

DOCUMENT 00 3132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Engineer, the Engineer's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. Soil-boring data for Project, is available for viewing as appended to this Document.
- D. A geotechnical investigation report for Project, prepared by, is available for viewing as appended to this Document.
 - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT 00 3132



**REPORT OF THE
GEOTECHNICAL INVESTIGATION FOR
WOODLAND CENTER CORRECTIONAL – UTILITY PROGRAM**

**GREEN OAK TOWNSHIP
LIVINGSTON COUNTY
MICHIGAN**

DECEMBER 1, 2023



*Nowak & Fraus Engineers
46777 Woodward Avenue
Pontiac, Michigan 48342*

Project No. 2023.1746



December 1, 2023

Nowak & Fraus Engineers
46777 Woodward Avenue
Pontiac, Michigan 48342

Attention: Mr. Steve Sutton, P.E.

Regarding: Woodland Center Correctional - Utility Program
Geotechnical Report
Green Oak Township, Livingston County, Michigan
Project No. 2023.1746

Dear Mr. Sutton:

Soils & Structures is pleased to present this geotechnical investigation report for the Woodland Center Correctional - Utility Program project located at 8701 and 9036 East M-36 in Green Oak Township, Livingston County, Michigan.

The investigation included twenty-eight (28) test borings extended to depths of 2.5, 10.0, and 20.0 feet. The test boring was conducted in accordance with ASTM D 1586 procedures.

The report, test boring location plan, and test boring logs are enclosed. The report provides recommendations for the proposed utility program.

We appreciate the opportunity to provide engineering services to Nowak & Fraus Engineers. If you have any questions regarding this report, please contact our office.

Sincerely,
Soils & Structures, Inc.

A handwritten signature in black ink, appearing to read "Vincent O. Oderah".

Vincent O. Oderah, P.E.
VOO/vo,

Reviewed by:

A handwritten signature in black ink, appearing to read "Michael J. Partenio".

Michael J. Partenio, P.E.

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Location of Soil Investigation

The soil investigation was conducted at the site located at 8701 and 9036 East M-36 in Sections 30 and 31 of Green Oak Township, Livingston County, Michigan. The parcel numbers for the site are 4716-30-400-010 and 4716-31-200-001.

Purpose of Investigation

The purpose of this investigation is to provide geotechnical engineering recommendations for the proposed watermain installation.

Design Information

The project will consist of new 6.0 and 8.0-inch watermains at the Woodland Center Correctional and Green Oaks Academy facilities. The watermain construction will include two trenchless crossings below East M-36 in the areas of Test Boring Three through Test Boring Six. If the actual design is significantly different than assumed in this report, then Soils & Structures should be contacted so that the recommendations included in this report may be reviewed and revised if necessary.

Excavation will be required for construction of the watermain, and launching and receiving pits. At the time of this report, the maximum depth of excavation has not been determined but is anticipated to be approximately 10.0 feet below existing grade. Backfill will be required over the utilities. The amount of fill required over the utilities is anticipated to be less than 10.0 feet. Groundwater controls and dewatering may be necessary depending on the depth of excavation for construction of the watermains.

Tests Performed

The investigation included twenty-eight (28) test borings extended to depths of 2.5, 10.0, and 20.0 feet. The test borings are designated as Test Boring One (TB-01) through Test Boring Twenty-Eight (TB-28). Test Boring Sixteen was terminated prior to reaching the planned depth of 10.0 feet due to auger refusal. The locations were determined by Nowak & Fraus Engineers. The locations were reviewed for accessibility and adjusted as necessary by Soils & Structures. The test borings were conducted in accordance with ASTM D 1586 procedures. The ASTM D 1586 standard describes the procedure for sampling and testing soil using the Standard Penetration Test. An automatic hammer was used to obtain the soil samples.

The surface elevations at the test boring locations and additional points of reference were obtained with a Global Navigation Satellite System (GNSS) Receiver. The receiver was connected to the local MDOT CORS base station. Through this system, vertical measurements are obtained and referenced to the North American Vertical Datum (NAVD88). Horizontal measurements are also obtained at the test boring locations which are referenced to the Michigan State Plane Coordinate System. Measurements of additional site-specific reference points were also obtained. Both the vertical and horizontal measurements typically have an accuracy of approximately 0.5 inches. The measured test boring location and surface elevation can be found in Table 1.

Table 1: Measured Test Boring and Points of Reference Locations and Surface Elevations

Test Boring / Location	Elevation (feet)	Northing (feet)	Easting (feet)	Surface Cover
Test Boring One	904.9	344261.5	13282525.3	Topsoil
Test Boring Two	903.5	343995.2	13282825.4	Asphalt
Test Boring Three	902.3	343858.1	13283129.1	Gravel
Test Boring Four	902.9	343812.3	13283131.8	Topsoil
Test Boring Five	908.3	343908.1	13284119.9	Gravel
Test Boring Six	908.3	343873.6	13284122.4	Topsoil
Test Boring Seven	906.3	343297.8	13283096.0	Topsoil
Test Boring Eight	908.7	343368.6	13284099.7	Topsoil
Test Boring Nine	916.7	343464.0	13284900.5	Topsoil
Test Boring Ten	917.0	343327.3	13285378.0	Topsoil
Test Boring Eleven	912.4	343411.2	13285805.9	Asphalt
Test Boring Twelve	908.0	342911.4	13282556.2	Topsoil
Test Boring Thirteen	913.1	343084.7	13284477.0	Topsoil
Test Boring Fourteen	917.3	343122.7	13285279.0	Asphalt
Test Boring Fifteen	916.5	342903.4	13285532.8	Topsoil
Test Boring Sixteen	914.8	342484.5	13284586.2	Topsoil
Test Boring Seventeen	905.2	342410.3	13284267.5	Topsoil
Test Boring Eighteen	915.2	342406.6	13284961.6	Asphalt
Test Boring Nineteen	908.1	342155.3	13282620.1	Topsoil
Test Boring Twenty	907.8	342262.9	13283077.6	Topsoil
Test Boring Twenty-One	911.3	342076.9	13283754.4	Topsoil

Table 1(cont.): Measured Test Boring and Points of
Reference Locations and Surface Elevations

Test Boring Twenty-Two	914.5	341976.5	13284379.2	Topsoil
Test Boring Twenty-Three	906.5	341698.6	13282741.5	Topsoil
Test Boring Twenty-Four	908.8	341824.7	13283282.5	Topsoil
Test Boring Twenty-Five	918.6	341566.1	13283978.2	Topsoil
Test Boring Twenty-Six	898.1	341584.7	13281212.4	Asphalt
Test Boring Twenty-Seven*	889.9	341726.6	13281696.3	Topsoil
Test Boring Twenty-Eight*	900.8	341773.5	13282383.4	Topsoil
Base Setup VRS1	970.6	372345.0	13287777.6	-
Base Setup VRS2	910.9	290465.0	13265910.3	-

*Note: GNSS data including elevation, northing, and easting may be inaccurate due to overhead signal obstruction

Soil samples were classified according to the Unified Soil Classification System. This method is a standardized system for classifying soil according to its engineering properties. Please refer to the appendix of this report for the Unified Classification System Chart. The classification is shown in the "Material Description" column of the test boring logs.

The soil strength and the allowable soil bearing value were evaluated using the "N" value. The "N" value is the number of blows required to drive a soil sampler one foot with a standard 140-pound drop hammer. The sampler is driven a distance of 18.0 inches. The number of blows for each 6.0-inch increment is recorded. The sum of the second and third intervals is the "N" value. The number of blows for each 6.0-inch interval is shown on the test boring logs under the column labeled "Blow Counts". The "N" value for each sample is shown in the adjacent column.

Laboratory testing consisted of natural moisture content (ASTM D 2216), particle size (sieve) analysis (ASTM D 6913), Atterberg limits (ASTM D 4318), and unconfined compression (ASTM D 2166). The tests were performed in accordance with the ASTM standards listed above. The tests were performed on representative soil samples. The moisture content documents the presence of groundwater in a soil sample. The sieve analysis determines the particle distribution which is used to classify the soil and estimate its properties. The Atterberg limit and unconfined compression testing aid in determining the properties of cohesive soils.

The U.S. Geological Survey Topographic map and the Quaternary Geology map of Michigan were reviewed. These maps provide general geological information about the region. Publicly available well log records were reviewed to determine the depth of bedrock.

Description of Soil

The general soil profile consists of a layer of sand which extends to depths of 2.0 to 6.5 feet overlying a layer of clay with silt and sand pockets which extends to a depth of at least 20.0 feet. The soil profile is part of a medium-textured glacial till. A medium-textured glacial till is an unsorted sediment consisting of a mixture of soil types deposited by glacial meltwater.

Topsoil is present at the surface of the majority of the test borings. The topsoil thickness ranges from 4.0 to 14.0 inches. The average topsoil thickness is 9.0 inches. Pavement is present at the surface in the areas of Test Boring Two, Test Boring Eleven, Test Boring Eighteen, and Test Boring Twenty-Six. The pavement consists of 2.5 to 5.0 inches of asphalt overlying 4.0 to 20.0 inches of gravel base. A layer of gravel is present at the surface in the areas of Test Boring Three and Test Boring Five and extends to a depth of approximately 2.0 feet.

The sand layer consists of brown, fine to medium clayey sand and extends to depths of 2.0 to 6.5 feet. In the areas of Test Boring Five and Test Boring Six, the sand layer extends to a depth of at least 20.0 feet. The sand layer near the surface is probably fill placed during the construction of the existing structures. The "N" values of the sand layer range from 5 to over 50, indicating the sand is in a slightly compact to extremely compact state. The "N" values correspond to an internal friction angle between 28 and 38 degrees.

The clay layer consists of brown and gray sandy clay with varying amounts of silt and gravel. The clay layer extends to a depth of at least 20.0 feet. The "N" values of the clay layer range from 6 to over 50, indicating the clay is in a firm to extremely stiff state. The majority of the clay layer is in a stiff to extremely stiff state. The undrained shear strength of the clay layer ranges from 2,560 to 6,060 pounds per square foot, indicating the clay is in a stiff to extremely stiff state. The internal friction angle of the clay is between 0 and 5 degrees.

Pockets of brown silt with varying amounts of clay and sand are present generally between depths of 6.5 and 10.0 feet throughout the site. The "N" values of the silt pockets range from 9 to 51, indicating the silt is in a stiff to extremely stiff state. The majority of the silt pockets are in a very stiff state. The internal friction angle of the silt is between 5 and 10 degrees.

Bedrock is present below a depth of approximately 90.0 feet. The bedrock consists primarily of bluish-gray to gray shale which is part of the Coldwater Shale Formation.

Description of Groundwater Conditions

Groundwater was encountered at depths ranging from 4.0 to 17.0 feet. These depths correspond to elevations of 909.4 to 885.3 feet. Additionally, perched groundwater was encountered at shallower depths of 1.8 to 3.0 feet in Test Boring Eleven and Test Boring Seventeen, respectively. The static water elevation is anticipated to fluctuate based on seasonal precipitation. Long-term groundwater monitoring was not included as part of this investigation.

Description of Site

The site is located at 8701 and 9036 East M-36 in Green Oak Township, Livingston County, Michigan. The site consists of the existing Woodland Center Correctional and Green Oak Academy facilities. The site is surrounded by wooded land, residential, and commercial properties. The surface elevation of the site ranges from 898.1 to 917.3 feet. Photographs #1 and #2 show the site conditions at the time of investigation.



Photograph #1: Location of Test Boring Seven. View is to the east. (Project No. 2023.1746, Green Oak Township, Livingston County, Michigan, October 2023)



Photograph #2: Location of Test Boring Four. View is to the east. (Project No. 2023.1746, Green Oak Township, Livingston County, Michigan, October 2023)

Recommendations

Site & Subgrade Preparation

Trees and vegetation in the construction area should be cleared and removed as part of subgrade preparation. The topsoil should be removed to the extent that all soil with an organic content of 3.0 percent or greater is removed. Soil containing roots should be removed to the extent that the root content by volume is 5.0 percent or less. All roots over 0.5 inches in diameter should be removed. The amount of topsoil anticipated to be removed is 9.0 inches.

Excavation will be required for construction of the watermain. Excavations should extend at least 6.0 inches below the invert elevation of the watermain to allow for the placement of a sand or aggregate bedding layer. Excavated soil may be retained for use as fill in areas where drainage is not a consideration. Fill should be placed following the recommendations in the “Fill” section of this report.

The clay subgrade below the watermain should be inspected and tested with a pocket penetrometer before placing fill. Clay exhibiting a shear strength of less than 1500 pounds per square foot should be excavated to a minimum depth of 12.0 inches below the anticipated bottom of excavation and replaced with clean sand or aggregate meeting MDOT Class II or 6AA specifications, respectively.

In-situ sand below the watermain should be compacted to 95.0 percent of the sand's maximum density. A hoe-pack connected to an excavator may be used for compaction. Compaction tests should be performed to verify these levels of compaction. Soils not exceeding the minimum density should be recompacted.

Soil brought to the site for fill should be clean sand meeting MDOT Class II specifications. Fill should be placed in accordance with the "Fill" section of this report. The fill should be compacted to 95.0 percent of its maximum density, as determined by the modified proctor method per the ASTM D 1557 standard. The soil which will be used for fill should be kept free of topsoil and other organic materials. Compaction tests are recommended to check the compaction of the new fill.

Trenchless Crossing

Two new trenchless crossings for the watermain will be constructed below East M-36 in the areas of Test Boring Three through Test Boring Six. The soil profile in the areas of Test Boring Three and Test Boring Four consists primarily of clay. The soil profile in the areas of Test Boring Five and Test Boring Six consists primarily of clayey sand. The trenchless crossings are anticipated to utilize a jack-and-bore construction method. A jack-and-bore method consists of forming a bore by advancing an auger and a casing pipe simultaneously from a launching pit to a receiving pit. The casing pipe typically has greater diameter than the watermain. The auger removes the spoils inside of the casing pipe. The auger and the casing pipe are advanced through the soil by a hydraulic jack located in the launching pit. After the casing is fully installed, the watermain is installed inside the casing pipe. The annulus is then grouted to complete the installation.

Excavations to construct the launching and receiving pits are anticipated to be vertical excavations. The excavations will require temporary shoring to control the size of excavation and minimize disturbance to the road. Temporary shoring methods such as trench boxes or sheet piling may be utilized.

The reaction capacity of the in-situ soil may be calculated using a soil density of 120 pounds per cubic foot and coefficients of earth pressure of 1.0 and 3.4 for the in-situ clay and sand, respectively. The equivalent fluid pressures are 120 and 360 pounds per cubic foot above the water table for the in-situ clay and sand, respectively. The effects of any surcharge, hydrostatic pressure or sloping backfill should also be included in the design. The temporary shoring should be designed by a licensed engineer and should take groundwater conditions into account.

Existing utility lines should be identified prior to trenchless installation. The trenchless installation contractor should establish the minimum clearances of the existing utilities as per MDOT requirements. Lubricating fluids may be utilized to facilitate the installation of the casing pipe. The lubricating fluids should be limited to a mixture of water, bentonite and MDOT approved polymers. A guiding system should be used during the casing pipe installation.

Spacers should be used to install and position the watermain within the casing pipe. The number and location of the spacers should be sufficient to maintain the elevation and alignment of the watermain while the annulus between the casing pipe and the drain is grouted. The grout strength should meet MDOT requirements and should provide support at least as great as the surrounding soil.

A precondition survey of the area consisting of elevation readings and photos should be performed by the contractor prior to construction. If the pavement over the pipe settles more than 0.5 inches, the pavement should be releveled. The pavement should be releveled through the injection of high-density polymers, replacement of the pavement, or placement of an overlay. The leveling method should be selected by MDOT.

Lateral Earth Pressure

Clean sand meeting MDOT Class II specifications should be used as backfill around utilities. Lateral earth pressures should be designed using a soil density of 120 pounds per cubic foot, a coefficient of active earth pressure of 0.33, and a coefficient of at-rest earth pressure of 0.45 for level clean sand backfill. The effects of any surcharge, hydrostatic pressure or sloping backfill should also be included in the design. Coefficients of passive earth pressure of 1.0, 1.4, and 3.0 may be used for the in-situ clay, silt, and sand, respectively.

Excavations

The in-situ soils are a mixture of OSHA type "B" and "C" soils. Excavations that will be entered by personnel should be based on OSHA requirements for type "C" soil. Based on OSHA requirements, a maximum allowable side slope of 34 degrees (1.5H:1V) is recommended for excavations 4.0 to 20.0 feet deep. Excavations less than 4.0 feet deep may have vertical side slopes. For excavations adjacent to property lines, structures such as buildings and roads, or excavations over 15.0 feet deep retaining systems are recommended.

Temporary shoring methods such as trench boxes or sheet piles are recommended in areas where the OSHA required excavation slopes cannot be achieved. The temporary shoring should be designed by a licensed engineer and should take groundwater conditions into account.

Fill

Fill should be compacted to a density of 95.0 percent of its maximum density to its full depth. The maximum density should be determined in accordance with the ASTM D 1557 standard. A maximum thickness per layer of 6.0 inches is recommended for compaction. The lift thickness may be increased to 12.0 inches if a vibratory roller or loader is used for compaction. Compaction tests are recommended to confirm that the fill is compacted to the required density.

Excavated sand may be used as fill in areas where drainage is not required. If the amount of fill required exceeds the amount of material available on site, additional material will have to be imported. Soil brought to the site for structural fill should be sand meeting MDOT Class II requirements or ASTM requirements for an SP or SW which are the designations for clean sand.

Fill should not be placed over frozen ground, snow, or ice. Soil which contains frozen material should not be used as fill. During winter construction, removal of frozen ground may be necessary prior to placing fill.

Groundwater Management

Groundwater controls and dewatering may be necessary for the construction of the watermain if excavations encounter the water table or a significant quantity of perched water. Temporary well points and sumps may be used to control groundwater during construction. Dewatering in the launching and receiving pits will probably be required. A layer of open-graded stone placed over the bottom of excavation in conjunction with a sump should be sufficient to control water in excavations. Sheet piling may be necessary to control the size of excavation and simplify dewatering efforts. The design should include a hydraulic analysis to check for quick conditions.

Quality Control Testing

Compaction tests are recommended to confirm that in-situ soil and backfill are compacted to the specified density. The tests should be performed in accordance with the ASTM D 6938 standard. While fill is being placed, compaction tests should be performed at the rate of one test per 400 cubic yards of fill and throughout the depth of the fill with a minimum of five tests at each 1.0-foot elevation interval. Full time inspection is recommended while sand and fill are compacted in the construction area. The maximum density should be determined in accordance with ASTM D 1557 or ASTM D 4253 procedures.

The elevation of the surface should be monitored during the trenchless pipe installation. The monitoring should consist of elevation readings. The monitoring points should be located at the edge of pavement and at the center of the road. The monitoring points should be centered over the pipe and at points offset 50 feet on both sides of the centerline. At least two sets of elevation readings should be obtained prior to construction. Readings should be obtained on completion of the pipe installation.

A smooth 0.5 to 0.75-inch diameter rod should be used in conjunction with compaction tests to probe for loose areas in fill. A dynamic cone should not be substituted for compaction tests for evaluating fill. Testing should be performed by technicians supervised by a registered geotechnical engineer.



General Conditions & Reliance

The report was prepared in accordance with generally accepted practices of the geotechnical engineering profession. The scope of work consisted of performing twenty-eight (28) test borings and providing soil related recommendations for the design and construction of the proposed watermain installation. The scope of work did not include an environmental study or wetland determination.

The report and the associated test borings were prepared specifically for the previously described project and site. Soils & Structures should be consulted if a significant change in the scope of the project is made.

The test borings represent point information and may not have encountered all of the soil types and materials present on this site. This report does not constitute a guarantee of the soil or groundwater conditions or that the test borings are an exact representation of the soil or groundwater conditions at all points on this site.

The descriptions and recommendations contained in this report are based on an interpretation of the test borings and laboratory tests. The test borings should not be used independently of the report. If soil conditions are encountered which are significantly different from the test borings, Soils & Structures should be consulted for additional recommendations.

The report and test borings may be relied upon by Nowak & Fraus Engineers for the design, construction, permitting, and financing associated with the Woodland Center Correctional - Utility Program project located at 8701 and 9036 East M-36 in Green Oak Township, Livingston County, Michigan. The use of the report and test borings by third parties not associated with this project or for other sites has not been agreed upon by Soils & Structures. Soils & Structures does not recommend or consent to third party use or reliance of the report or test borings unless allowed to review the proposed use of these materials. Unless obtained in writing, consent to third party use should not be assumed. Third parties using the report or test boring logs do so at their own risk and are offered no guarantee or promise of indemnity.

