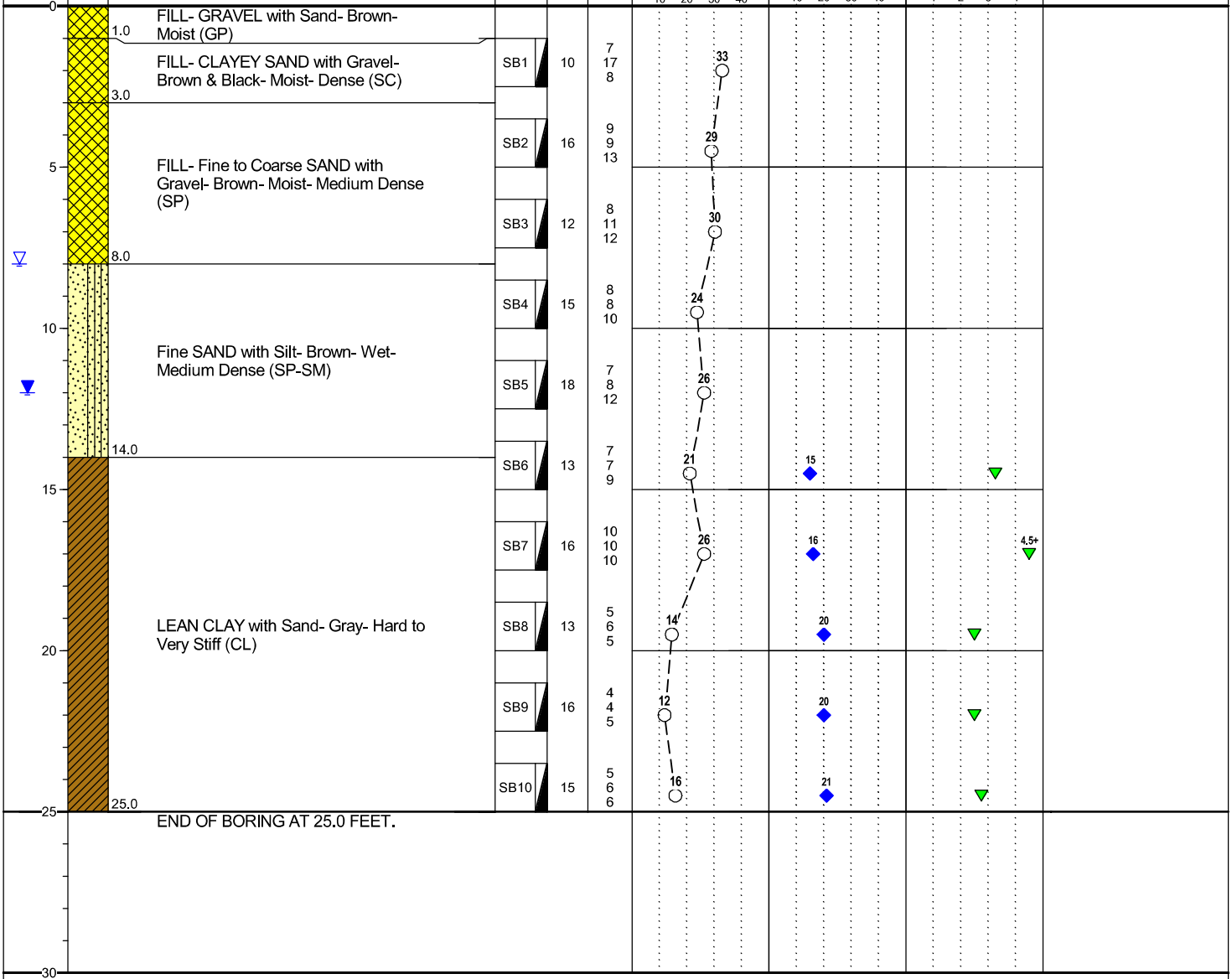
DEPTH (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE/NO.	RECOVERY LENGTH (INCHES)	SPT BLOWS PER SIX INCHES
0	FILL- GRAVEL with Sand- Brown- Moist (GP)			
1.0	FILL- CLAYEY SAND with Gravel- Brown & Black- Moist- Dense (SC)	SB1	10	7 17 8
3.0		SB2	16	9 9 13
5	FILL- Fine to Coarse SAND with Gravel- Brown- Moist- Medium Dense (SP)	SB3	12	8 11 12
8.0 ▽		SB4	15	8 8 10
10	Fine SAND with Silt- Brown- Wet- Medium Dense (SP-SM)	SB5	18	7 8 12
14.0		SB6	13	7 7 9
15	LEAN CLAY with Sand- Gray- Hard to Very Stiff (CL)	SB7	16	10 10 10
20		SB8	13	5 6 5
		SB9	16	4 4 5
25.0		SB10	15	5 6 6
25	END OF BORING AT 25.0 FEET.			
30				