Appendix

Test Boring Location Plan

Test Boring Logs

Laboratory Tests

General Soil Information

Project Id: 2023.1746

Project Title: Woodland Corrections - Utility Program

Location: Whitmore Lake, Michigan

Client: Nowak & Fraus Engineers

Title: Section line 1

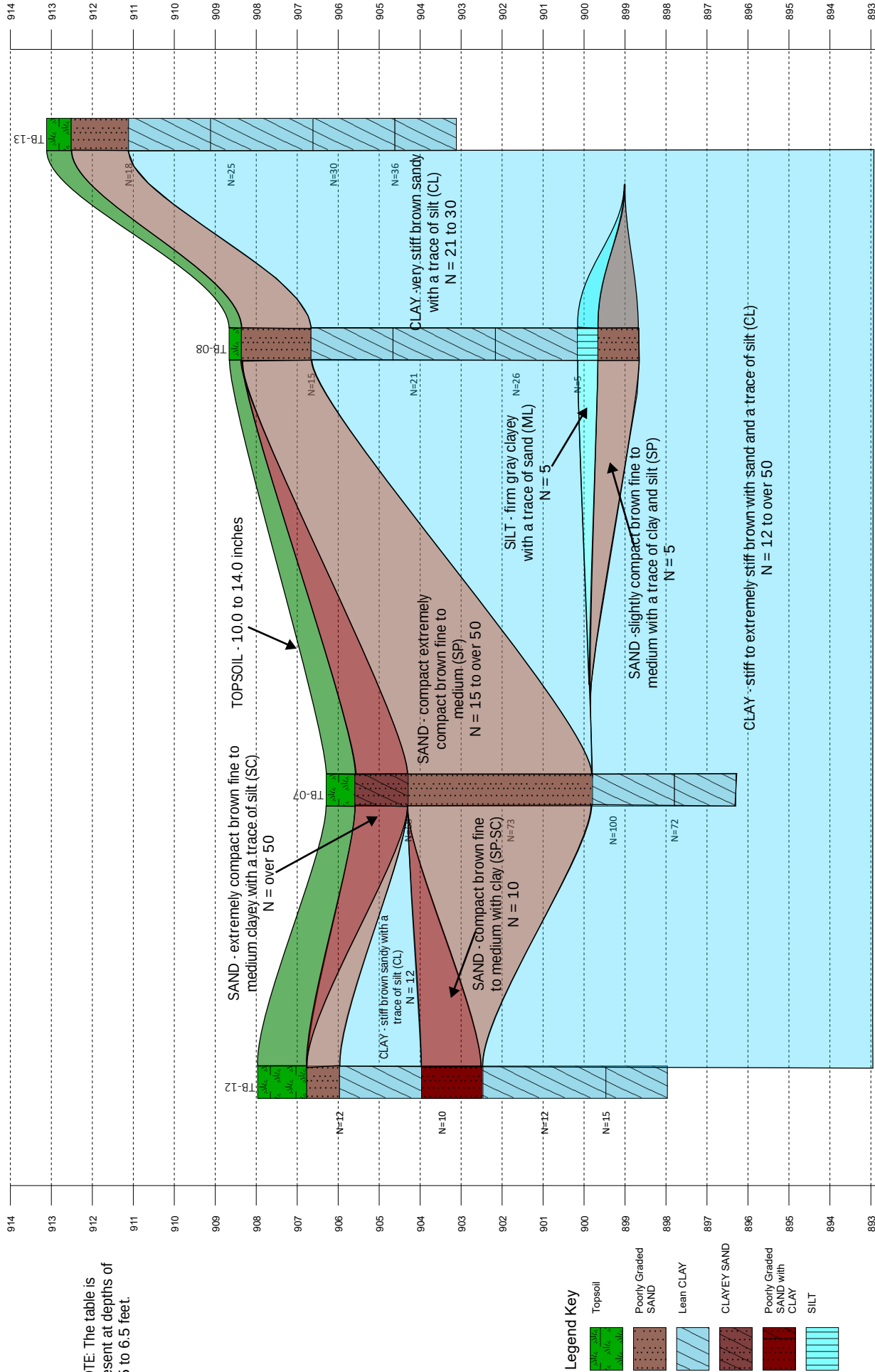
Vertical Scale: 1:40

Horizontal Scale: 1:3722

Engineer: Vincent Oderah, P.E.

GENERAL SOIL PROFILE

NOTE: The table is present at depths of 4.5 to 6.5 feet





Project Name: Woodland Corrections - Utility Program Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 10.00
Date Started: Oct 04 2023 Completed: Oct 04 2023 Northing: 344261.5 Easting: 13282525.3 Elevation: 904.87
Drilling Method: 3-1/4" Hollow Stem Auger Frost Depth
Equipment: Diedrich D-50 Ground Water Levels
Hammer Type: Manual Hammer ☒ At Time of Drilling 7.00' on Oct 04 2023 - Perched Water Encountered
Notes: ☒ End of Drilling 9.00' on Oct 04 2023

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		TOPSOIL - brown sandy with a trace of gravel (5.0")													
2		SAND - dark brown fine to medium clayey with a trace of gravel													
3		CLAY - very stiff brown sandy with silt													
4															
5															
6															
7		▽ SILT - very stiff brown clayey with a trace of sand													
8															
9		▼ SILT - very stiff brown clayey with a trace of sand gravel and lenses of sand													
10															
11															
12															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 04 2023	Completed:	Oct 04 2023	Northing:	343995.2	Easting:	13282825.4	Elevation:	903.46
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	At Time of Drilling	Oct 04 2023 - Water Not Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		ASPHALT - (2.5")													
2		GRAVEL - gray medium to coarse (3.5")													
3		SAND - brown fine to medium													
4		CLAY - stiff brown silty with a trace of sand	SPT-A		100	6-7-7	14								CL
5		CLAY - very stiff brown with a trace of silt and sand	SPT-B		100	12-13-17	30			10.6					CL
6		CLAY - very stiff brown with a trace of silt sand and gravel	SPT-C		100	9-13-12	25		1.67	9.9					CL
7		CLAY - very stiff brown with a trace of silt sand and gravel	SPT-D		100	6-9-33	42								CL
8		CLAY - very stiff gray sandy with a trace of silt													CL
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher
Client:	Nowak & Fraus Engineers	Reviewed By:	K Martella
Date Started:	Oct 03 2023	Survey Datum:	NAD 1983 StatePlane Michigan South
Completed:	Oct 03 2023	Hole Depth:	20.00
Drilling Method:	3-1/4" Hollow Stem Auger	Northing:	343858.1
Equipment:	Diedrich D-50	Easting:	13283129.1
Hammer Type:	Manual Hammer	Elevation:	902.35
Notes:	Frost Depth ☒ At Time of Drilling 17.00' on Oct 03 2023		

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		GRAVEL - brown fine to coarse with cobbles													
2		CLAY - stiff brown sandy	▲	SPT-A	80	5-5-7	12			14.3	23	15	8		CL
3			▲												
4			▲	SPT-B	47	6-5-4	9			14.5					CL
5			▲												
6			▲												
7		CLAY - firm brown silty with a trace of sand	▲	SPT-C	87	3-3-3	6			23.6					CL
8			▲												
9		CLAY - stiff brown with sand and a trace of silt and gravel	▲	SPT-D			WO			11.0					CL
10			▲	SPT-D	87	6-9-11	H		2.76						CL
11			▲				20								
12		CLAY - very stiff brown with a trace of silt and sand	▲	SPT-E	80	10-13-16	29								CL
13			▲												
14		CLAY - stiff gray sandy with a trace of silt	▲	SPT-F	80	6-7-9	16			9.8					CL
15			▲												
16			▲												
17		SAND - very compact gray fine to coarse clayey with a trace of silt	▲	SPT-G	73	9-9-12	21			8.9					SC
18			▲												
19		CLAY - stiff gray sandy with a trace of silt	▲	SPT-H	100	6-8-8	16								SC
20															
21															
22															
23															
24															
25															
26															
27															
28															
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Project Name: Woodland Corrections - Utility Program	Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan	Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers	Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 20.00
Date Started: Oct 03 2023 Completed: Oct 03 2023	Northing: 343812.3 Easting: 13283131.8 Elevation: 902.88
Drilling Method: 3-1/4" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Manual Hammer	☒ At Time of Drilling Oct 03 2023 - Water Not Encountered
Notes:	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		TOPSOIL - dark brown sandy (4.0")													
2		SAND - dark brown fine to coarse with a trace of clay and gravel													
3		CLAY - stiff brown sandy		SPT-A	73	4-4-4	8								CL
4															
5		SAND - compact brown fine to medium clayey gravelly		SPT-B	67	6-10-4	14			14.4					SC
6															
7		CLAY - firm brown silty with a trace of sand		SPT-C	80	3-4-3	7			21.0					CL
8		SAND - slightly compact brown fine clayey													
9															
10		CLAY - stiff brown with sand and a trace of silt and gravel		SPT-D	100	6-7-10	17								CL
11															
12		CLAY - very stiff brown with sand		SPT-E	53	12-22-23	45								CL
13															
14		CLAY - very stiff gray sandy gravelly with a trace of silt		SPT-F	80	9-10-15	25			6.4					CL
15															
16															
17		CLAY - stiff gray sandy with a trace of gravel		SPT-G	67	10-7-9	16		1.28	8.7					CL
18				SPT-H	87	7-9-9	18			8.2					CL
19															
20															
21															
22															
23															
24															
25															
26															
27															
28															
29															
30															



Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	20.00				
Date Started:	Oct 03 2023	Completed:	Oct 03 2023	Northing:	343908.1	Easting:	13284119.9	Elevation:	908.27
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	At Time of Drilling	10.00' on Oct 03 2023						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		GRAVEL - brown fine to coarse (3.0")													
2		SAND - brown fine to medium gravelly													
3		SAND - slightly compact brown fine to medium clayey with a trace of gravel	▲	SPT-A	47	3-2-3	5								SC
4		SAND - compact brown fine to medium clayey	▲	SPT-B	80	3-5-9	14			9.2					SC
5			▲												
6			▲												
7			▲												
8		SAND - compact brown fine to medium	▲	SPT-C	73	8-9-9	18								SC
9			▲												
10		SAND - very compact brown fine to medium clayey	▲	SPT-D	80	6-9-12	21			13.3					SP
11			▲												
12		SAND - compact brown fine silty with a trace of gravel	▲	SPT-E	80	6-9-9	18								SM
13			▲												
14		SAND - compact brown fine to coarse with a trace of clay and gravel	▲	SPT-F	80	7-6-7	13			5.4					SP
15			▲												
16			▲												
17		SAND - very compact brown fine to medium	▲	SPT-G	80	10-15-15	30								SP
18			▲												
19		SAND - very compact brown fine to coarse with a trace of clay and gravel	▲	SPT-H	100	20-22-23	45								SP
20															
21															
22															
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24															
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Project Name: Woodland Corrections - Utility Program	Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan	Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers	Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 20.00
Date Started: Oct 03 2023 Completed: Oct 03 2023	Northing: 343873.6 Easting: 13284122.4 Elevation: 908.33
Drilling Method: 3-1/4" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Manual Hammer	☒ At Time of Drilling 17.00' on Oct 03 2023
Notes:	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		TOPSOIL - dark brown sandy (7.0")													
2		SAND - brown fine to coarse gravelly													
3		SAND - compact brown fine clayey	▲	SPT-A	80	4-4-4	8			15.8					SC
4		SAND - very compact brown fine to medium clayey with a trace of gravel	▲												
5			▲	SPT-B	93	10-15-21	36								SC
6			▲												
7			▲	SPT-C	110	23-40	40			7.1					SC
8		SAND - very compact brown fine to medium	▲												
9			▲	SPT-D	87	24-24-25	49			6.1					SC
10			▲												
11			▲	SPT-E	87	15-14-14	28								SP
12		SAND - very compact brown fine to coarse	▲												
13			▲	SPT-F	80	11-12-14	26			4.7					SP
14			▲												
15			▲	SPT-G	87	12-12-11	23								SP
16		SAND - compact brown fine to coarse with a trace of clay	▲												
17			▲	SPT-H	100	8-8-11	19			14.4					SP
18			▲												
19			▲												
20															
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Project Name: Woodland Corrections - Utility Program **Project Number:** 2023.1746
Project Location: Whitmore Lake, Michigan **Logged By:** J Christopher **Reviewed By:** K Martella
Client: Nowak & Fraus Engineers **Survey Datum:** NAD 1983 StatePlane Michigan South **Hole Depth:** 10.00
Date Started: Oct 11 2023 **Completed:** Oct 11 2023 **Northing:** 343297.8 **Easting:** 13283096.0 **Elevation:** 906.29
Drilling Method: 3-1/4" Hollow Stem Auger **Frost Depth**
Equipment: Diedrich D-50 **Ground Water Levels**
Hammer Type: Manual Hammer ☒ At Time of Drilling 4.50' on Oct 11 2023 - Perched Water Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown sandy with a trace of clay and gravel (8.0")													
2		SAND - brown fine to medium clayey with a trace of silt													
3		SAND - extremely compact brown fine to medium		SPT-A	80	32-39-29	68			10.4					SP
4															
5				SPT-B	60	30-34-39	73			12.6					SP
6															
7		CLAY - extremely stiff brown with a trace of silt and sand		SPT-C	48	50/0.42'	50/5"								CL
8															
9		CLAY - extremely stiff brown with sand and a trace of silt		SPT-D	67	32-40-32	72			12.1					CL
10															
11															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher
Client:	Nowak & Fraus Engineers	Reviewed By:	K Martella
Date Started:	Oct 05 2023	Survey Datum:	NAD 1983 StatePlane Michigan South
Completed:	Oct 05 2023	Hole Depth:	10.00
Drilling Method:	3-1/4" Hollow Stem Auger	Northing:	343368.6
Equipment:	Diedrich D-50	Easting:	13284099.7
Hammer Type:	Manual Hammer	Elevation:	908.66
Notes:	Frost Depth ☒ At Time of Drilling 9.00' on Oct 05 2023		

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - brown sandy (4.0")													
2		SAND - brown fine to coarse with a trace of gravel													
3		CLAY - stiff brown sandy with silt	▲	SPT-A	80	6-7-8	15								CL
4			▲												
5		CLAY - very stiff brown sandy with silt and a trace of gravel	▲	SPT-B	80	8-9-12	21			12.9					CL
6			▲												
7		CLAY - very stiff brown sandy with a trace of silt	▲	SPT-C	100	9-12-14	26		3.03	12.3					CL
8			▲												
9		SILT - firm gray clayey with a trace of sand	▲	SPT-D	87	7-2-3	5			16.4					ML
10		SAND - slightly compact brown fine to medium with a trace of clay and silt	▲												
11															
12															
13															
14															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 05 2023	Completed:	Oct 05 2023	Northing:	343464.0	Easting:	13284900.5	Elevation:	916.71
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	☒ At Time of Drilling	Oct 05 2023 - Water Not Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		SAND - brown fine to coarse gravelly													
2		SAND - dark brown fine to coarse with a trace of gravel													
3		CLAY - stiff brown sandy with a trace of silt	SPT-A		67	7-9-8	17								CL
4		CLAY - very stiff brown with a trace of silt and sand													
5			SPT-B		80	9-12-13	25			16.6					CL
6															
7															
8			SPT-C		87	9-10-13	23								CL
9		CLAY - extremely stiff brown with sand and a trace of gravel													
10			SPT-D		87	10-22-32	54			10.8					CL
11															
12															
13															
14															
15															
16															
17															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 13 2023	Completed:	Oct 13 2023	Northing:	343327.3	Easting:	13285378.0	Elevation:	917.04
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	☒ At Time of Drilling	Oct 13 2023 - Water Not Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		TOPSOIL - dark brown sandy with a trace of silt (11.0")													
2		SAND- very compact brown clayey gravelly													
3			▲	SPT-A	80	8-10-12	22			7.1					SC
4		SAND - very compact brown fine to coarse with gravel	▲												
5		CLAY - very stiff brown with silt and a trace of sand	▲	SPT-B	73	8-12-13	25								CL
6			▲												
7			▲												
8			▲	SPT-C	100	7-11-14	25		2.36	12.8					CL
9		CLAY - very stiff brown with a trace of silt sand and gravel	▲	SPT-D	100	12-20-29	49								CL
10															
11															
12															
13															
14															
15															
16															
17															
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SOILS & STRUCTURES

Borehole ID: TB-11

Sheet 1 of 1

Project Name: Woodland Corrections - Utility Program	Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan	Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers	Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 10.00
Date Started: Oct 12 2023 Completed: Oct 12 2023	Northing: 343411.2 Easting: 13285805.9 Elevation: 912.35
Drilling Method: 3-1/4" Hollow Stem Auger	Frost Depth
Equipment: Diedrich D-50	Ground Water Levels
Hammer Type: Manual Hammer	☒ At Time of Drilling 1.80' on Oct 12 2023 - Perched Water Encountered
Notes:	

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		ASPHALT - (4.0")													
2		GRAVEL - gray fine to coarse sandy (20.0")													
3		SILT - very stiff brown with a trace of clay and sand		SPT-A	67	7-11-13	24								ML
4															
5		SILT - very stiff brown with a trace of clay and sand		SPT-B	100	8-10-12	22		1.57	11.6					ML
6															
7		CLAY - very stiff brown with gravel and a trace of silt and sand		SPT-C	80	32-16-15	31			11.2	28	15	13		CL
8															
9		CLAY - very stiff brown with gravel and a trace of silt and sand		SPT-D	87	10-18-18	36								CL
10															
11															
12															
13															
14															
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17															
18															
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Project Name: Woodland Corrections - Utility Program Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 10.00
Date Started: Oct 11 2023 Completed: Oct 11 2023 Northing: 342911.4 Easting: 13282556.2 Elevation: 907.97
Drilling Method: 3-1/4" Hollow Stem Auger Frost Depth
Equipment: Diedrich D-50 Ground Water Levels
Hammer Type: Manual Hammer ☒ At Time of Drilling 4.00' on Oct 11 2023
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown clayey sandy with a trace of gravel (14.0")													
2		SAND - brown fine to medium													
3		CLAY - stiff brown sandy with a trace of silt	▲	SPT-A	53	5-6-6	12			10.2					CL
4		SAND - compact brown fine to medium with clay	▲	SPT-B	67	3-5-5	10								SP-SC
5		CLAY - stiff brown with a trace of silt and sand	▲												
6			▲	SPT-C	80	3-4-8	12			11.7					CL
7			▲												
8			▲	SPT-D	87	5-6-9	15								CL
9		CLAY - stiff gray with a trace of silt and sand	▲												
10															
11															
12															
13															
14															
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16															
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Project Name: Woodland Corrections - Utility Program Project Number: 2023.1746
Project Location: Whitemore Lake, Michigan Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 10.00
Date Started: Oct 12 2023 Completed: Oct 12 2023 Northing: 343084.7 Easting: 13284477.0 Elevation: 913.12
Drilling Method: 3-1/4" Hollow Stem Auger Frost Depth
Equipment: Diedrich D-50 Ground Water Levels
Hammer Type: Manual Hammer ☒ At Time of Drilling Oct 12 2023 - Water Not Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown sandy with a trace of clay (7.0")													
2		SAND - brown fine to coarse gravelly with a trace of clay													
3		CLAY - stiff brown sandy with a trace of silt and gravel		SPT-A	80	6-8-10	18								CL
4															
5		CLAY - very stiff brown with a trace of silt and sand		SPT-B	87	8-11-14	25			11.4					CL
6															
7		CLAY - very stiff brown with sand gravel and a trace of silt		SPT-C	100	6-12-18	30								CL
8															
9		CLAY - very stiff brown with a trace of silt and sand		SPT-D	100	12-16-20	36		2.32	13.9					CL
10															
11															
12															
13															
14															
15															
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Sheet 1 of 1

Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Index		
1		ASPHALT - (4.0")													
2		GRAVEL - gray fine to coarse sandy (16.0")													
3		SAND - compact brown fine													
4		CLAY - stiff brown with a trace of silt and sand	▲	SPT-A	87	5-6-10	16			12.9					SP
5		CLAY - very stiff brown with a trace of silt and sand	▲												
6		CLAY - very stiff brown with a trace of silt and sand	▲	SPT-B	53	13-14-15	29			12.3					CL
7		CLAY - very stiff brown with a trace of silt sand and gravel	▲												
8		CLAY - very stiff brown with a trace of silt sand and gravel	▲	SPT-C	100	8-12-15	27								CL
9		CLAY - very stiff brown with a trace of silt and sand	▲	SPT-D	87	13-19-23	42								CL
10															
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Project Name: Woodland Corrections - Utility Program Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 10.00
Date Started: Oct 12 2023 Completed: Oct 12 2023 Northing: 342903.4 Easting: 13285532.8 Elevation: 916.50
Drilling Method: 3-1/4" Hollow Stem Auger Frost Depth
Equipment: Diedrich D-50 Ground Water Levels
Hammer Type: Manual Hammer ☒ At Time of Drilling 7.00' on Oct 12 2023 - Perched Water Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		GRAVEL - gray fine to coarse with a trace of clay and sand (12.0")													
2		CLAY - brown silty sandy													
3		CLAY - very stiff brown sandy with a trace of silt	▲	SPT-A	80	10-11-13	24								CL
4		CLAY - stiff brown sandy with silt	▲												
5			▲	SPT-B	100	9-10-9	19			11.4					CL
6			▲												
7		CLAY - very stiff brown sandy with a trace of silt gravel and lenses of sand	▲	SPT-C	80	20-21-17	38			18.5					CL
8			▲												
9		CLAY - very stiff brown with a trace of silt and sand	▲	SPT-D	100	12-13-18	31			12.4					CL
10															
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Project Name: Woodland Corrections - Utility Program Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 2.50
Date Started: Oct 12 2023 Completed: Oct 12 2023 Northing: 342484.5 Easting: 13284586.2 Elevation: 914.76
Drilling Method: 3-1/4" Hollow Stem Auger Frost Depth
Equipment: Diedrich D-50 Ground Water Levels
Hammer Type: Manual Hammer
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown clayey sandy with a trace of silt (10.0")													
2		CLAY - extremely stiff brown sandy with a trace of silt	✱	SPT-A	43	50/0.46'	50/6"			9.9					CL
3															
4															
5															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 12 2023	Completed:	Oct 12 2023	Northing:	342410.3	Easting:	13284267.5	Elevation:	905.24
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	At Time of Drilling	3.00' on Oct 12 2023 - Perched Water Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown clayey sandy with a trace of silt (8.0")													
2		CLAY - stiff brown sandy with a trace of silt and gravel													
3		SAND - compact brown fine to medium clayey		SPT-A	80	8-8-10	18			22.4					CL
4		SAND - compact brown fine to medium clayey with a trace of gravel		SPT-B	67	9-9-10	19			9.1					SC
5		SILT - stiff gray with a trace of clay		SPT-C	87	6-8-8	16								ML
6		SILT - stiff gray clayey		SPT-D	80	4-4-5	9			16.5					ML
7															
8															
9															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 12 2023	Completed:	Oct 12 2023	Northing:	342406.6	Easting:	13284961.6	Elevation:	915.22
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	At Time of Drilling	Oct 12 2023 - Water Not Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Index	
1		ASPHALT - (4.0")													
2		GRAVEL - brown fine to coarse gravelly (10.0")													
3		CLAY - very stiff brown sandy with a trace of silt and gravel	SPT-A		100	7-9-12	21								CL
4															
5			SPT-B		100	12-16-18	34			11.1					CL
6															
7		SILT - very stiff to extremely stiff brown with a trace of sand and gravel	SPT-C		0	13-19-25	44								ML
8			SPT-D		47	18-25-26	51			12.4					ML
9															
10															
11															
12															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 11 2023	Completed:	Oct 11 2023	Northing:	342155.3	Easting:	13282620.1	Elevation:	908.07
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	☒ At Time of Drilling	Oct 11 2023 - Water Not Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown clayey sandy (12.0")													
2		CLAY - dark brown sandy with a trace of silt													
3		CLAY - very stiff brown sandy with a trace of silt	▲	SPT-A	87	11-15-22	37								CL
4		CLAY - extremely stiff brown with a trace of silt and sand	▲	SPT-B	80	29-39-32	71			10.5					CL
5		CLAY - very stiff brown with a trace of silt and sand	▲	SPT-C	100	13-15-18	33			11.9					CL
6			▲	SPT-D	100	9-11-13	24								CL
7															
8															
9															
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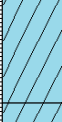
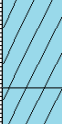
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Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Index		
1		TOPSOIL - dark brown sandy with a trace of clay and silt (8.0")													
2		SAND - dark brown fine to medium clayey with a trace of silt	▲	SPT-A	60	16-20-24	44			11.9					CL
3		CLAY - very stiff brown with a trace of silt and sand	▲												
4		CLAY - very stiff brown sandy with a trace of silt	▲	SPT-B	80	9-15-15	30								CL
5		CLAY - stiff brown with sand and a trace of silt	▲												
6		CLAY - firm brown with silt and sand	◆	SPT-C	80	5-4-5	9			12.1					CL
7															
8															
9															
10			▲	SPT-D	40	2-2-4	6			13.7					CL
11															
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Depth	Graphic	Material Description	Sample Type	Number	Recovery %	RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS
												Liquid Limit	Plastic Limit	Plasticity Index			
1		TOPSOIL - dark brown clayey sandy (14.0")															
2		CLAY - brown silty sandy															
3		CLAY - very stiff brown with sand and a trace of silt	▲▼	SPT-A	87	8-13-18	31										CL
4																	
5			▲▼	SPT-B	100	13-15-20	35				10.2						CL
6			▲▼														
7		SILT - very stiff brown clayey with a trace of sand	▲▼	SPT-C	87	7-13-15	28										ML
8			◆														
9		SILT - very stiff brown clayey sandy	▲▼	SPT-D	80	7-11-12	23				9.7						ML
10			▲▼														
11																	
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher
Client:	Nowak & Fraus Engineers	Reviewed By:	K Martella
Date Started:	Oct 12 2023	Survey Datum:	NAD 1983 StatePlane Michigan South
Completed:	Oct 12 2023	Hole Depth:	10.00
Drilling Method:	3-1/4" Hollow Stem Auger	Northing:	341976.5
Equipment:	Diedrich D-50	Easting:	13284379.2
Hammer Type:	Manual Hammer	Elevation:	914.49
Notes:	Frost Depth ☒ At Time of Drilling 8.00' on Oct 12 2023		

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown sandy with a trace of clay and gravel (10.0")		SPT-A	67	9-9-8	17								CL
2		SAND - dark brown fine to medium clayey gravelly													
3		CLAY - stiff brown sandy with a trace of silt													
4		CLAY - very stiff brown sandy with a trace of silt													
5		CLAY - very stiff brown sandy with a trace of silt		SPT-B	80	8-13-16	29			14.0					CL
6															
7															
8															
9		CLAY - very stiff brown sandy with lenses of sand		SPT-C	60	16-15-20	35			11.0					CL
10															
11															
12															
13				SPT-D	67	16-19-18	37								CL
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Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery %	RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS	
												Liquid Limit	Plastic Limit	Plasticity Index			
1		TOPSOIL - dark brown clayey sandy (10.0")															
2		CLAY - brown silty sandy															
3		CLAY - very stiff brown sandy with a trace of silt		SPT-A	47	8-10-13	23				10.1					CL	
4																	
5				SPT-B	100	10-11-12	23										CL
6																	
7				SPT-C	100	12-13-15	28										CL
8																	
9				SPT-D	100	8-12-15	27						11.5	26	14	12	CL
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Project Name: Woodland Corrections - Utility Program Project Number: 2023.1746
Project Location: Whitmore Lake, Michigan Logged By: J Christopher Reviewed By: K Martella
Client: Nowak & Fraus Engineers Survey Datum: NAD 1983 StatePlane Michigan South Hole Depth: 10.00
Date Started: Oct 11 2023 Completed: Oct 11 2023 Northing: 341824.7 Easting: 13283282.5 Elevation: 908.84
Drilling Method: 3-1/4" Hollow Stem Auger Frost Depth
Equipment: Diedrich D-50 Ground Water Levels
Hammer Type: Manual Hammer ☒ At Time of Drilling Oct 11 2023 - Water Not Encountered
Notes:

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown clayey sandy (9.0")													
2		CLAY - brown with a trace of silt and sand													
3		CLAY - very stiff brown with sand with a trace of silt	SPT-A	80	13-15-19	34				11.1					CL
4															
5			SPT-B	87	8-11-13	24									CL
6															
7															
8			SPT-C	100	8-13-15	28		2.23		11.0					CL
9		CLAY - very stiff brown with a trace of silt sand and gravel	SPT-D	87	21-12-13	25				11.5					CL
10															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher
Client:	Nowak & Fraus Engineers	Reviewed By:	K Martella
Date Started:	Oct 11 2023	Survey Datum:	NAD 1983 StatePlane Michigan South
Completed:	Oct 11 2023	Hole Depth:	10.00
Drilling Method:	3-1/4" Hollow Stem Auger	Northing:	341566.1
Equipment:	Diedrich D-50	Easting:	13283978.2
Hammer Type:	Manual Hammer	Elevation:	918.59
Notes:	Frost Depth ☒ At Time of Drilling 9.20' on Oct 11 2023		

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits					USCS
											Liquid Limit	Plastic Limit	Plasticity Index			
1		TOPSOIL - dark brown clayey sandy with a trace of gravel (10.0")														
2		CLAY - brown silty sandy														
3		CLAY - very stiff brown sandy with a trace of silt	▲	SPT-A	80	10-15-16	31			11.2						
4		CLAY - very stiff brown with a trace of silt sand and gravel	▲													
5		CLAY - very stiff brown with a trace of silt sand and gravel	▲	SPT-B	80	8-14-17	31									
6			▲													
7		CLAY - stiff gray with a trace of silt sand and gravel	▲													
8		CLAY - stiff gray with a trace of silt sand and gravel	▲	SPT-C	87	8-8-10	18			11.4						
9		CLAY - very stiff brown sandy with a trace of silt	▲	SPT-D	87	8-12-15	27			9.6						
10			▲													
11		SAND - very compact brown fine to medium clayey														
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 05 2023	Completed:	Oct 05 2023	Northing:	341584.7	Easting:	13281212.4	Elevation:	898.07
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	☒ At Time of Drilling			Oct 05 2023 - Water Not Encountered				
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		ASPHALT - (5.0")													
2		GRAVEL - crushed asphalt (4.0")													
3		SAND - brown fine to coarse with a trace of clay (8.0")													
4		CLAY - very stiff brown sandy with a trace of gravel													
5		CLAY - very stiff brown sandy with a trace of silt and lenses of sand													
6															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher
Client:	Nowak & Fraus Engineers	Reviewed By:	K Martella
Date Started:	Oct 05 2023	Survey Datum:	NAD 1983 StatePlane Michigan South
Completed:	Oct 05 2023	Hole Depth:	10.00
Drilling Method:	3-1/4" Hollow Stem Auger	Northing:	341726.6
Equipment:	Diedrich D-50	Easting:	13281696.3
Hammer Type:	Manual Hammer	Elevation:	889.88
Notes:	Frost Depth ☒ At Time of Drilling 7.00' on Oct 05 2023 ☐		

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown sandy with a trace of gravel (7.0")													
2		SAND - compact dark brown fine to medium clayey													
3			▲	SPT-A	73	6-6-7	13								SC
4			▲												
5			▲	SPT-B	67	5-5-4	9			17.5					SC
6			▲												
7		☞ SAND - slightly compact brown fine to medium clayey	▲												
8			▲	SPT-C	47	4-4-3	7								SC
9		SAND - loose brown fine to medium with a trace of clay	▲												
10			▲	SPT-D	53	3-2-2	4			17.5					SP
11															
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Project Name:	Woodland Corrections - Utility Program	Project Number:	2023.1746						
Project Location:	Whitemore Lake, Michigan	Logged By:	J Christopher	Reviewed By:	K Martella				
Client:	Nowak & Fraus Engineers	Survey Datum:	NAD 1983 StatePlane Michigan South	Hole Depth:	10.00				
Date Started:	Oct 04 2023	Completed:	Oct 05 2023	Northing:	341773.5	Easting:	13282383.4	Elevation:	900.78
Drilling Method:	3-1/4" Hollow Stem Auger	Frost Depth							
Equipment:	Diedrich D-50	Ground Water Levels							
Hammer Type:	Manual Hammer	☒ At Time of Drilling	Oct 05 2023 - Water Not Encountered						
Notes:									

Depth	Graphic	Material Description	Sample Type	Number	Recovery % RQD	Blow Counts	N-Value	Pocket Pen (tsf)	Shear Strength (tsf)	Moisture Content (%)	Atterberg Limits				USCS
											Liquid Limit	Plastic Limit	Plasticity Limit	Plasticity Index	
1		TOPSOIL - dark brown clayey sandy with a trace of gravel (13.0")			80	5-8-9	17			19.1					CL
2		SAND - dark brown fine to medium clayey													
3		CLAY - stiff brown with sand and a trace of silt		SPT-A											
4		CLAY - very stiff brown with a trace of silt and sand													
5				SPT-B	93	13-13-14	27								CL
6															
7															
8				SPT-C	80	9-12-15	27								CL
9				SPT-D	80	8-15-20	35			10.7					CL
10															
11															
12															
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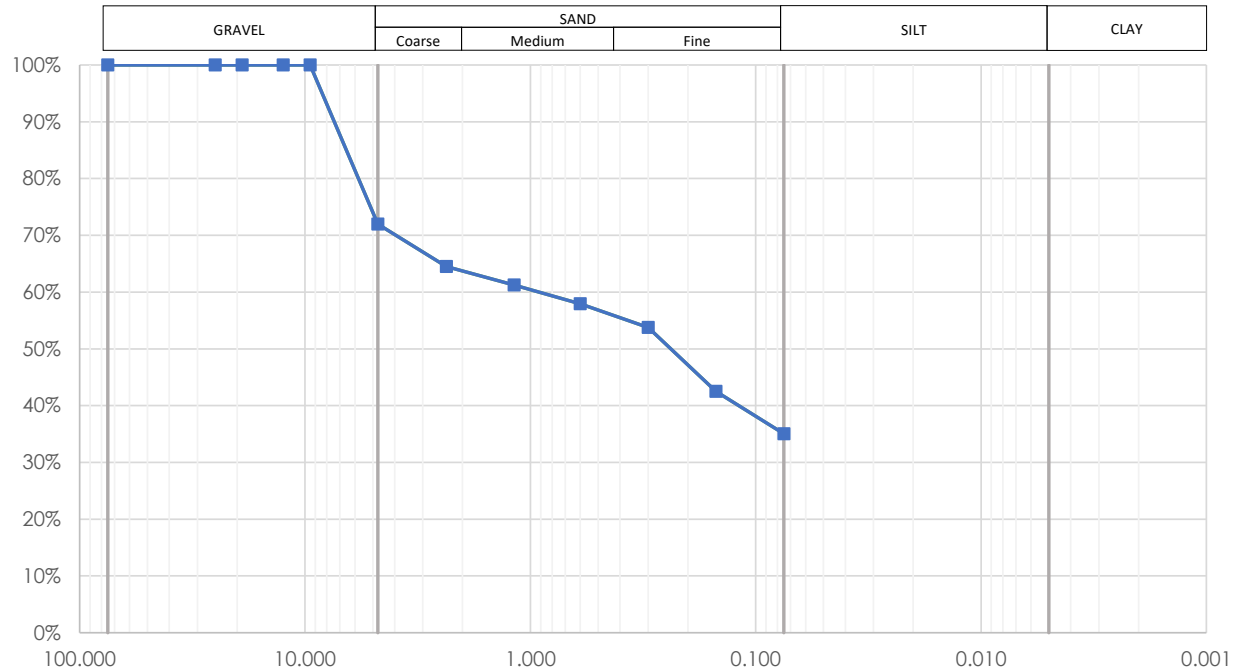
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SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Woodland Corrections - Utility Program
 Project Number 2023.1746
 Client Nowak & Fraus Engineers
 Date 10/30/2023
 Sample Location TB-10 Sample ID A Depth (ft) 2.0



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	28.0%	8.5%	8.0%	20.4%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
6.9588	0.9646	0.2500	0.0642	0.0321	0.0214	35.0%	

Particle Size		Hydrometer		Material Description
Sieve	% Passing	Particle Size (mm)	% Passing	Fine Clayey Gravelly SAND (SC)
3 in.	100%			
1 in.	100%			
3/4 in.	100%			
1/2 in.	100%			
3/8 in.	100%			
No. 4	72%			
No. 8	64%			
No. 16	61%			Remarks
No. 30	58%			
No. 50	54%			
No. 100	43%			
No. 200	35.0%			

Technician
bfritz

Checked
mvanweelden

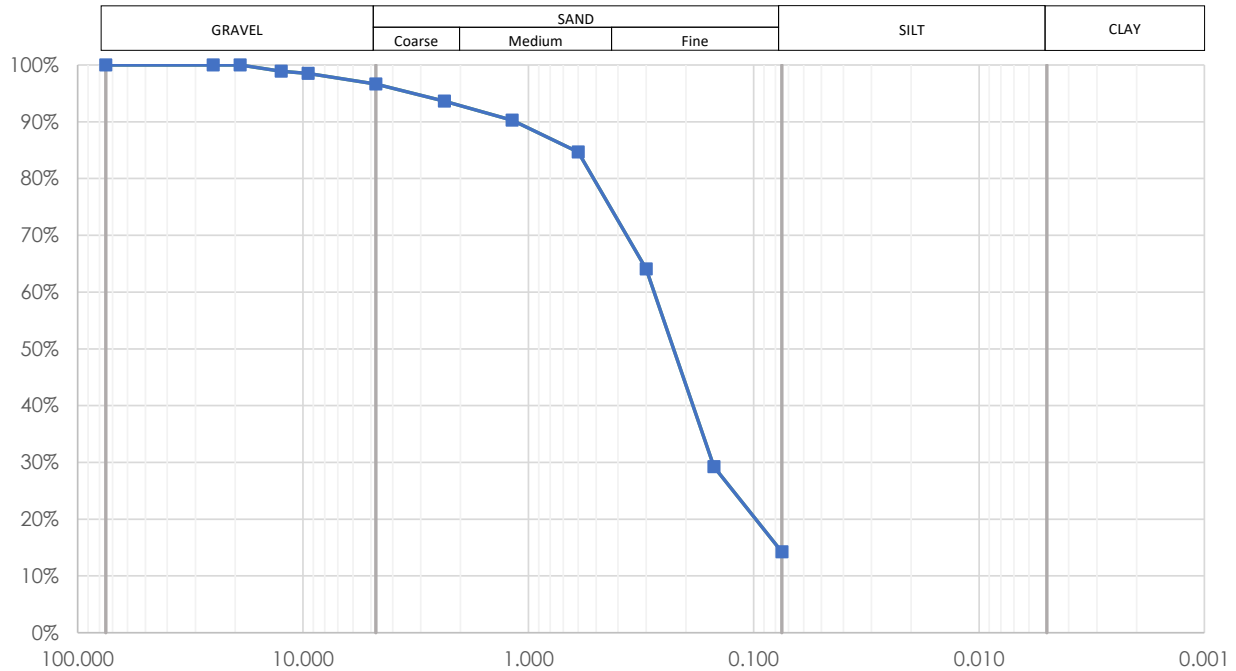
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mvanweelden



SOILS & STRUCTURES

Particle Size Distribution Report

Project Name Woodland Corrections - Utility Program
 Project Number 2023.1746
 Client Nowak & Fraus Engineers
 Date 10/30/2023
 Sample Location TB-27 Sample ID B Depth (ft) 4.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	3.4%	4.0%	20.0%	58.4%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
0.6367	0.2826	0.2395	0.1534	0.0788	0.0527	14.2%	

Particle Size		Hydrometer		Material Description
Sieve	% Passing	Particle Size (mm)	% Passing	Fine to Medium Clayey SAND (SC)
3 in.	100%			
1 in.	100%			
3/4 in.	100%			
1/2 in.	99%			
3/8 in.	99%			
No. 4	97%			
No. 8	94%			
No. 16	90%			
No. 30	85%			
No. 50	64%			
No. 100	29%			Remarks
No. 200	14.2%			

Technician
bfritz

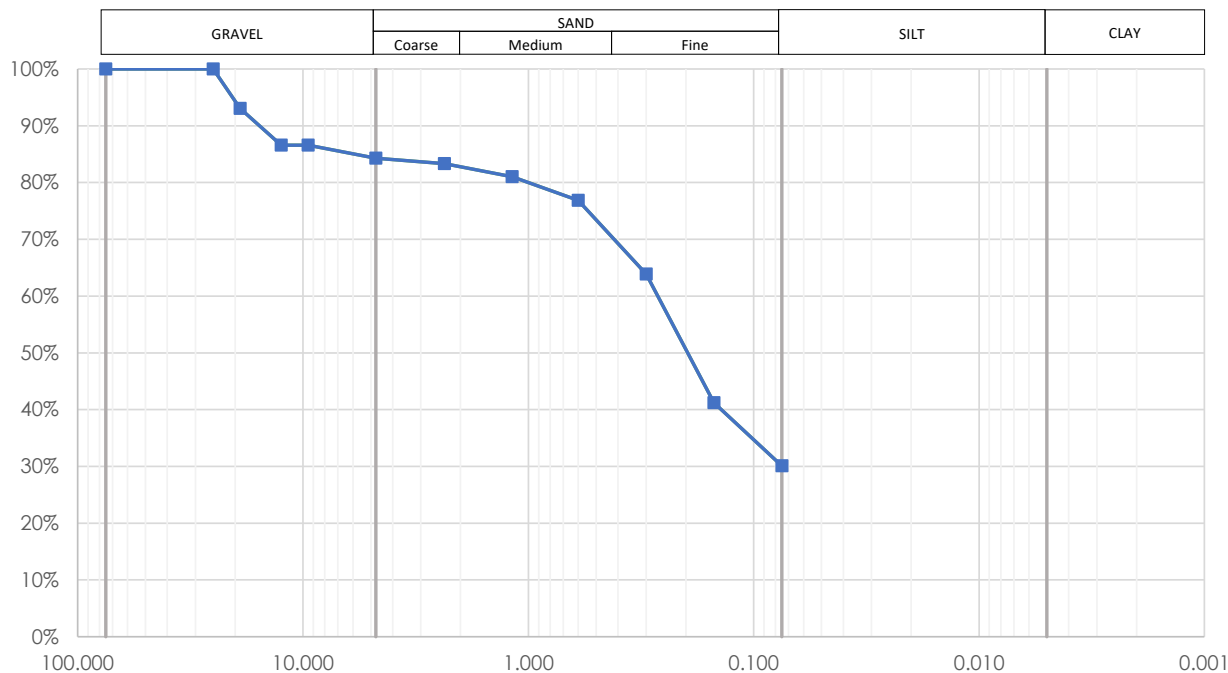
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mvanweelden

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mvanweelden



Particle Size Distribution Report

Project Name Woodland Corrections - Utility Program
 Project Number 2023.1746
 Client Nowak & Fraus Engineers
 Date 10/30/2023
 Sample Location TB-04 Sample ID B Depth (ft) 4.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	6.9%	8.8%	1.6%	13.3%	39.2%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
6.2700	0.2743	0.2082	0.0748	0.0374	0.0249	30.1%	

Particle Size		Hydrometer		Material Description
Sieve	% Passing	Particle Size (mm)	% Passing	Fine to Medium Clayey Gravelly SAND (SC)
3 in.	100%			
1 in.	100%			
3/4 in.	93%			
1/2 in.	87%			
3/8 in.	87%			
No. 4	84%			
No. 8	83%			
No. 16	81%			
No. 30	77%			
No. 50	64%			Remarks
No. 100	41%			
No. 200	30.1%			

Technician
bfritz

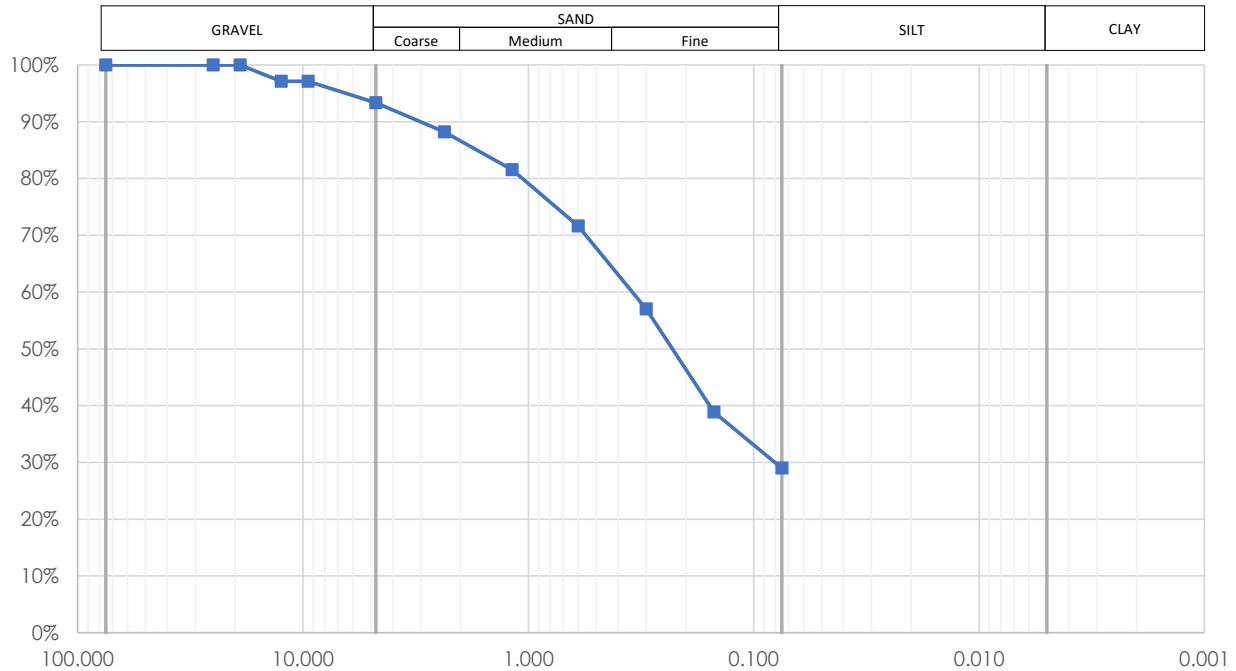
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mvanweelden