HAMMER EFFICIENCY: 79%
DATE: 11/11/2021
N_{60} – ○

DRY DENSITY (pcf) – ■ (90 100 110 120)
MOISTURE & ATTERBERG LIMITS (%) (PL MC LL)

▽ HAND PENE.
⊠ TORVANE SHEAR
● UNC. COMP.
⊡ VANE SHEAR (PK)
× VANE SHEAR (REM)
⊕ TRIAXIAL (UU)
SHEAR STRENGTH (KSF)

REMARKS



GROUNDWATER & BACKFILL INFORMATION

	DEPTH (FT)
▽ DURING BORING:	8.0
▼ AT END OF BORING:	12.0

BACKFILL METHOD: Auger Cuttings & EPCO Hole Plug

NOTES:
1. The indicated stratification lines are approximate. The in-situ transitions between materials may be gradual.
2. The colors depicted on the symbolic profile are solely for visualization purposes and do not necessarily represent the in-situ colors encountered.

APPENDIX C

MDOT SIG-DESIGN-284-A

Mast Arm Foundation Chart

Mast Arm Type	Soil Type	Soil Condition		Diameter (in)	Foundation Depth (ft)	Casing Depth
		S_u	N_{60}			
Single Arm	Low Sand	-	$5 \le N_{60} \le 10$	42	19.5	As Shown on Plans
	Med Sand	-	$10 < N_{60} \le 20$	42	13.0	
	High Sand	-	$N_{60} > 20$	42	12.5	
	Low Clay	$500 \le S_u < 1000$	-	42	16.5	
	Med Clay	$1000 \le S_u < 2000$	-	42	14.0	
	High Clay	$S_u \ge 2000$	-	42	11.5	
Double Arm	Low Sand	-	$5 \le N_{60} \le 10$	42	18.0	
	Med Sand	-	$10 < N_{60} \le 20$	42	14.5	
	High Sand	-	$N_{60} > 20$	42	14.0	
	Low Clay	$500 \le S_u < 1000$	-	42	17.5	
	Med Clay	$1000 \le S_u < 2000$	-	42	15.5	
	High Clay	$S_u \ge 2000$	-	42	12.5	

*S_u = Ultimate Undrained Shear Strength in Cohesive Soil (psf)

*N_{60} = Standard Penetration Resistance (Blows/Foot according to ASTM D-1586) corrected to 60% Hammer Efficiency utilizing the Hammer's Calibrated Energy

*Table based on Drilled Shaft Head Deflection ≤ 1 inch, the Ground Water Table ≥ 3 feet below the ground surface, and the first 3.5 feet of soil modeled as Disturbed Soil assuming ground is disturbed to locate utilities

Note: A Detailed Site Specific Design is Required for the Following Conditions

1) If $N_{60} < 5$ or $S_u < 500$ psf
2) If mast are lengths are greater than 50 feet
3) If Rock Sockets are required for the drilled shaft

File: PW:Reference Documents/Traffic Reference/Signals/Design Guides/Final/SIG-DESIGN-284A.dgn