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mvanweelden



Particle Size Distribution Report

Project Name Woodland Corrections - Utility Program
 Project Number 2023.1746
 Client Nowak & Fraus Engineers
 Date 10/30/2023
 Sample Location TB-06 Sample ID D Depth (ft) 9.5



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0%	0.0%	6.7%	7.1%	23.1%	34.1%	0.0%	0.0%
D85	D60	D50	D30	D15	D10	Loss By Wash	
1.7925	0.3613	0.2421	0.0827	0.0388	0.0259	29.0%	

Particle Size		Hydrometer		Material Description
Sieve	% Passing	Particle Size (mm)	% Passing	Fine to Medium Clayey SAND with a Trace of Gravel (SC)
3 in.	100%			
1 in.	100%			
3/4 in.	100%			
1/2 in.	97%			
3/8 in.	97%			
No. 4	93%			
No. 8	88%			
No. 16	82%			
No. 30	72%			
No. 50	57%			
No. 100	39%			
No. 200	29.0%			
				Remarks

Technician
bfritz

Checked
mvanweelden

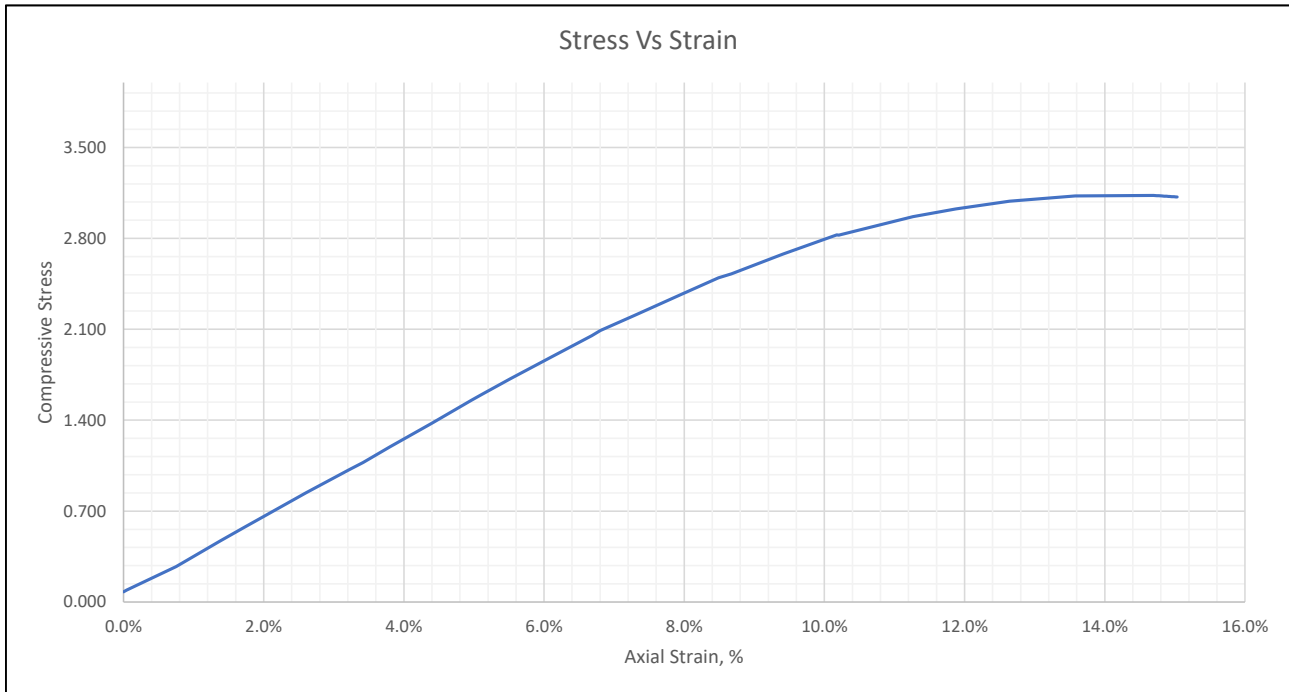
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mvanweelden



Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-11 Sample ID B

Depth (ft) 4.5



Sample ID	B
Unconfined Strength (tsf)	3.131
Undrained Shear Strength (tsf)	1.565
Failure Strain (%)	14.7%
Strain Rate, (in/min)	0.055
Moisture Content	11.6%
Wet Density (pcf)	136.3
Dry Density (pcf)	122.1
Void Ratio	0.3700
Saturation (%)	84.3%
Specimen Diameter (in)	1.51
Specimen Height (in)	2.99
Height/Diameter Ratio	1.98

Remarks

Technician
kmartella

Checked
mvanweelden

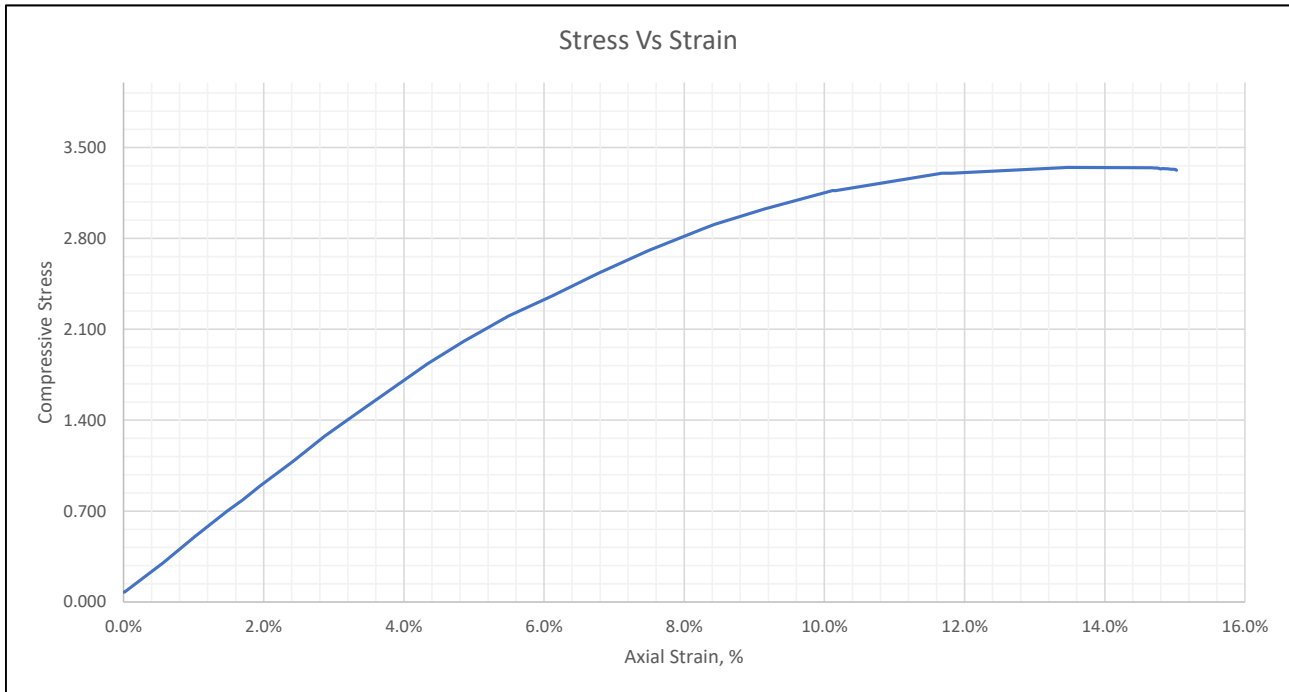
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mvanweelden



Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-02 Sample ID C

Depth (ft) 7.0



Sample ID	C
Unconfined Strength (tsf)	3.346
Undrained Shear Strength (tsf)	1.673
Failure Strain (%)	13.5%
Strain Rate, (in/min)	0.055
Moisture Content	9.9%
Wet Density (pcf)	138.7
Dry Density (pcf)	126.3
Void Ratio	0.3240
Saturation (%)	81.5%
Specimen Diameter (in)	1.52
Specimen Height (in)	3.01
Height/Diameter Ratio	1.98

Remarks

Technician
kmartella

Checked
mvanweelden

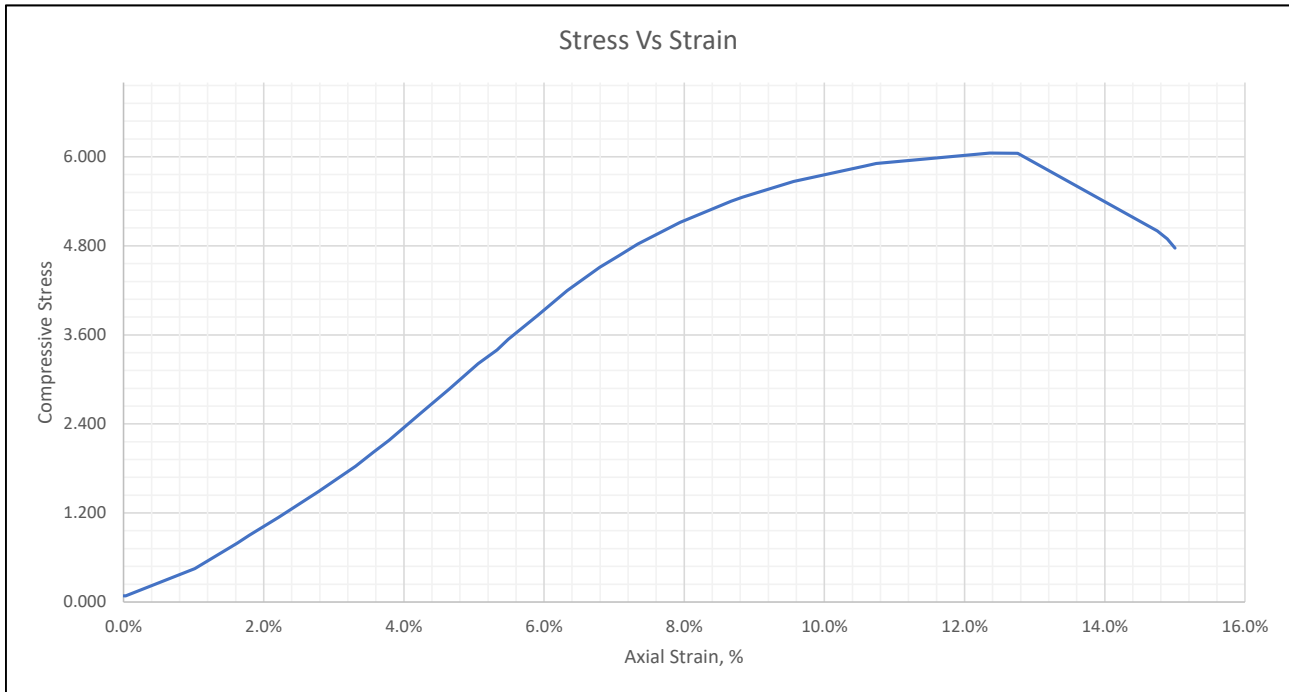
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Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-08 Sample ID C

Depth (ft) 7.0



Sample ID	C
Unconfined Strength (tsf)	6.050
Undrained Shear Strength (tsf)	3.025
Failure Strain (%)	12.4%
Strain Rate, (in/min)	0.055
Moisture Content	12.3%
Wet Density (pcf)	140.9
Dry Density (pcf)	125.4
Void Ratio	0.3333
Saturation (%)	99.1%
Specimen Diameter (in)	1.47
Specimen Height (in)	2.88
Height/Diameter Ratio	1.96

Remarks

Technician
kmartella

Checked
mvanweelden

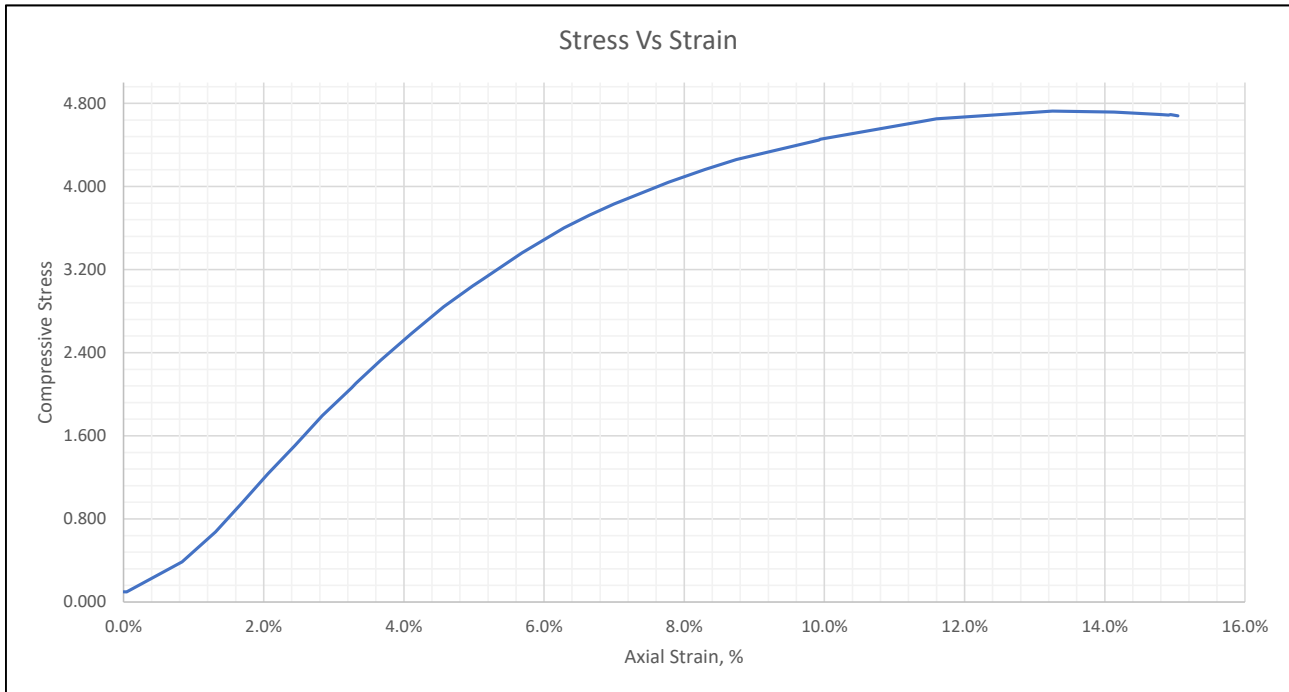
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Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-10 Sample ID C

Depth (ft) 7.0



Sample ID	C
Unconfined Strength (tsf)	4.725
Undrained Shear Strength (tsf)	2.363
Failure Strain (%)	13.3%
Strain Rate, (in/min)	0.055
Moisture Content	12.7%
Wet Density (pcf)	130.4
Dry Density (pcf)	115.7
Void Ratio	0.4460
Saturation (%)	76.6%
Specimen Diameter (in)	1.41
Specimen Height (in)	3.07
Height/Diameter Ratio	2.18

Remarks

Technician
kmartella

Checked
mvanweelden

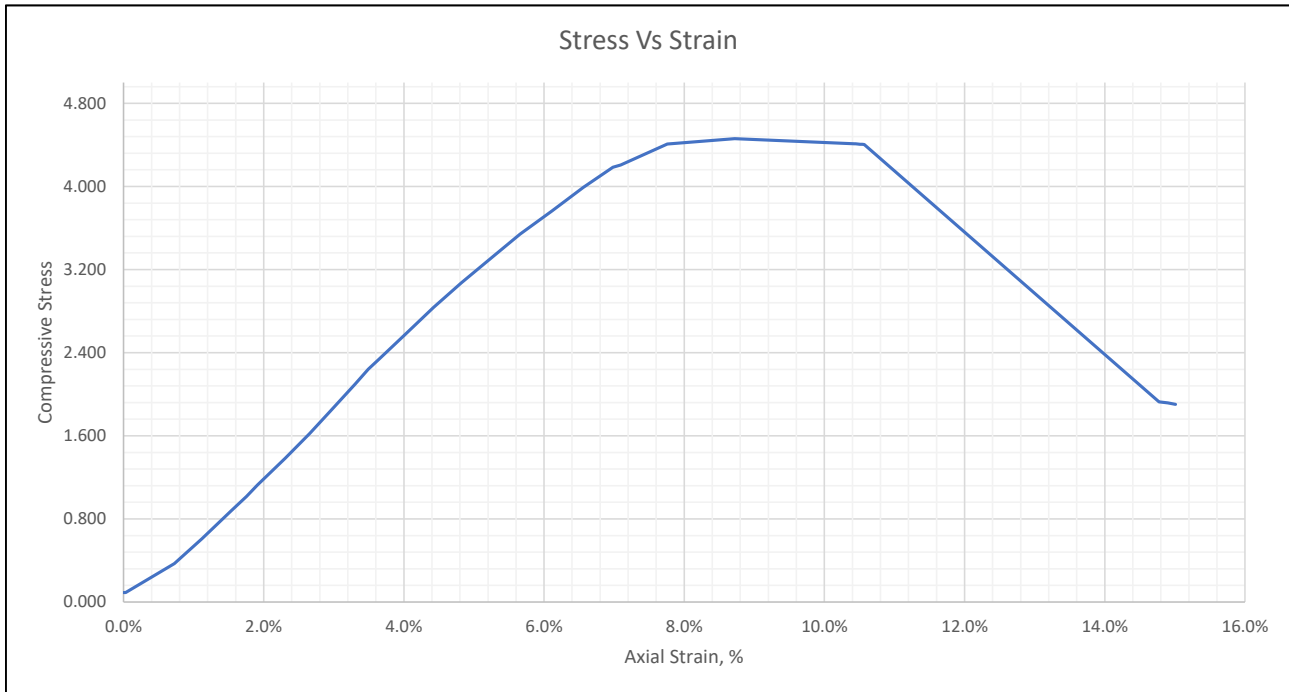
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Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-24 Sample ID C

Depth (ft) 7.0



Sample ID	C
Unconfined Strength (tsf)	4.460
Undrained Shear Strength (tsf)	2.230
Failure Strain (%)	8.7%
Strain Rate, (in/min)	0.055
Moisture Content	11.0%
Wet Density (pcf)	130.9
Dry Density (pcf)	117.9
Void Ratio	0.4188
Saturation (%)	70.7%
Specimen Diameter (in)	1.40
Specimen Height (in)	2.90
Height/Diameter Ratio	2.07

Remarks

Technician
kmartella

Checked
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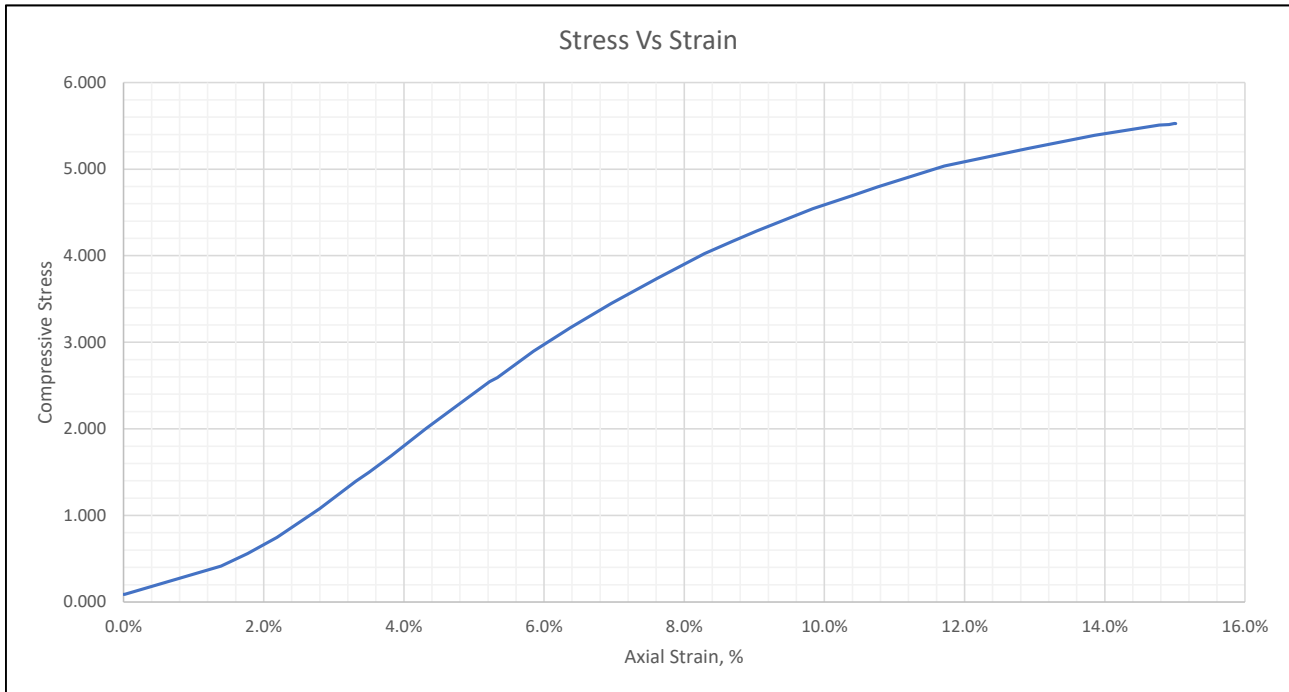
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Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-03 Sample ID D

Depth (ft) 8.5



Sample ID	D
Unconfined Strength (tsf)	5.528
Undrained Shear Strength (tsf)	2.764
Failure Strain (%)	15.0%
Strain Rate, (in/min)	0.055
Moisture Content	11.0%
Wet Density (pcf)	142.0
Dry Density (pcf)	127.9
Void Ratio	0.3078
Saturation (%)	96.1%
Specimen Diameter (in)	1.42
Specimen Height (in)	2.93
Height/Diameter Ratio	2.06

Remarks

Technician
kmartella

Checked
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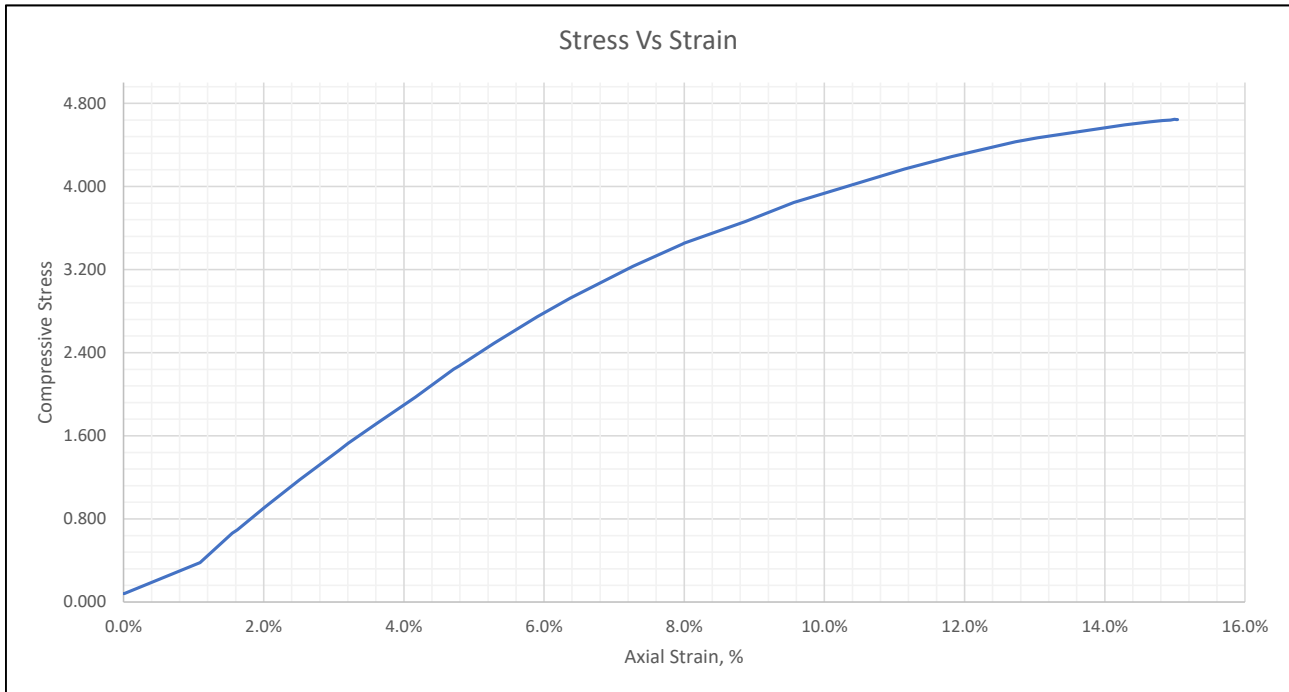
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Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-13 Sample ID D

Depth (ft) 8.5



Sample ID	D
Unconfined Strength (tsf)	4.646
Undrained Shear Strength (tsf)	2.323
Failure Strain (%)	15.0%
Strain Rate, (in/min)	0.055
Moisture Content	11.0%
Wet Density (pcf)	141.3
Dry Density (pcf)	127.3
Void Ratio	0.3138
Saturation (%)	93.9%
Specimen Diameter (in)	1.54
Specimen Height (in)	3.19
Height/Diameter Ratio	2.07

Remarks

Technician
kmartella

Checked

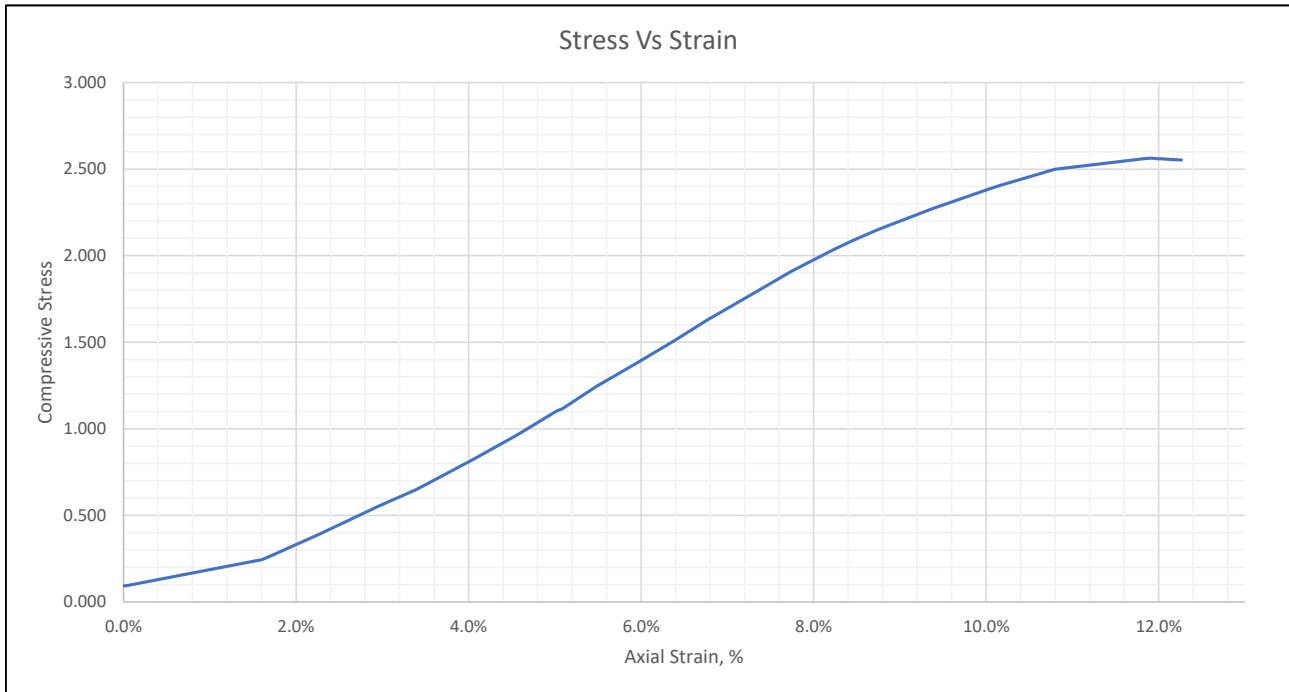
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Unconfined Compressive Strength

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Date 10/30/2023
Client Nowak & Fraus Engineers
Sample Location TB-04 Sample ID G

Depth (ft) 17.0



Sample ID	G
Unconfined Strength (tsf)	2.563
Undrained Shear Strength (tsf)	1.282
Failure Strain (%)	11.9%
Strain Rate, (in/min)	0.055
Moisture Content	8.7%
Wet Density (pcf)	144.2
Dry Density (pcf)	132.6
Void Ratio	0.2610
Saturation (%)	89.5%
Specimen Diameter (in)	1.49
Specimen Height (in)	3.00
Height/Diameter Ratio	2.01

Remarks

Technician
kmartella

Checked
mvanweelden

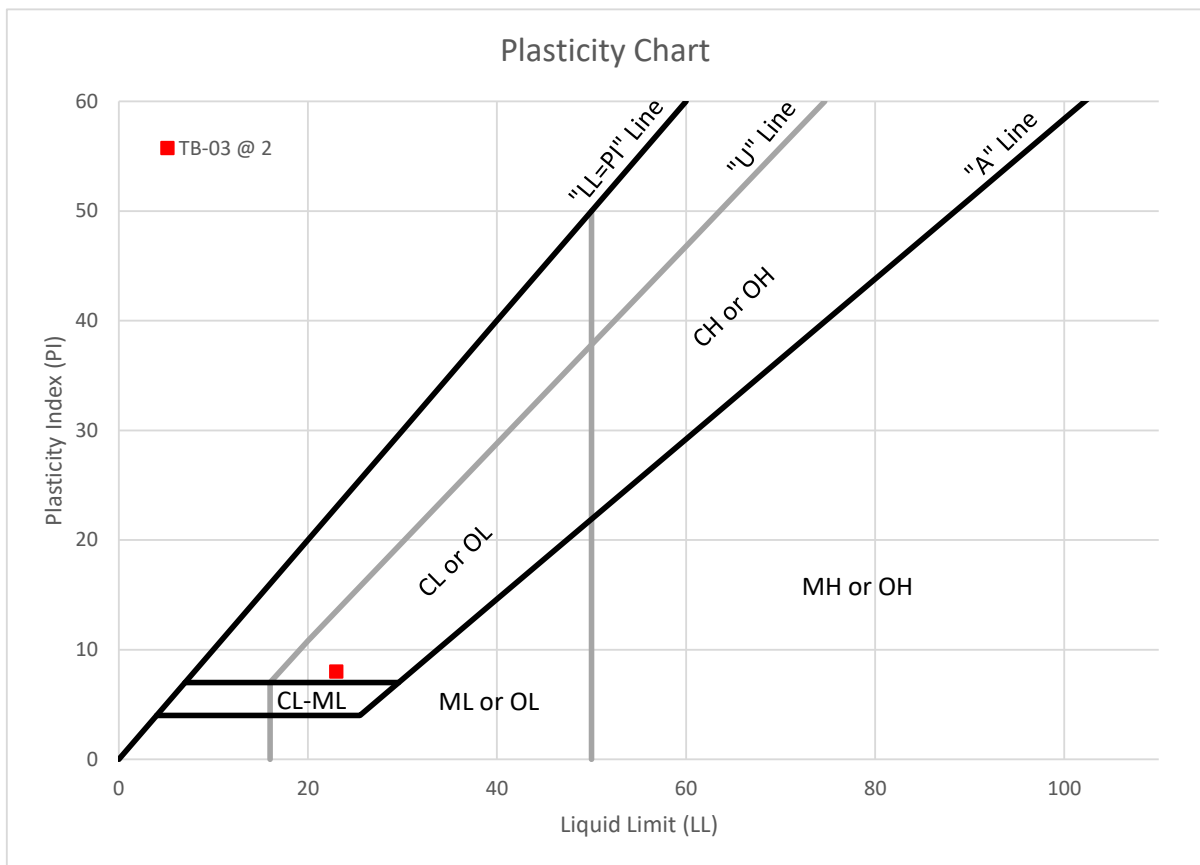
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LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX ASTM D4318-10, Multipoint Test

Project Name	Woodland Corrections - Utility Program		
Project Number	2023.1746		
Client	Nowak & Fraus Engineers		
Date	10/30/2023		
Sample Location	TB-03	Sample ID	A
Sample Description		Depth (ft)	2

		Liquid Limit		Plastic Limit
Mass of container	g	11.36	11.67	11.38
Mass of wet soil and container	g	39.38	35.97	32.96
Mass of dry soil and container	g	34.33	31.50	28.92
Water Content	%	21.99	22.54	23.03
		25 - 35	20 - 30	15 - 25
		35	25	21
		Average PL		
		15		

No. of blows, N



Remarks

LIQUID LIMIT	23
PLASTIC LIMIT	15
PLASTICITY INDEX	8

Technician
mvanweelden

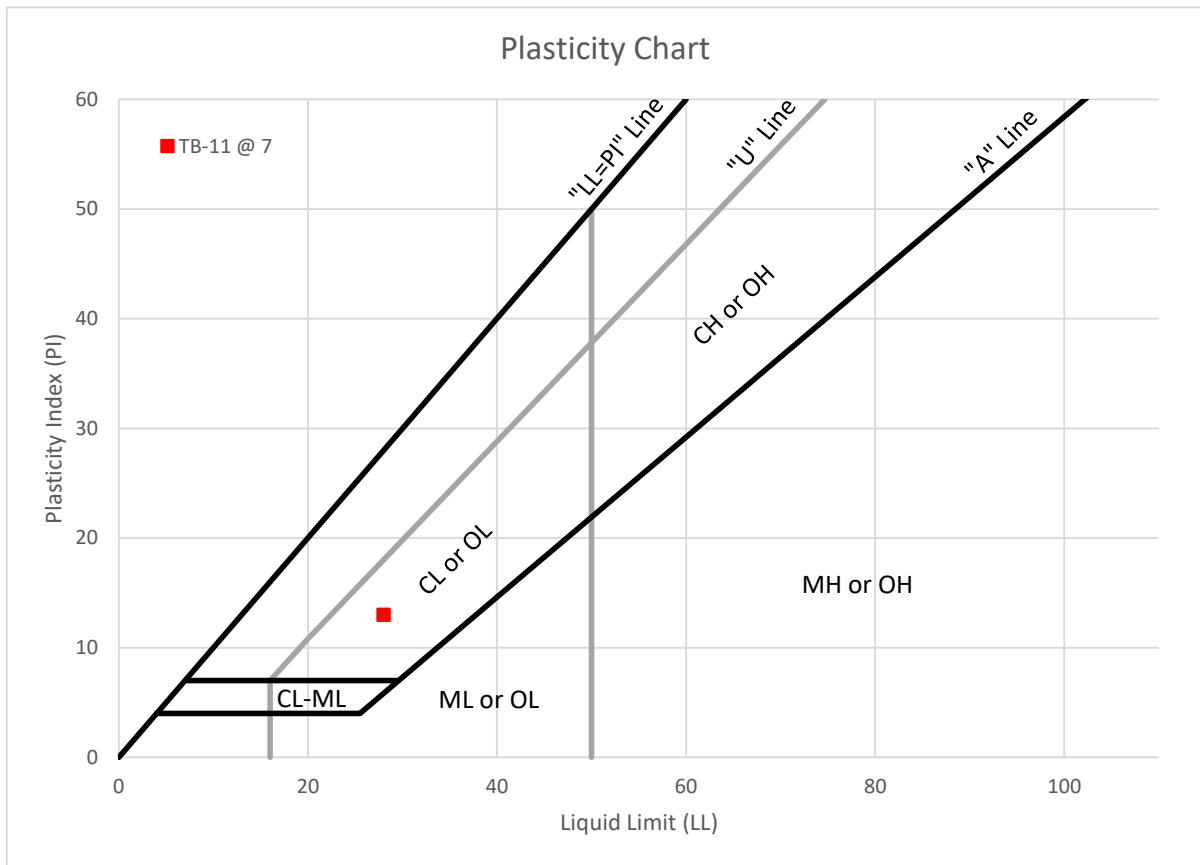
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mvanweelden

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mvanweelden

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX ASTM D4318-10, Multipoint Test

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023
Sample Location TB-11 Sample ID C Depth (ft) 7
Sample Description

		Liquid Limit			Plastic Limit	
Mass of container	g	11.64	11.36	11.32	11.38	11.24
Mass of wet soil and container	g	33.14	32.36	37.02	18.01	17.97
Mass of dry soil and container	g	28.49	27.79	31.30	17.16	17.08
Water Content	%	27.60	27.81	28.63	14.71	15.24
					Average PL	
					15	
		25 - 35	20 - 30	15 - 25		
No. of blows, N		35	28	19		



Remarks

LIQUID LIMIT	28
PLASTIC LIMIT	15
PLASTICITY INDEX	13

Technician
mvanweelden

Checked
mvanweelden

Approved
mvanweelden

LIQUID LIMIT, PLASTIC LIMIT AND PLASTICITY INDEX ASTM D4318-10, Multipoint Test

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023
Sample Location TB-23 Sample ID D Depth (ft) 8.5
Sample Description

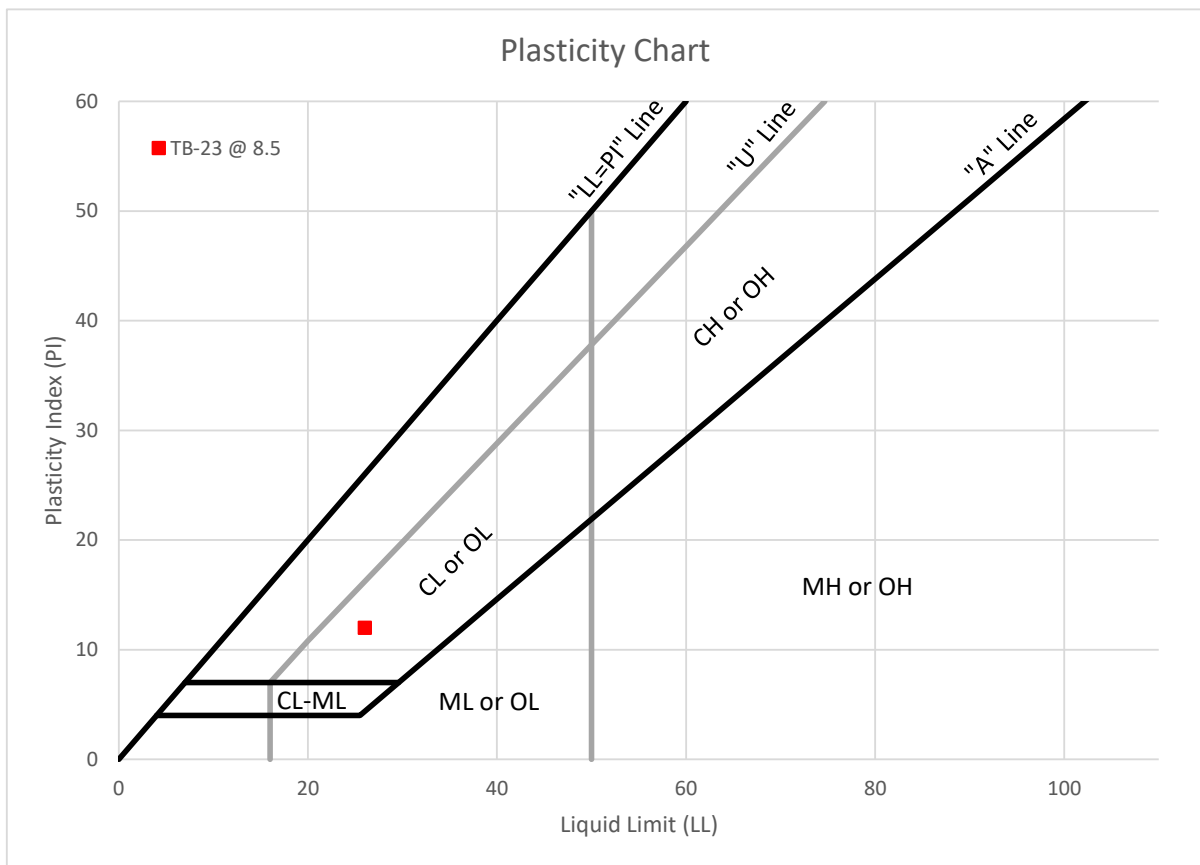
Mass of container
Mass of wet soil and container
Mass of dry soil and container
Water Content

Liquid Limit			
g	11.08	11.41	11.30
g	33.81	37.73	35.42
g	29.27	32.29	30.30
%	24.96	26.05	26.95

25 - 35	20 - 30	15 - 25
31	21	18

Plastic Limit	
11.47	11.54
18.24	18.33
17.41	17.47
13.97	14.50
Average PL	
14	

No. of blows, N



Remarks

LIQUID LIMIT	26
PLASTIC LIMIT	14
PLASTICITY INDEX	12

Technician
mvanweelden

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mvanweelden

Approved
mvanweelden



Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023

Sample Location

Sample ID

Depth

Sample Type

Mass of Container

Mass of Wet Soil and Container

Accepted Dry mass + container

Water Content

Remarks

	TB-03	TB-06	TB-07	TB-10	TB-12
	A	A	A	A	A
ft	2.0	2.0	2.0	2.0	2.0
	SPT	SPT	SPT	SPT	SPT
g	328.50	10.52	10.46	379.90	10.62
g	593.90	79.56	79.14	609.00	79.13
g	560.60	70.14	72.65	593.80	72.78
%	14.3	15.8	10.4	7.1	10.2

Sample Location

Sample ID

Depth

Sample Type

Mass of Container

Mass of Wet Soil and Container

Accepted Dry mass + container

Water Content

Remarks

	TB-14	TB-16	TB-17	TB-20	TB-23
	A	A	A	A	A
ft	2.0	2.0	2.0	2.0	2.0
	SPT	SPT	SPT	SPT	SPT
g	10.59	10.57	10.57	10.51	10.40
g	79.25	79.30	79.60	79.73	80.57
g	71.43	73.10	66.96	72.38	74.13
%	12.9	9.9	22.4	11.9	10.1

Sample Location

Sample ID

Depth

Sample Type

Mass of Container

Mass of Wet Soil and Container

Accepted Dry mass + container

Water Content

Remarks

	TB-24	TB-25	TB-26	TB-28	TB-27
	A	A	A	A	B
ft	2.0	2.0	2.0	2.0	4.5
	SPT	SPT	SPT	SPT	SPT
g	10.71	10.66	10.49	10.48	388.10
g	79.61	79.28	79.27	79.90	701.50
g	72.73	72.37	73.70	68.78	654.80
%	11.1	11.2	8.8	19.1	17.5

Technician
mvanweelden

Checked
mvanweelden

Approved
mvanweelden



Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023

Sample Location		TB-22	TB-21	TB-18	TB-19	TB-17
Sample ID		B	B	B	B	B
Depth	ft	4.5	4.5	4.5	4.5	4.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.45	10.50	10.50	10.64	10.55
Mass of Wet Soil and Container	g	79.25	79.51	79.90	79.60	79.26
Accepted Dry mass + container	g	70.81	73.10	72.97	73.07	73.55
Water Content	%	14.0	10.2	11.1	10.5	9.1
Remarks						

Sample Location		TB-14	TB-15	TB-13	TB-11	TB-07
Sample ID		B	B	B	B	B
Depth	ft	4.5	4.5	4.5	4.5	4.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.52	10.49	10.64	50.79	10.49
Mass of Wet Soil and Container	g	79.36	79.58	79.52	242.34	79.74
Accepted Dry mass + container	g	71.80	72.50	72.48	222.36	72.01
Water Content	%	12.3	11.4	11.4	11.6	12.6
Remarks						

Sample Location		TB-05	TB-08	TB-09	TB-04	TB-03
Sample ID		B	B	B	B	B
Depth	ft	4.5	4.5	4.5	4.5	4.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	380.70	19.78	19.35	385.30	20.78
Mass of Wet Soil and Container	g	669.80	89.69	89.70	632.50	89.61
Accepted Dry mass + container	g	645.50	81.72	79.70	601.30	80.87
Water Content	%	9.2	12.9	16.6	14.4	14.5
Remarks						

Technician mvanweelden
Checked mvanweelden
Approved mvanweelden



Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023

Sample Location

Sample ID

Depth

Sample Type

Mass of Container

Mass of Wet Soil and Container

Accepted Dry mass + container

Water Content

Remarks

	TB-01	TB-02	TB-02	TB-03	TB-04
	B	B	C	C	C
ft	4.5	4.5	7.0	7.0	7.0
	SPT	SPT	SPT	SPT	SPT
g	19.50	21.10	51.13	19.41	19.70
g	89.45	89.90	250.06	89.83	89.42
g	80.80	83.29	232.22	76.38	77.33
%	14.1	10.6	9.9	23.6	21.0