MDOT Michigan Department of Transportation TRAFFIC SIGNAL DESIGN	DESCRIPTION	DATE	TRAFFIC SIGNAL MAST ARM POLE FOUNDATION DESIGN TABLE	
	INITIAL POST TO WEB	02/15/11		
DRAWN BY:			SIG-DESIGN-284-A	SHEET 1 of 1
CHECKED BY:				

APPENDIX D

GENERAL COMMENTS
IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

GENERAL COMMENTS

BASIS OF GEOTECHNICAL REPORT

This report has been prepared in accordance with generally accepted geotechnical engineering practices to assist in the design and/or evaluation of this project. If the project plans, design criteria, and other project information referenced in this report and utilized by SME to prepare our recommendations are changed, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions and recommendations of this report are modified or approved in writing by our office.

The discussions and recommendations submitted in this report are based on the available project information, described in this report, and the geotechnical data obtained from the field exploration at the locations indicated in the report. Variations in the soil and groundwater conditions commonly occur between or away from sampling locations. The nature and extent of the variations may not become evident until the time of construction. If significant variations are observed during construction, SME should be contacted to reevaluate the recommendations of this report. SME should be retained to continue our services through construction to observe and evaluate the actual subsurface conditions relative to the recommendations made in this report.

In the process of obtaining and testing samples and preparing this report, procedures are followed that represent reasonable and accepted practice in the field of soil and foundation engineering. Specifically, field logs are prepared during the field exploration that describe field occurrences, sampling locations, and other information. Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory and differences may exist between the field logs and the report logs. The engineer preparing the report reviews the field logs, laboratory classifications, and test data and then prepares the report logs. Our recommendations are based on the contents of the report logs and the information contained therein.

REVIEW OF DESIGN DETAILS, PLANS, AND SPECIFICATIONS

SME should be retained to review the design details, project plans, and specifications to verify those documents are consistent with the recommendations contained in this report.

REVIEW OF REPORT INFORMATION WITH PROJECT TEAM

Implementation of our recommendations may affect the design, construction, and performance of the proposed improvements, along with the potential inherent risks involved with the proposed construction. The client and key members of the design team, including SME, should discuss the issues covered in this report so that the issues are understood and applied in a manner consistent with the owner's budget, tolerance of risk, and expectations for performance and maintenance.

FIELD VERIFICATION OF GEOTECHNICAL CONDITIONS

SME should be retained to verify the recommendations of this report are properly implemented during construction. This may avoid misinterpretation of our recommendations by other parties and will allow us to review and modify our recommendations if variations in the site subsurface conditions are encountered.

PROJECT INFORMATION FOR CONTRACTOR

This report and any future addenda or other reports regarding this site should be made available to prospective contractors prior to submitting their proposals for their information only and to supply them with facts relative to the subsurface evaluation and laboratory test results. If the selected contractor encounters subsurface conditions during construction, which differ from those presented in this report, the contractor should promptly describe the nature and extent of the differing conditions in writing and SME should be notified so that we can verify those conditions. The construction contract should include provisions for dealing with differing conditions and contingency funds should be reserved for potential problems during earthwork and foundation construction. We would be pleased to assist you in developing the contract provisions based on our experience.

The contractor should be prepared to handle environmental conditions encountered at this site, which may affect the excavation, removal, or disposal of soil; dewatering of excavations; and health and safety of workers. Any Environmental Assessment reports prepared for this site should be made available for review by bidders and the successful contractor.

THIRD PARTY RELIANCE/REUSE OF THIS REPORT

This report has been prepared solely for the use of our Client for the project specifically described in this report. This report cannot be relied upon by other parties not involved in the project, unless specifically allowed by SME in writing. SME also is not responsible for the interpretation by other parties of the geotechnical data and the recommendations provided herein.

Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

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

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

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

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

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

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

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

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

Read this Report in Full

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

You Need to Inform Your Geotechnical Engineer About Change

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

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

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

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are <u>Not</u> Covered

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

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

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

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Passionate People Building
and Revitalizing our World

SME