Sample Location

Sample ID

Depth

Sample Type

Mass of Container

Mass of Wet Soil and Container

Accepted Dry mass + container

Water Content

Remarks

	TB-06	TB-08	TB-11	TB-10	TB-12
	C	C	C	C	C
ft	7.0	7.0	7.0	7.0	7.0
	SPT	SPT	SPT	SPT	SPT
g	19.49	49.94	329.00	49.62	21.16
g	89.83	230.70	541.80	213.71	89.42
g	85.15	210.87	520.30	195.15	82.28
%	7.1	12.3	11.2	12.8	11.7

Sample Location

Sample ID

Depth

Sample Type

Mass of Container

Mass of Wet Soil and Container

Accepted Dry mass + container

Water Content

Remarks

	TB-15	TB-19	TB-20	TB-22	TB-25
	C	C	C	C	C
ft	7.0	7.0	7.0	7.0	7.0
	SPT	SPT	SPT	SPT	SPT
g	19.67	21.04	19.68	19.66	19.74
g	89.61	89.68	89.39	89.67	89.88
g	78.69	82.36	81.88	82.74	82.68
%	18.5	11.9	12.1	11.0	11.4

Technician
mvanweelden

Checked
mvanweelden

Approved
mvanweelden



Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023

Sample Location		TB-24	TB-26	TB-27	TB-28	TB-03
Sample ID		C	C	D	D	D
Depth	ft	7.0	7.0	8.5	8.5	8.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	50.72	19.58	19.71	21.08	50.42
Mass of Wet Soil and Container	g	204.10	89.65	89.41	89.62	223.36
Accepted Dry mass + container	g	188.84	81.10	79.02	82.98	206.17
Water Content	%	11.0	13.9	17.5	10.7	11.0
Remarks						

Sample Location		TB-24	TB-25	TB-23	TB-20	TB-21
Sample ID		D	D	D	D	D
Depth	ft	8.5	8.5	8.5	8.5	8.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	21.28	19.77	390.00	10.52	10.49
Mass of Wet Soil and Container	g	89.80	89.53	681.70	79.33	79.90
Accepted Dry mass + container	g	82.73	83.40	651.70	71.04	73.74
Water Content	%	11.5	9.6	11.5	13.7	9.7
Remarks						

Sample Location		TB-18	TB-15	TB-17	TB-13	TB-10
Sample ID		D	D	D	D	D
Depth	ft	8.5	8.5	8.5	8.5	8.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.66	10.70	10.38	51.07	
Mass of Wet Soil and Container	g	79.91	79.21	79.28	271.44	
Accepted Dry mass + container	g	72.25	71.64	69.53	244.60	
Water Content	%	12.4	12.4	16.5	13.9	
Remarks						

Technician mvanweelden
Checked mvanweelden
Approved mvanweelden



Determination of Water Content (Moisture) of Soil and Rock by Mass

(ASTM D2216)

Project Name Woodland Corrections - Utility Program
Project Number 2023.1746
Client Nowak & Fraus Engineers
Date 10/30/2023

Sample Location		TB-08	TB-09	TB-07	TB-01	TB-06
Sample ID		D	D	D	D	D
Depth	ft	8.5	8.5	8.5	8.5	9.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.51	10.55	10.55	10.57	360.20
Mass of Wet Soil and Container	g	79.90	79.20	79.45	79.42	693.50
Accepted Dry mass + container	g	70.12	72.49	72.02	69.72	674.40
Water Content	%	16.4	10.8	12.1	16.4	6.1
Remarks						

Sample Location		TB-05	TB-05	TB-06	TB-04	TB-03
Sample ID		D	F	F	F	F
Depth	ft	9.5	14.5	14.5	14.5	14.5
Sample Type		SPT	SPT	SPT	SPT	SPT
Mass of Container	g	10.62	10.47	10.49	10.51	10.49
Mass of Wet Soil and Container	g	79.37	79.52	79.48	79.54	79.29
Accepted Dry mass + container	g	71.31	76.01	76.38	75.38	73.17
Water Content	%	13.3	5.4	4.7	6.4	9.8
Remarks						

Sample Location		TB-03	TB-04	TB-04	TB-06	
Sample ID		G	G	H	H	
Depth	ft	17.0	17.0	18.5	18.5	
Sample Type		SPT	SPT	SPT	SPT	
Mass of Container	g	10.50	49.82	10.40	10.41	
Mass of Wet Soil and Container	g	79.41	247.79	79.60	79.20	
Accepted Dry mass + container	g	73.75	231.92	74.37	70.56	
Water Content	%	8.9	8.7	8.2	14.4	
Remarks						

Technician mvanweelden
Checked mvanweelden
Approved mvanweelden

General Information for Method of Field Investigation

The soil investigation was performed in accordance with the American Society of Testing and Materials method ASTM D 1586, which is the "Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". Samples of compressible clays or organic soils are obtained in accordance with ASTM D 1587, which is the "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes." Rock may be cored in conjunction with the above methods as specified in ASTM D 2113 which is the "Standard Practice for Rock Core Drilling and Sampling of Rock for Site Investigation."

Field Testing

Standard Penetration Tests (SPT) in accordance with ASTM D 1586 were generally performed at depths of 2.0', 4.5', 7.0', 9.5' and 5.0' intervals thereafter.

Laboratory Testing

Samples obtained from the Standard Penetration Test, ASTM D 1586 or thin walled tube method, ASTM D 1587, were tested in the laboratory for the moisture content and density and/or particle size, where applicable. When soils sampled possessed sufficient cohesive properties, it was tested for its compressive strength in the unconfined state.

Natural Percent Moisture content (N.P.M.) of the soil is the percentage by weight of water contained in the soil sample compared to the dry weight of the solids of which the soil is composed. The NPM of select samples is determined in accordance with ASTM D 2216.

Natural Density (N.D.) of soil as reported on the appended boring logs is the natural wet density of the soils expressed in pounds per cubic foot.

The unconfined compressive strength of cohesive soils is determined in the laboratory on "undisturbed" select samples in accordance with ASTM D 2166. This test determines the maximum load required at a specified rate to deform the cohesive soil specimen length twenty (20%) percent. The primary purpose of the unconfined compression test is to obtain approximate quantitative values of the compressive strength of soils possessing sufficient coherence to permit testing in the unconfined state. The shear strength of the cohesive soil can be calculated from the results of the unconfined compressive strength test.

Color

When the color of the soils is uniform throughout, the color recorded will be such as brown, gray, and black and may be modified by adjectives such as light and dark. If the soils predominant color is shaded by secondary color, the secondary color precedes the primary color, such as gray-brown, or yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled; such as mottled brown and gray.

Water Observations

Depth of water recorded in the test boring is measured from the ground surface to the water surface. Initial depth indicates water level during boring, completing depth indicates water level immediately after boring, and depth after "X" number of hours indicates water level after allowing the groundwater rise or fall over a period of time. Water observations in pervious soils are considered reliable groundwater levels for accurate groundwater measurements at the time the test borings were performed unless records are made over several days' time. Factors such as weather, soils porosity, etc., will cause the groundwater level to fluctuate for both pervious and impervious soils.

Sample Type

If not otherwise indicated, the sample is a split-barrel liner sample ASTM D 1586.

"S.T." – Shelby tube sample, ASTM D 1587
"A" – disturbed augered sample
"C" – rock core sampled ASTM D 2113
N.P.M. – Natural Percent Moisture of in-situ soils sample
N.D. – Natural Density of in-situ soils sample in pcf.
S.S. – Shear Strength of cohesive soils samples as determined by the Unconfined Compression tests in ksf.

Classification Data – Laboratory data to assist in classification of soils and classification of soils characteristics; i.e., plastic limit or liquid limit

Test Boring Logs

Particle Size	Visual
Boulders	Larger than 12" (300 mm)
Cobbles	12" to 3" (300 to 75 mm)
Gravel - Coarse	3" to ¾" (75 to 19 mm)
Gravel - Fine	19.0 to 4.75 mm
Sand- Coarse	4.75 to 2.0 mm
Sand - Medium	2.0 to 0.425 mm
Sand - Fine	0.425 to 0.075 mm
Silt	0.075 to 0.002 mm
Clay	0.002 mm and smaller

Soils Components

Major Component	Minor Component
Gravel	Trace [1 - 10%]
Sand	Some [11 - 35%]
Silt/Clay	And [36 - 50%]

Condition of Soil Relative to Compactness

Granular Material	"N" Value
Loose	0 - 4
Slightly Compact	5 - 7
Compact	8 - 20
Very Compact	21 - 50
Extremely Compact	51 and above

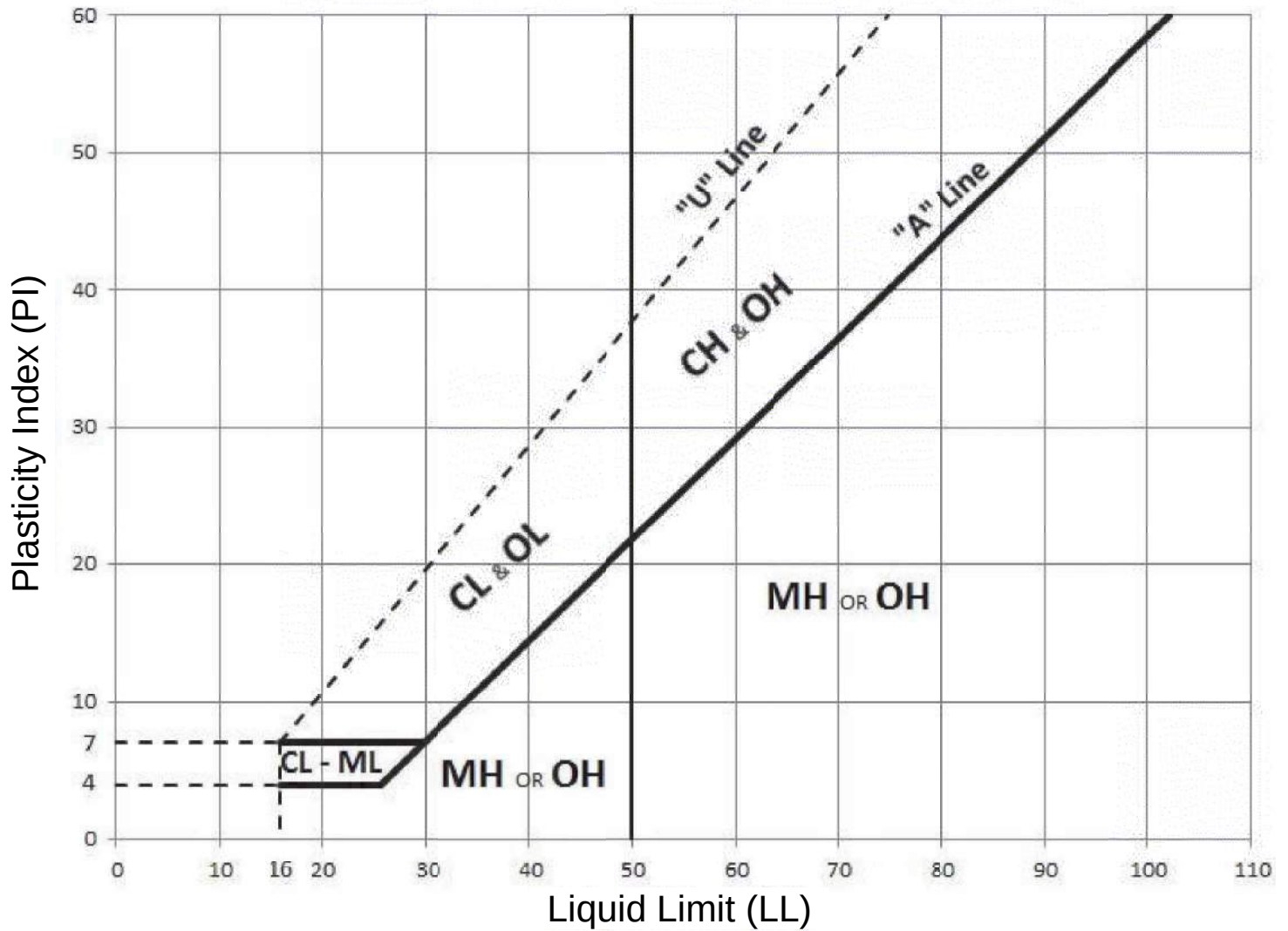
Cohesive Material	"N" Value
Soft	0 - 4
Firm	5 - 7
Stiff	8 - 20
Very Stiff	21 - 50
Extremely Stiff	51 and above

"N" values in clay soils are not to be used as a measure of shear strength. However, they may be used as a general indication of strength.

Unified Soil Classification System Chart

Major Divisions			Letter Symbol	Typical Descriptions
Coarse Grained Soils More than 50% of material is larger than No. 200 sieve size	Gravel – Gravelly Soils more than 50% of coarse fraction retained on No. 4 sieve	Clean gravels (little or no fines)	GW	Well-Graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-Graded gravels, gravel-sand mixtures, little or no fines
		Gravel with Fines (appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More than 50% of coarse fraction passing No. 4 sieve	Clean Sand (little or no fines)	SW	Well-Graded sands, gravelly sands, little or no fines
			SP	Poorly-Graded sands, gravelly sands, little or no fines
		Sand with Fines (appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine Grained Soils More than 50% of material is smaller than No. 200 sieve size	Silts and Clays Liquid limit less than 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	Inorganic clays or low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays or low plasticity
	Silts and Clays Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays or medium to high plasticity, organic silts
	Highly organic soils	PT	Peat, humus, swamp soils with high organic contents	

For Laboratory Classification of Fine Grained Soil Plasticity Chart



SECTION 01 2100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
 - 1. Unit-cost allowances.
 - 2. Contingency allowances.
- C. Related Requirements:
 - 1. Section 01 2200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
 - 2. Section 01 2600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Engineer of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Engineer's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Engineer from the designated supplier.

1.5 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Engineer under allowance and shall include taxes, freight and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Engineer under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Engineer, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation , **taxes**, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION 01 2100

SECTION 01 2200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 01 2100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
 - 2. Section 01 2600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 3. Section 01 4000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- C. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Subgrade Undercutting Type X

1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 31 2000 "Earth Moving" and per the cross section on the plans.
2. Unit of Measurement: cubic yard of soil excavated, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 2100 "Allowances."

B. Unit Price No. Misc. HMA Repairs

1. Description: All work required to sawcut, remove and replace added areas of HMA pavement, regardless of existing cross section, in accordance with Section "Asphalt Pavement and per the cross section on the plans.
2. Unit of Measurement: Square Yard
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 2100 "Allowances."

C. Unit Price No. Misc. Concrete Repairs

1. Description: All work required to sawcut, remove and replace added areas of concrete pavement, regardless of existing cross section, in accordance with Section "Concrete Pavement" and per the cross section on the plans.
2. Unit of Measurement: Square Yard
Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 2100 "Allowances."

END OF SECTION 01 2200

SECTION 01 2300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

END OF SECTION 01 2300

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 01 3100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or DTMB contract time requirements after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish

times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms provided by Owner.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer .

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 2500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: form acceptable to Engineer.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 01 2100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 01 2200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor on form included in Project Manual.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Engineer may issue a Construction Change Directive on form included in Project Manual. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.8 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive on form included in Project Manual. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 01 2900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 01 2100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 01 2200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 3. Section 01 2600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 4. Section 01 3200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than **seven** days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

4. Sub schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub schedules showing values coordinated with each element.
 5. Sub schedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide sub schedules showing values coordinated with the scope of each design services contract, as described in Section 01 1000 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Engineer.
 - e. Engineer's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 2. Arrange schedule of values consistent with format of AIA Document G703.
 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Change Orders (numbers) that affect value.
 - d. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of **five** percent of the Contract Sum.
 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
 8. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
 9. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling six percent of the Contract Sum and subcontract amount.

10. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Engineer and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. Evidence that claims have been settled.
6. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
7. Final liquidated damages settlement statement.
8. Proof that taxes, fees, and similar obligations are paid.
9. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 01 3200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities **and scheduled activities of other contractors** to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of Engineerural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Indicate required installation sequences.

- f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
2. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
3. Review: Engineer will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make suitable modifications and resubmit.
4. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 3300 "Submittal Procedures."

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Engineer.
5. Engineer's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.

15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: **Software-generated form with substantially the same content as indicated above, acceptable to Engineer.**
 1. Attachments shall be electronic files in PDF format.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow **seven** days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within **5** days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log **weekly. Include the following:**
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Engineer.
 4. RFI number, including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Engineer's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within **three** days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

- A. General: Engineer **will schedule and conduct** meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Contractor of scheduled meeting dates and times a minimum of **seven** days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Contractor within Five days of the meeting.
- B. Preconstruction Conference: DTMB **will schedule and conduct** a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than **15** days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Submittal procedures.
 - l. Preparation of Record Documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.

- q. Responsibility for temporary facilities and controls.
 - r. Procedures for disruptions and shutdowns.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. First aid.
 - w. Security.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer, of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: **Schedule and conduct** a project closeout conference, at a time convenient to Owner and Engineer, but no later than 10 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Owner's partial occupancy requirements.
 - k. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
 - a. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - b. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.

- 17) Pending changes.
5. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Unusual event reports.
- B. Related Requirements:
 - 1. Section 01 2900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 - 2. Section 01 4000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time **belongs to Owner**.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

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

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.
- 3.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Daily Construction Reports: Submit at **weekly** intervals.

F. Unusual Event Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values,] submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for **the Notice to Proceed** to date of **Substantial Completion**.
 - 1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than **20** days, unless specifically allowed by Engineer.
 - 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Regulatory agency approvals.
 - e. Punch list.
 - 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - 4. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's [**and Construction Manager's**] administrative procedures necessary for certification of Substantial Completion.
 - 6. Punch List and Final Completion: Include not more than **30** days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 - 3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.

- b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
4. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
- 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: At bi-monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule before each regularly scheduled progress meeting.
- 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate Final Completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is **14** or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

- I. Distribution: Distribute copies of approved schedule to Engineer Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 7 days of date established for **the Notice to Proceed**.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.

1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
- B. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within **one** day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3200

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
- B. Related Requirements:
 - 1. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 02 4119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 4. Section 31 1000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 QUALITY ASSURANCE

- A. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.3 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of **12** megapixels, and at an image resolution of not less than **3200 by 2400** pixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time]from camera.
- D. File Names: Name media files with **date and Project area** and sequential numbering suffix.

1.4 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.

- B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by **Engineer** .
1. Take **20** photographs to show existing conditions adjacent to property before starting the Work.
 2. Take **20** photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
1. Underground utilities.
 2. Piping.
 3. Electrical conduit.
- D. Periodic Construction Photographs: Take **20** photographs weekly . Select vantage points to show status of construction and progress since last photographs were taken.
- E. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Immediate follow-up when on-site events result in construction damage or losses.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3233

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 3100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
 - 3. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 01 3233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
 - 5. Section 01 4000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 6. Section 01 7700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 7. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 9. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with

requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Engineer.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Submittal purpose and description.
 9. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.

- B. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- C. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
 - a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
 - 3. Paper: Prepare submittals in paper form and deliver to Engineer.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. **Engineer reserves** the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on **Engineer's** receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow **15** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. **Engineer** will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow **15** days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow **21** days for initial review of each submittal
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow **15** days for review of each submittal. Submittal will be returned to **Engineer** before being returned to Contractor.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Statement of compliance with specified referenced standards.
 - d. Notation of coordination requirements.
 - e. Availability and delivery time information.
 4. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Compliance with specified standards.
 - c. Notation of dimensions established by field measurement.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit **[one]** <Insert number> full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
 6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit **three** sets of Samples. Engineer will retain **two** Sample sets; remainder will be returned. **Mark up and retain one returned Sample set as a project record Sample.**
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
- D. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a **uniform approval stamp**. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ENGINEER'S REVIEW

- A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, **and return**.
 - 1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Engineer will **discard** submittals received from sources other than Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3300

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
 - 1. Section 01 2100 "Allowances" for testing and inspection allowances.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of [**five**] <Insert number> previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.3 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Reports: Prepare and submit certified written reports and documents as specified.
- D. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.5 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within **10** days of **Notice of Award** and not less than **five** days prior to preconstruction conference. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager **may also serve as Project superintendent**
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.6 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, telephone number, and email address of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- F. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- G. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 1. Contractor's Responsibilities:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

1.8 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor , **and the Contract Sum will be adjusted by Change Order.**
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
- C. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- D. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents **as a component of Contractor's quality-control plan**. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Engineer.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.
 - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
 - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. "]The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Engineerural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Engineers (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Engineerural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; **American Society of Mechanical Engineers (The)**
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.

38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Engineerural Woodwork Institute; www.awinet.org.
40. AWMAC - Engineerural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.

83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridarooft.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Engineerural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.

127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.

175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
188. TRI - Tile Roofing Industry Alliance; www.tilerroofing.org.
189. UL - Underwriters Laboratories Inc.; www.ul.org.
190. UL LLC - UL LLC; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov.
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.

11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from U.S. General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specification and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Engineerural & Transportation Barriers Compliance Board; (see USAB).

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPPH/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.

6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development;
<https://tfsweb.tamu.edu/>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 01 1200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.
 - 3. Section 01 2100 "Allowances" for allowance for metered use of temporary utilities.

1.2 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, **Owner's construction forces**, Engineer, testing agencies, and authorities having jurisdiction.

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

1.4 QUALITY ASSURANCE

- A. Accessible Temporary Egress: Comply with applicable provisions in **the DOJ's "2010 ADA Standards for Accessible Design"**.

1.5 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

- A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 1000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Utilize designated area within existing building for temporary field offices.

3. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 31 2000 "Earth Moving."
 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: **Use designated areas of Owner's existing** parking areas for construction personnel.
- E. Storage and Staging: **Use designated areas of Project site** for storage and staging needs.
- F. Waste Disposal Facilities:
 1. Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Temporary Erosion and Sedimentation Control:
 1. Comply with **requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and** requirements specified in Section 31 1000 "Site Clearing."
 2. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, in accordance with **erosion- and sedimentation-control Drawings**
 - a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.

- b. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - d. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

END OF SECTION 01 5000

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 1000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 01 2100 "Allowances" for products selected under an allowance.
 - 3. Section 01 2300 "Alternates" for products selected under an alternate.
 - 4. Section 01 2500 "Substitution Procedures" for requests for substitutions.
 - 5. Section 01 4200 "References" for applicable industry standards for products specified.
 - 6. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model

number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 3300 "Submittal Procedures."
- F. Substitution: Refer to Section 01 2500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 2. Store products to allow for inspection and measurement of quantity or counting of units.
 3. Store materials in a manner that will not endanger Project structure.
 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 7700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Engineer will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.
- B. Product Selection Procedures:
1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered .
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 2. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered **unless otherwise indicated**.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
 3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 2500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 01 3300 "Submittal Procedures."
 - 1. Form of Approval of Submittal: As specified in Section 01 3300 "Submittal Procedures."
 - 2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- B. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering.
 - 3. Installation.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Requirements:
 - 1. Section 01 1000 "Summary" for coordination of , and limits on use of Project site.
 - 2. Section 01 3300 "Submittal Procedures" for submitting surveys.
 - 3. Section 01 7700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 02 4119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor .

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

- B. Professional Engineer Qualifications: Refer to Section 01 4000 "Quality Requirements."
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, **mechanical and electrical systems**, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where

indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to **local utility** that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance with requirements in Section 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 2. Establish limits on use of Project site.
 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 4. Inform installers of lines and levels to which they must comply.
 5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 1000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to **[minimize] [prevent]** interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. **Concrete:** Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall

and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel.
1. Refer to Section 01 1000 "Summary" for other requirements for Owner-furnished, Contractor-installed **and Owner-furnished, Owner-installed** products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel **and Owner's separate contractors**.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel **and Owner's separate contractors** at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in **Section 01 5000 "Temporary Facilities and Controls." Section 01 7419 "Construction Waste Management and Disposal."**
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 7300

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Related Requirements:
 - 1. Section 31 1000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 INFORMATIONAL SUBMITTALS

- A. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 1. Comply with operation, termination, and removal requirements in Section 01 5000 "Temporary Facilities and Controls."
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 2. Comply with Section 01 5000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 ATTACHMENTS

END OF SECTION 01 7419

SECTION 02 3200 – HYDRO OR PNEUMATIC VACUUM EXCAVATION

1 - GENERAL

.1SUMMARY

A.Work Included: Hydro or pneumatic vacuum excavation operations include various types of excavations including “pot-holing” and “slot trenching” for underground utility locating, shafts and pits, and other types of excavations.

.2 SUBMITTALS

A.Submittals for Review:

1. Hydro plan.

.3REFERENCES/ CODES

A. Codes, Regulations and Environmental:

1. Hydro or pneumatic vacuum excavation shall conform to all applicable federal, state, and local codes, regulations, and permit requirements.
2. Vacuum truck tanks, pumps, and other equipment shall conform to all applicable codes which would include the Department of Transportation (DOT) and American Society of Mechanical Engineers (ASME) (for pressure vessels).
3. Transporting spoils must be managed by site environmental coordinators and comply with all federal environmental and DOT regulations.

.4 QUALITY ASSURANCE

A. Hydro or Pneumatic Vacuum Excavation Qualifications:

1. Minimum of ten years’ experience in performing hydro or pneumatic vacuum excavation.
2. Technicians trained and certified by hydro or pneumatic vacuum excavation radar equipment manufacturer.
3. Technicians maintain OSHA safety training certificate.
4. Maintain General Liability Insurance of \$1,000,000, Automobile Liability of \$1,000,000 and Umbrella Liability of \$6,000,000.
5. All personnel involved in hydro or pneumatic vacuum excavation shall be at least 18 years of age and be a full-time employee of the company providing the service. They shall satisfactorily complete a training course, provided by Qualified Trainer representing the manufacturer or owner of the equipment, which includes all safety considerations and equipment operation before working on site. The training course shall include the items listed in the Training Requirements Section.

6. The contractor shall be able to verify the current qualifications of each member of the excavation crew that will be operating the equipment.
 7. An excavation crew shall be composed of at least two persons. The operator shall be in view of another crewmember at all times.
 8. Supervisors and Operators shall have at least 500 hours of documented experience in hydro or pneumatic vacuum excavation
 9. Supervisors and Operators shall successfully complete a written examination to demonstrate an understanding of this operating procedure.
 10. Supervisors and Operators shall meet one of the following re-certification criteria on an annual basis:
 - a. Provide documentation of 500 hours of active hydro or pneumatic vacuum excavation supervision or operation over the past year.
 - b. Successfully complete the Training Requirements
- B. Before beginning work, meet with Owner, Engineer and Contractor, and others whose Work requires survey results.
1. Review limits of area.
 2. Review depth limits for the holes.
 3. Review project Geotechnical Report.
 4. Review project Electromagnetic Report.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

.1 HYDRO OR PNEUMATIC VACUUM EXCAVATION PLAN

- A. Develop a detailed plan for hydro or pneumatic vacuum excavation include:

- 1.Area of investigation.
- 2.Depth of investigation.
- 3.Elements to be located.
- 4.Operational constraints.

.2 PREPARATION

- A. Review existing topographic surveys, aerial photos, geotechnical reports, and other available information.
- B. Review site for cultural sources of noise, including reflections from nearby vehicles, buildings, fences, power lines, lampposts trees and vegetation.

- C. Review site soil conditions to determine if they are conducive to successful data gathering via the GPR process.
 - 1. If soil conditions are too wet, allow soil to dry before proceeding.
- D. Do not proceed with work until unacceptable conditions are corrected.

PART 4 – OPERATING GUIDELINES FOR HYDRO OR PNEUMATIC VACUUM EXCAVATION EQUIPMENT

- A. When setting up the hose, it is best to take the shortest straight line possible from the vacuum source to the loading area. If the distance encompasses more than 50 feet during “dry” product loading, it is best to run the set-up line with “hard pipe” as long as possible using gradual turns where possible. When the loading area is reached, then a lightweight flexible hose can be used as a “work whip”. Refer to owner’s handbook on guidelines for hose set-up.
- B. Positioning and maneuvering of the loading hose is a very important task. Proper handling will maximize the performance of the vacuum source. Refer to operator’s handbook on specific hose handling tips.
- C. Operators shall follow the guidelines around “loading dusty products and powders” located in the owner’s handbook.

1.1 Minimum and maximum operating settings for the equipment are as follows:

Water Pressure:	1,500 to 2,500 psig
Water Flow Rate	4 to 10 gpm (hydro excavation rigs) 38 gpm max. (combo rigs)
Vacuum Rate:	2,500 to 4,500 cfm (minimum)
Vacuum Capacity:	14 to 28 inches Hg

- D. The operator(s) of the unit are responsible for equipment care while it is being used and following the guidelines for safe operation when:
 - Filling the vacuum pump with service liquid.
 - Engaging the main vacuum pump.
 - To engage the auxiliary vacuum pump and hydraulic system.
 - Operating automatic cyclone clean-out.
 - To disengage main vacuum pump.
 - To open the rear door. Refer to rear control panel description.
 - To close the rear door. Refer to rear control panel description.

E. RECORDS

- 1) All hydro or pneumatic vacuum excavation equipment supervisor and operator training records shall be maintained in the employee’s training file and be made available upon request. Supervisors and operators shall also have on their person a valid operator's card.
- 2) Maintenance and inspection records shall be kept on file and made available upon request. A qualified manufacturer’s representative or an owner's mechanic that is qualified shall

perform maintenance on the hydro or pneumatic vacuum excavation equipment (tanks, pumps, valves, etc.).

PART 5 – OPERATIONS AND SAFETY RULES

1. The operation of hydro or pneumatic vacuum excavation equipment shall conform to the following items to ensure a safe and productive work environment:

PART 1 Operator(s) must be thoroughly familiar with and follow the operator's procedure and operator's handbook guidelines. Individuals operating the hydro or pneumatic vacuum excavation equipment shall be qualified per this specification and the site's operating procedure.

PART 2 All tasks shall be reviewed to ensure the proper equipment/attachments for the job are used.

PART 3 All employees other than the individuals using the hydro or pneumatic vacuum excavation equipment will maintain a safe distance from the task being performed.

PART 4 Employees operating motor vehicles shall have a valid operator permit.

PART 5 Employees' driving/riding in the cab of the hydro or pneumatic vacuum excavation truck are required to use a restraint system (seatbelts) when the vehicle is traveling.

PART 6 The hydro or pneumatic vacuum excavation equipment must not be used for any purpose other than that for which it was designed. Accessories other than those manufactured for use with the equipment shall not be used without prior approval from the manufacturer and site safety personnel.

PART 7 The wheels of the hydro or pneumatic vacuum excavation equipment shall be chocked prior to operating the equipment.

PART 8 The hydro or pneumatic vacuum excavation equipment shall not be operated beyond its specified capabilities as outlined in the operator's manual without special approval.

- 8.3 Steel toe rubber boots, hardhat, hearing protection, ANSI approved safety glasses with rigid side shields, rubber gloves and slicker suit are minimum personal protective equipment to be worn at all times when performing hydro or pneumatic vacuum excavating operations. The operators of the high-pressure water or air nozzle and the vacuum pipe shall wear face shields.

PART 9 Never leave the hydro or pneumatic vacuum excavation equipment running and unattended.

PART 10 A spotter will be required when the view to the rear of the hydro or pneumatic vacuum excavation equipment is obstructed or when positioning/repositioning equipment in highly congested areas.

PART 11 Drivers of the hydro or pneumatic vacuum excavation equipment shall follow all applicable aspects of any site excavation specifications, guidelines, and procedures around safe vehicle usage.

PART 12 Keep the suction line away from your body and especially your face.

PART 13 Use caution when making any adjustments on the unit while it is running or operating. Stop the engine and then make adjustments.

PART 14 Keep hands away from moving parts.

PART 15 Complete a specific job safety analysis sheet identifying all hazards associated with task.

PART 16 When working close to the edge of an excavation and a potential fall hazard exists a plan shall be in place and addressed on appropriate site forms.

PART 17 Ensure all the following permits are in place prior to beginning the job:

17.3 Work permit

17.4 Excavation permit

17.5 Confined Space Entry Permit if required

PART 18 A danger/do not operate tag shall be placed on the hydro or pneumatic vacuum excavation equipment, if it is deemed unsafe to operate, until repairs can be made.

PART 19 Prior to operating the unit, the operator(s) shall check all items listed in the Operator Daily Checklist.

PART 20 At the conclusion of the work shift, the operator shall check all items listed in the Operator Post Job Checklist.

PART 21 Operator shall secure all connections starting at the source and follow through to the loading site.

PART 22 Do not exceed the recommended RPM found in the owner's handbook. When changing from "vacuum mode" to "pressure mode" vent tank to "0" Hg first, if required by manufacturer.

END OF SECTION 023200

SECTION 02 4119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 01 1000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 01 7300 "Execution" for cutting and patching procedures.
3. Section 31 1000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and **deliver to Owner ready for reuse**.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at [**Project site**] <**Insert location**>.
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 3233 "Photographic Documentation." Submit before Work begins.

1.6 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before selective demolition, Owner will remove the following items:
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of
 - 1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 5000 "Temporary Facilities and Controls."
- B. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 - 5. Maintain adequate ventilation when using cutting torches.
 - 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 8. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at

perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 4119

SECTION 22 1313 - FACILITY SANITARY SEWERS

PART 4 - GENERAL

4.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

4.2 SUMMARY

- A. Section Includes:
 - 1. PVC pipe and fittings.
 - 2. Nonpressure-type transition couplings.
 - 3. Cleanouts.
 - 4. Manholes.
 - 5. Concrete.

4.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

4.4 ACTION SUBMITTALS

- A. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

4.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

4.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

4.7 FIELD CONDITIONS

PART 5 - PRODUCTS

5.1 PVC PIPE AND FITTINGS

A. PVC Cellular-Core Sewer Piping:

1. Pipe: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, [SDR 35] <Insert SDR>, PVC socket-type fittings.

B. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

5.2 HDPE PIPE AND FITTINGS

A. Pipe: ASTM D2239, ASTM D2737, ASTM D3035

B. Fusible Thermoplastic Pipe Connection (Butt-Fusion):

1. HDPE, Fire-Service Pipe: ASTM F714, AWWA C906, or equivalent for PE water pipe; FM Global approved, with minimum thickness equivalent to FM Global.
 - Molded PE Fittings: ASTM D3350, PE resin, butt-fusion type, and made to match PE pipe dimensions and class.
2. HDPE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than 200 psig.
 - HDPE, AWWA Fittings: AWWA C906, butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than 200 psig.

5.3 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Concrete Pipes: ASTM C 443, rubber.
3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with **stainless-steel shear ring and** corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

5.4 CLEANOUTS

A. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

5.5 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: **individual FRP steps or FRP ladder**; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than **60 inches**.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch- minimum-width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: **ASTM A 536, Grade 60-40-18 ductile** iron unless otherwise indicated.

5.6 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, ACI 350, and the following:
 1. Cement: ASTM C 150/C 150M, Type II.
 2. Fine Aggregate: ASTM C 33/C 33M, sand.
 3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
 1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: **4** percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
 1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

PART 6 - EXECUTION

6.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 31 2000 "Earth Moving."

6.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Install piping pitched down in direction of flow, at percent slope noted on the plans.
 - 2. Install piping **NPS 6** and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
 - 3. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 4. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
- G. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

6.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
 - 1. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
 - 2. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
 - 3. Join dissimilar pipe materials with nonpressure-type, flexible couplings.
- B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
 - 1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
 - a. Unshielded flexible couplings for pipes of same or slightly different OD.
 - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

6.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.

- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Install FRP manholes according to manufacturer's written instructions.
- D. Form continuous concrete channels and benches between inlets and outlet.
- E. Install manhole-cover inserts in frame and immediately below cover.

6.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

6.6 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Light-Duty, top-loading classification cleanouts in **earth or unpaved foot-traffic** areas.
 - 2. Use Medium-Duty, top-loading classification cleanouts in **paved foot-traffic** areas.
 - 3. Use Heavy-Duty, top-loading classification cleanouts in **vehicle-traffic service** areas.
 - 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in **roads**.
- B. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

6.7 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 22 1316 "Sanitary Waste and Vent Piping."
- B. Connect force-main piping to building's sanitary force mains specified in Section 22 1316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.
- C. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
 - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless

otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

- a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

6.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 1. Close open ends of piping with at least **8-inch** thick, brick masonry bulkheads.
 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Backfill to grade according to Section 31 2000 "Earth Moving."

6.9 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
 1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.

5. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Test plastic gravity sewer piping according to ASTM F 1417.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
 6. Manholes: Perform hydraulic test according to ASTM C 969.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

6.10 CLEANING

- A. Clean dirt and superfluous material from interior of piping.

END OF SECTION 22 1313

SECTION 31 2319 - DEWATERING

PART 4 - GENERAL

4.1 SUMMARY

A. Section Includes:

1. Construction dewatering. Dewatering will not be paid for separately.

B. Related Requirements:

1. Section 01 3233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
2. Section 31 2000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

4.2 INFORMATIONAL SUBMITTALS

- A. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

PART 5 - PRODUCTS

PART 6 - EXECUTION

6.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.

- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 31 1000 "Site Clearing," during dewatering operations.

6.2 INSTALLATION

- A. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.

6.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
 - 1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 - 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

6.4 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 31 2319

SECTION 31 05 07 - HORIZONTAL DIRECTIONAL DRILLING (HDD)

PART 1 – GENERAL

1.01 SUMMARY

- A. Furnish all labor, equipment, materials, supervision, drilling fluids, testing, and incidentals necessary to install underground water mains, sanitary sewer force mains, and sanitary sewer pipelines utilizing Horizontal Directional Drilling (HDD).
- B. Work includes:
 - 1. Pilot bore installation.
 - 2. Bore path tracking and guidance.
 - 3. Reaming operations.
 - 4. HDPE pipe fusion.
 - 5. Pipe pullback.
 - 6. Tracer wire installation.
 - 7. Utility crossing verification.
 - 8. Testing and disinfection.
 - 9. Restoration.
 - 10. Preparation of boring records and as-built documentation.

1.02 REFERENCES

- A. ASTM D3350
- B. ASTM F714
- C. ASTM D3035
- D. ASTM F2160
- E. AWWA C906
- F. ASTM F1962
- G. ASTM F2206
- H. MDOT Standard Specifications for Construction
- I. Applicable permitting agency requirements.

1.03 SUBMITTALS

Submit the following for review:

- A. Pipe material certifications.
- B. Final boring report.

1.04 QUALIFICATIONS

- A. HDD contractor shall have successfully installed a minimum of 10,000 linear feet of HDD pipe of similar diameter and complexity within the previous five years.

1.05 UTILITY COORDINATION

- A. Contractor shall contact MISS DIG (811) prior to construction.
- B. Utility crossings shown on plans are approximate and shall be field verified.

PART 2 – PRODUCTS

2.01 PIPE MATERIALS

Water Main

- A. HDPE PE4710.
- B. SDR 11 unless otherwise indicated.
- C. Conforming to AWWA C906 and ASTM F714.

Sanitary Sewer Force Main

- A. HDPE PE4710.
- B. SDR 11 or SDR 13.5 as indicated.
- C. Fully restrained fusion joints.

Gravity Sewer

- A. HDPE DR11 or DR17 as indicated.
- B. Pipe shall be specifically manufactured for HDD installation.
- C. Minimum pipe stiffness as specified on Drawings.

2.02 FITTINGS

- A. Fittings shall be HDPE molded or fabricated fittings suitable for butt fusion.
- B. Mechanical couplings shall not be permitted below ground unless specifically approved.

2.03 TRACER WIRE

- A. Water mains and force mains shall be provided with #12 AWG insulated copper tracer wire.
- B. Tracer wire shall be rated for direct burial.
- C. Tracer wire shall be installed continuously with no splices unless approved.

PART 3 – EXECUTION

3.01 GENERAL

- A. Contractor shall be responsible for means and methods of installation.
- B. Bore alignment shall match plan profile within approved tolerances.
- C. Contractor shall immediately notify the Engineer if deviation occurs. [Twin Lakes...2025-04-02 | PDF]

3.02 PIPE FUSION

- A. All pipe joints shall be butt fused.
- B. Fusion shall conform to pipe manufacturer recommendations.
- C. All fusion joints shall receive visual inspection.
- D. Fusion logs shall be maintained and submitted.

3.03 PILOT BORE

- A. Install pilot bore along approved alignment.
- B. Utilize electronic guidance equipment capable of determining:
 - 1. Horizontal location.
 - 2. Vertical location.
 - 3. Pitch.
 - 4. Roll.
 - 5. Depth.
- C. Bore path shall maintain minimum separations required by applicable utility standards and permits.

3.04 REAMING

- A. Reaming shall occur after successful completion of pilot bore.
- B. Reamer diameter shall be appropriately sized for the product pipe and soil conditions.
- C. Multiple reaming passes may be required.
- D. Contractor shall prevent excessive bore enlargement.

3.05 DRILLING FLUIDS

- A. Drilling fluid shall consist primarily of bentonite-based slurry.
- B. Contractor shall monitor drilling pressures continuously.
- C. Loss of circulation shall be reported immediately.
- D. Inadvertent fluid returns shall be contained and cleaned immediately.
- E. Contractor shall comply with all environmental permit requirements.

3.06 PIPE PULLBACK

- A. Pipe shall be assembled and fused into a continuous string before pullback.
- B. Pulling forces shall not exceed manufacturer recommendations.
- C. Pipe shall be adequately supported to prevent damage.
- D. Pullback shall occur in one continuous operation whenever practical.

3.07 UTILITY CROSSINGS

- A. All known utility crossings shall be exposed prior to drilling.
- B. Minimum clearances shall comply with owner requirements.
- C. Sewer and water crossings shall maintain required separation distances.
- D. Crossing locations shall be documented in as-built drawings. [\[Nowicki Pa...2026-08-26 | PDF\]](#), [\[K648-06-SI...let in 02 1 | PDF\]](#)

3.08 TESTING

Water Main

- A. Pressure test in accordance with project water system specifications.
- B. Disinfect in accordance with AWWA C651.
- C. Bacteriological testing shall be satisfactory prior to acceptance. [\[Twin Lakes...2025-04-02 | PDF\]](#)

Sanitary Sewer Force Main

- A. Hydrostatic pressure test.
- B. Leakage testing as specified.

Gravity Sewer

- A. Low-pressure air testing.
- B. Deflection testing where applicable.
- C. CCTV inspection of all installed pipe.

3.09 ACCEPTANCE CRITERIA

- A. No damage, gouging, buckling, or deformation of pipe.
- B. Pipe shall remain within design alignment tolerance.
- C. All testing shall be successfully completed.
- D. All tracer wire shall demonstrate continuity.

3.10 BORING REPORT AND RECORD DOCUMENTATION

Submit record documentation within 21 days of drilling completion including:

1. Bore profile.

2. Horizontal alignment.
3. Entry and exit elevations.
4. Utility crossing locations.
5. Pipe material and size.
6. Fusion records.
7. Tracer wire testing results.
8. Final installed length.
9. Deviations from design alignment. [\[Twin Lakes...2025-04-02 | PDF\]](#)

3.11 MEASUREMENT AND PAYMENT

Horizontal Directional Drilling, Water Main shall be measured by linear foot of installed pipe.

Horizontal Directional Drilling, Sanitary Sewer Force Main shall be measured by linear foot of installed pipe.

Horizontal Directional Drilling, Sanitary Sewer shall be measured by linear foot of installed pipe.

Unit price shall include:

- Pilot boring
- Reaming
- Drilling fluids
- Pipe fusion
- Pipe installation
- Tracer wire
- Utility potholing
- Testing
- Restoration
- As-built documentation
- All incidentals required to complete the work

END OF SECTION 31 05 07

SECTION 31 1000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and removing site utilities abandoning site utilities in place.
6. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 01 5000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.2 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.
- B. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.5 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Notify **One Call** for area where Project is located before site clearing.
- C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- D. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.
- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than **two** days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- D. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 02 4119 "Selective Demolition."

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than **2 inches** in diameter, obstructions, and debris to a depth of **18 inches** below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and **dispose of off-site**.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

END OF SECTION 31 1000

SECTION 31 2000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Preparing subgrades for walks pavements turf and grasses.
 - 2. Subbase course for concrete **walks and pavements**.
 - 3. Subbase course **and base course** for asphalt paving.
 - 4. Excavating and backfilling trenches for utilities and pits for buried utility structures.

- B. Related Requirements:

- 1. **Section 01 3200 "Construction Progress Documentation" Section 01 3233 "Photographic Documentation"** for recording preexcavation and earth-moving progress.
 - 2. Section 31 1000 "Site Clearing" for site stripping, grubbing, stripping [**and stockpiling**] topsoil, and removal of above- and below-grade improvements and utilities.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

- 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for **changes in the Work**.
2. Bulk Excavation: Excavation more than **10 feet** in width and more than **30 feet** in length.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed **1 cu. yd.** for bulk excavation or **3/4 cu. yd.** for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.
2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 INFORMATIONAL SUBMITTALS

- A. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.5 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
1. Do not proceed with work on adjoining property until directed by Engineer.
- C. Utility Locator Service: Notify **"One Call"** for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in **Section 01 5000 "Temporary Facilities and Controls"** and **Section 31 1000 "Site Clearing"** are in place.
- E. Do not direct vehicle or equipment exhaust towards protection zones.
- F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification **Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487**, or a combination of these groups; free of rock or gravel larger than **3 inches** in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: Soil Classification **Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D2487**, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of **washed** crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C33/C33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: **12 inches each side of pipe or conduit.**
- C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade **below the building slabs and pavements** with a pneumatic-tired **and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons** to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction]. Limit vehicle speed to 3 mph.

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for **changes in the Work**.
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.
 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Engineer.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for Record Documents.
 3. Testing and inspecting underground utilities.
 4. Removing concrete formwork.
 5. Removing trash and debris.
 6. Removing temporary shoring, bracing, and sheeting.
 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill voids with satisfactory soil while removing shoring and bracing.
- D. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of subbase material , free of particles larger than **1 inch** in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- E. Final Backfill:
 - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.12 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than **8 inches** in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to **ASTM D698**:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at **95** percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at **92** percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at **85** percent.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus **1 inch**.
 - 2. Walks: Plus or minus **1 inch**.
 - 3. Pavements: Plus or minus **1/2 inch**.
 - 4.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course to required crown elevations and cross-slope grades.
 - 4. Place subbase course 6 inches or less in compacted thickness in a single layer.

5. Place subbase course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
6. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than **95** percent of maximum dry unit weight according to **ASTM D698**.

3.17 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 2. Place drainage course 6 inches or less in compacted thickness in a single layer.
 3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than **95** percent of maximum dry unit weight according to ASTM D698.

3.18 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:
 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every **2000 sq. ft.** or less of paved area or building slab but in no case fewer than three tests.
 2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every **150 feet** or less of trench length but no fewer than two tests.

- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 31 2000

SECTION 32 1216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Hot-mix asphalt paving.

- B. Related Requirements:

- 1. **Section 02 4119 "Selective Demolition"** for demolition and removal of existing asphalt pavement.
 - 2. Section 31 2000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
 - 3. Section 32 1313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.

1.3 ACTION SUBMITTALS

- A. Hot-Mix Asphalt Designs:

- 1. Certification, by authorities having jurisdiction, of approval of each hot-mix asphalt design proposed for the Work.
 - 2. For each hot-mix asphalt design proposed for the Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For paving-mix manufacturer .

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: **A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the MDOT.**

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 deg F.
 - 2. Tack Coat: Minimum surface temperature of 60 deg F.
 - 3. Asphalt Base Course **and Binder Course** Minimum surface temperature of 40 deg F and rising at time of placement.
 - 4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D1073 , sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
 - 1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: ASTM D242/D242M , rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: ASTM D6373 binder designation **PG 64-22**.
- B. Asphalt Cement: **ASTM D3381/D3381M for viscosity-graded material**
- C. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- D. Water: Potable.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

2.4 MIXES

1. Surface Course Limit: Recycled content no more than **10** percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes; **designed in accordance with procedures in AI MS-2, "Asphalt Mix Design Methods"**; and complying with the following requirements:
 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
- C. Emulsified-Asphalt Slurry: ASTM D3910, **Type 1**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

3.3 SURFACE PREPARATION

- A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.
- B. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.
- C. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 2. Protect primed substrate from damage until ready to receive paving.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACEMENT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course **and binder course** in number of lifts and thicknesses indicated.
 2. Place hot-mix asphalt surface course in single lift.
 3. Spread mix at a minimum temperature of 250 deg F.
 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
 2. Complete a section of asphalt base course **and binder course** before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints **using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."**
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.6 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927 , but not less than 94 percent or greater than 100 percent.
 2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
 - 1. Base Course **and Binder Course**: Plus or minus 1/2 inch.
 - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 - 1. Base Course **and Binder Course** : **1/4 inch**.
 - 2. Surface Course: **1/8 inch**.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with **ASTM D979/D979M** .
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 1216

SECTION 32 1313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes Concrete Paving
 - 1. Driveways.
 - 2. Curbs and gutters.
 - 3. Walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

- A. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer .

1.6 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

1.7 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. **Do not use notched and bent forms.**
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from **as-drawn** steel wire into flat sheets.
- B. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
- C. Plain-Steel Wire: ASTM A1064/A1064M, .
- D. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, .
- E. Tie Bars: ASTM A615/A615M, Grade 60; deformed.
- F. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.4 CONCRETE MATERIALS

- A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150/C150M, **gray** portland cement **Type I**
 - 2. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C33/C33M, **Class 4S**, uniformly graded. Provide aggregates from a single source **with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.**
 - 1. Maximum Coarse-Aggregate Size: **1 inch** nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

- A. Water: Potable.
- B. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.

2.6 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: **Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent**
 - 1. Slag Cement: 50 percent.
 - 2. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content, 1-inch Nominal Maximum Aggregate Size: **6** percent plus or minus 1-1/2 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to **0.15** percent by weight of cement.
- E. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): **3500 psi**.
 - 2. Maximum W/C Ratio at Point of Placement: **0.45**.
 - 3. Slump Limit: **4 inches**, plus or minus 1 inch.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M **and** ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below **concrete paving** to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of **1/2 inch** according to requirements in Section 31 2000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use **bonding agent** at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of **50 feet** unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows , **to match jointing of existing adjacent concrete paving**:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a **1/4-inch** radius. Repeat tooling of edges after applying surface finishes. **Eliminate edging-tool marks on concrete surfaces.**

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation , **steel reinforcement**, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface **and steel reinforcement** before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies , **reinforcement**, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating **reinforcement** joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by **curing compound** as follows:
 - 1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-feet- long; unlevelled straightedge not to exceed 1/2 inch.
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 6. Vertical Alignment of Dowels: 1/4 inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 8. Joint Spacing: 3 inches.

9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- C. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- E. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
- F. Concrete paving will be considered defective if it does not pass tests and inspections.
- G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- H. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Engineer.
- B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313

SECTION 32 98 00 - PROJECT RESTORATION, SCREENED TOPSOIL, AND HYDROSEEDING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This work consists of furnishing, placing, grading, and compacting screened topsoil; preparing disturbed areas for seeding; and furnishing and applying hydraulic mulch seeding (hydroseeding) to all disturbed areas as shown on the Plans or directed by the Engineer.
- B. The Contractor shall restore all areas disturbed by construction activities, including staging areas, equipment access routes, trench excavations, grading operations, and site improvements.
- C. Restoration work shall include all labor, materials, equipment, water, fertilizers, seed, mulch, maintenance, re-seeding, and corrective actions necessary to establish a healthy, uniform vegetative cover.

1.02 REFERENCES

- MDOT Standard Specifications for Construction, latest edition.
- ASTM D5268 – Topsoil Quality.
- Michigan Seed Law.

1.03 SUBMITTALS

Submit the following for review:

- A. Topsoil source and laboratory analysis.
- B. Seed mix certification identifying:
 - Species
 - Purity
 - Germination percentages
 - Origin
 - Date tested
- C. Fertilizer analysis.
- D. Hydromulch product data.
- E. Restoration maintenance plan.

PART 2 – MATERIALS

2.01 SCREENED TOPSOIL

- A. Topsoil shall be fertile, friable, natural loam capable of sustaining healthy vegetation.
- B. Topsoil shall be free of:
 - Stones larger than 1 inch.
 - Roots.
 - Sod.
 - Brush.
 - Construction debris.
 - Asphalt or concrete fragments.
 - Noxious weeds.
 - Toxic substances.
- C. Topsoil shall meet the following requirements:

Property	Requirement
Organic Matter	3% to 10%
pH	5.5 to 8.0

Clay Content	Less than 35%
Sand Content	Less than 70%
Debris	None
Screening	1-inch maximum

D. Imported topsoil shall be tested by an independent laboratory if requested by the Engineer.

2.02 SEED MIXTURE

- A. Seed shall be certified and suitable for the intended site conditions.
- B. Unless otherwise specified, provide a Michigan roadside/permanent turf mixture consisting of:
 - 40% Kentucky Bluegrass
 - 30% Perennial Ryegrass
 - 30% Fine Fescue
- C. Application rate shall be:
 - 200 pounds per acre minimum
 - or as recommended by the seed supplier and approved by the Engineer.

2.03 FERTILIZER

- A. Commercial fertilizer shall be:
 - Slow release
 - Uniform composition
 - Weed free
- B. Fertilizer analysis:
 - 12-12-12 minimum or approved equal.
- C. Apply at:
 - 300 to 500 pounds per acre
 - unless soil testing recommends otherwise.

2.04 HYDROMULCH

- A. Hydromulch shall consist of wood fiber or wood/cellulose blend specifically manufactured for hydraulic application.
- B. Mulch application rate:
 - Minimum 2,000 pounds per acre.
- C. Mulch shall contain a tackifier sufficient to resist erosion until vegetative establishment occurs.

PART 3 – EXECUTION

3.01 SITE PREPARATION

- A. Remove all debris, excess materials, stones, roots, and unsuitable soils prior to placement of topsoil.
- B. Subgrade shall be loosened to a minimum depth of 3 inches prior to topsoil placement.
- C. Areas with excessive compaction shall be scarified.
- D. Areas exhibiting rutting, ponding, or poor drainage shall be corrected before restoration operations commence.

3.02 TOPSOIL PLACEMENT

- A. Place screened topsoil in all disturbed turf areas.
- B. Minimum compacted topsoil depth:

Area	Minimum Depth
------	---------------

Turf Areas	3 inches
Highly Disturbed Areas	4 inches
Sloped Areas >4H:1V	4 inches

C. Topsoil shall be spread uniformly and graded to match adjacent contours.

D. Finished surface shall be free of:

- Depressions.
- Humps.
- Rocks.
- Equipment tracks.
- Surface irregularities.

E. Topsoil shall not be placed on frozen, saturated, or muddy ground.

3.03 HYDROSEEDING

A. Hydroseeding shall occur immediately following final grading and topsoil placement.

B. Hydroseed slurry shall contain:

- Seed
- Fertilizer
- Mulch
- Tackifier
- Water

C. Materials shall be uniformly mixed and applied using equipment designed for hydraulic seeding.

D. Application shall provide complete and uniform coverage.

E. Hydroseeding shall not be performed:

- During rainfall.
- During high winds.
- On frozen ground.

3.04 MAINTENANCE

A. The Contractor shall maintain all restored areas until final acceptance.

B. Maintenance shall include:

- Watering.
- Mowing.
- Repair of erosion damage.
- Weed control.
- Additional fertilization if necessary.
- Re-seeding of deficient areas.

C. Areas damaged by erosion, washouts, settlement, construction traffic, or inadequate germination shall be restored at no additional cost.

3.05 PERFORMANCE REQUIREMENTS

Establishment Period

A. The establishment period shall begin upon completion of hydroseeding and continue until final acceptance.

B. The Contractor shall be responsible for achieving successful germination and vegetative establishment.

Germination Requirements

A. Initial germination shall be visible within:

- 21 days during normal growing conditions.

B. If germination is not achieved within 30 days, the Contractor shall evaluate the cause and perform corrective measures including:

- Additional watering.
- Soil amendments.
- Re-seeding.
- Re-hydroseeding.

C. Corrective work shall be performed at no additional cost to the Owner.

Final Acceptance Criteria

Prior to acceptance, restored areas shall achieve:

Vegetative Coverage

- Minimum 90 percent uniform live vegetative cover over all seeded areas.

Bare Spots

- No individual bare area greater than 10 square feet.
- Combined bare areas shall not exceed 5 percent of the total restored area.

Weed Content

- Weeds shall not exceed 10 percent of the total vegetative cover.

Erosion

- No evidence of active erosion, rilling, gullies, washouts, settlement, or sediment transport.

Turf Quality

- Vegetation shall exhibit:
 - Uniform color.
 - Healthy growth.
 - Adequate root development.
 - Consistent density across restored areas.

Topsoil Stability

- Topsoil shall remain in place without sloughing, settlement, or displacement.

Re-establishment

A. Any area failing to meet the above acceptance criteria shall be reworked, re-seeded, and maintained until compliance is achieved.

B. Final acceptance shall not occur until all restoration areas satisfy the performance requirements specified herein.

2.05 EROSION CONTROL BLANKET

A. An erosion control mulch blanket shall be installed on all slopes steeper than or equal to 4H:1V and in any location directed by the Engineer.

B. The blanket shall be:

- Machine-produced weed-free straw blanket, excelsior blanket, or approved equivalent.
- Biodegradable.
- Suitable for a minimum design life of 12 months.

C. The blanket shall be installed in accordance with the manufacturer's recommendations including:

- Trench anchoring at the top of slope.
- Overlapping adjacent sections.
- Stapling at intervals recommended by the manufacturer.
- Full contact between the blanket and the soil surface.

D. Hydroseeding shall be applied prior to placement of the blanket unless otherwise recommended by the manufacturer.

E. Areas exhibiting washouts, undermining, displacement, or loss of blanket shall be repaired or replaced at no additional cost to the Owner.

3.03 HYDROSEEDING (Add)

- F. All slopes 4H:1V or steeper shall receive an erosion control blanket immediately following hydroseeding operations.
- G. Hydroseed and blanket installation shall be coordinated to minimize exposure of bare soils and shall be completed within the same working day whenever practicable.

3.05 PERFORMANCE REQUIREMENTS

Establishment and Watering Responsibility

- A. The Contractor shall be solely responsible for achieving the specified germination and vegetative cover requirements.
- B. Natural rainfall shall not relieve the Contractor of the obligation to provide supplemental watering as necessary to achieve establishment.
- C. Areas failing to establish due to insufficient watering, erosion, washouts, poor soil preparation, improper seeding techniques, or other Contractor-controlled factors shall be restored at no additional cost to the Owner.

END OF SECTION 32 98 00

SECTION 33 01 30.13 - TEMPORARY SANITARY SEWER FLOW CONTROL AND BYPASS PUMPING

PART 1 – GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment, fuel, monitoring systems, temporary piping, controls, security measures, and incident response procedures necessary to maintain continuous sanitary sewer service during construction activities.
- B. Work includes:
 - 1. Design, installation, operation, maintenance, and removal of temporary bypass pumping systems.
 - 2. Temporary sewer plugs, flow diversion structures, and force mains.
 - 3. Continuous monitoring and alarm notification systems.
 - 4. Emergency response and overflow prevention measures.
 - 5. Restoration of all disturbed areas.
 - 6. Coordination with Correctional Facility Operations and Security Staff.

1.02 PERFORMANCE REQUIREMENTS

- A. Sanitary service interruptions shall not be permitted.
- B. No sanitary sewage discharge, bypass overflow, or release shall be allowed.
- C. The bypass system shall maintain 100 percent of anticipated peak wet weather flow.
- D. Contractor shall be solely responsible for damages, cleanup costs, regulatory penalties, and facility impacts resulting from bypass system failure.

1.03 REFERENCES

- A. OSHA 29 CFR 1926
- B. EPA Clean Water Act
- C. NASSCO Guidelines
- D. ASTM F714
- E. Michigan EGLE Requirements

1.04 SUBMITTALS

Submit a complete Bypass Pumping Plan a minimum of four (4) weeks prior to implementation.

Plan shall include:

- 1. Hydraulic calculations.
- 2. Estimated average, peak, and peak wet weather flow rates.
- 3. Pump sizing calculations.
- 4. Pump curves.
- 5. Temporary force main layout.
- 6. Bypass connection details.
- 7. Equipment staging locations.
- 8. Site security provisions.
- 9. Alarm protocol.
- 10. Emergency response procedures.
- 11. Facility communication procedures.
- 12. Response time commitments.
- 13. Backup power provisions.

14. Fuel management plan.
15. Twenty-four-hour emergency contact list.

No bypass operation shall commence until written acceptance of the plan by the Owner and Engineer.

1.05 CORRECTIONAL FACILITY COORDINATION

- A. Coordinate all bypass activities with Facility Administration and Security Personnel.
- B. Contractors, subcontractors, operators, and service personnel shall comply with all facility security requirements.
- C. Tools, fuel, equipment, fencing, and temporary piping shall be secured at all times.
- D. Temporary piping crossing roadways, pedestrian routes, or security access areas shall be protected and approved by Facility Operations.

PART 2 – PRODUCTS

2.01 BYPASS PUMPS

- A. Pumps shall be diesel-powered or electric-driven with standby generator backup.
- B. Pumps shall be capable of passing solids not less than 3 inches in diameter.
- C. System capacity shall equal peak wet weather flow plus a minimum 15 percent reserve capacity.
- D. Provide:
 1. One duty pump.
 2. One automatic standby pump.
 3. Automatic lead/lag operation.
- E. Failure of any single pump shall not reduce required bypass capacity.

2.02 TEMPORARY FORCE MAINS

- A. HDPE pipe meeting ASTM F714.
- B. Minimum pressure rating: SDR-17 unless otherwise approved.
- C. All connections shall be restrained.
- D. Leakage is not permitted.
- E. Temporary piping shall be anchored and protected against movement.

2.03 FLOW CONTROL DEVICES

- A. Inflatable sewer plugs or mechanical plugs specifically designed for sanitary sewer service.

2.04 BACKUP POWER

- A. Provide permanently connected standby generator or backup generator capable of assuming full load immediately upon power loss.
- B. Fuel supply shall support minimum 24-hour operation without refueling.

2.05 MONITORING EQUIPMENT

- A. High level alarms.
- B. Pump run status monitoring.
- C. Backup pump activation alarms.
- D. Generator failure alarms.
- E. Remote telemetry system capable of notifying multiple designated personnel.
- F. Data logging capability.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install bypass system in accordance with approved Bypass Pumping Plan.
- B. Verify all connections and piping prior to diverting flow.
- C. Conduct operational testing under simulated peak loading conditions.
- D. Provide Engineer and Facility Operations with minimum forty-eight (48) hours notice prior to activation.

3.02 TESTING

- A. Perform dry-run testing of all equipment.
- B. Demonstrate automatic startup of standby pumps.
- C. Demonstrate alarm notification system.
- D. Demonstrate generator startup and load transfer.

3.03 OPERATIONS

- A. Bypass system shall operate continuously throughout the duration of work.
- B. Contractor shall provide continuous monitoring twenty-four (24) hours per day, seven (7) days per week.
- C. Alarm notifications shall be transmitted immediately upon:
 - 1. High wet well level.
 - 2. Duty pump failure.
 - 3. Standby pump activation.
 - 4. Generator failure.
 - 5. Overflow condition.
- D. Contractor shall maintain personnel capable of mobilizing to the site within thirty (30) minutes of alarm notification.

3.04 CORRECTIONAL FACILITY REQUIREMENTS

- A. Pumps, hoses, power cables, and fuel storage shall not interfere with facility operations or emergency access routes.
- B. All equipment shall be secured against tampering.
- C. Fuel storage shall comply with facility safety requirements.
- D. Contractor personnel requiring access inside secure areas shall comply with all MDOC security requirements.
- E. Any bypass activity within secured areas shall have prior approval from designated facility personnel.

3.05 CONTINGENCY REQUIREMENTS

- A. Maintain one additional standby pump on-site.
- B. Maintain repair parts, hoses, fittings, and plugs on-site.
- C. Maintain spill containment equipment at all times.
- D. Contractor shall immediately implement contingency procedures in the event of any equipment malfunction.

3.06 REMOVAL AND RESTORATION

- A. Remove all temporary equipment upon completion.
- B. Restore disturbed pavement, gravel, lawn, fence, and site features.
- C. Leave the site in equal or better condition than existed prior to construction.

END OF SECTION - 33 01 30.13

SECTION 33 01 32.71 - CURED-IN-PLACE PIPE (CIPP) REHABILITATION OF SANITARY SEWERS**PART 1 – GENERAL****1.01 SUMMARY**

- A. Work covered under this Section includes furnishing all labor, materials, equipment, bypass pumping, cleaning, televising, lining, reinstatement, testing, and ancillary work necessary to rehabilitate existing sanitary sewer mains utilizing the cured-in-place pipe (CIPP) method.
- B. Sewer diameters shall be 4-inch through 12-inch sanitary sewers as shown on the Drawings.
- C. Work includes:
 - 1. Cleaning and preparation of existing sewer lines.
 - 2. Pre-installation CCTV inspection.
 - 3. Temporary sewer flow control and bypass pumping.
 - 4. Installation and curing of CIPP liners.
 - 5. Robotic reinstatement of service connections.
 - 6. Post-installation CCTV inspection.
 - 7. Testing and acceptance.
 - 8. Coordination with Correctional Facility Operations and Security Personnel.

1.02 REFERENCES

- A. ASTM F1216 – Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of a Resin-Impregnated Tube.
- B. ASTM F1743 – Rehabilitation of Existing Pipelines by Pulled-in-Place Pipe.
- C. ASTM D5813 – CIPP Materials.
- D. NASSCO Pipeline Assessment Certification Program (PACP).
- E. OSHA 29 CFR 1926.
- F. Michigan EGLE Requirements.

1.03 DESIGN REQUIREMENTS

- A. The CIPP liner shall be designed as a fully structural pipe capable of independently supporting all earth and live loads.
- B. Design shall assume the host pipe provides no structural support.
- C. Minimum design life shall be fifty (50) years.

1.04 SUBMITTALS

Submit the following for review:

- 1. Manufacturer's product data.
- 2. Liner thickness calculations.
- 3. Resin data sheets.
- 4. Installation procedures.
- 5. Curing procedures.
- 6. Quality control plan.
- 7. Sample calculations.
- 8. Bypass pumping plan.
- 9. Facility security and access plan.
- 10. Traffic and operational impact plan.
- 11. Emergency response procedures.
- 12. CCTV inspection reports.

1.05 CONTRACTOR QUALIFICATIONS

- A. Contractor shall have successfully completed a minimum of five (5) projects involving installation of CIPP liners in sanitary sewer systems of comparable size and complexity.
- B. Installation supervisor shall have a minimum of three (3) years direct experience with CIPP installations.
- C. CCTV operators shall be NASSCO certified.

1.06 CORRECTIONAL FACILITY REQUIREMENTS

- A. All contractor personnel shall comply with correctional facility security requirements.

- B. Personnel screening, identification, vehicle inspections, and tool inventories shall be coordinated through Facility Administration.
- C. No materials, equipment, tools, cameras, communications devices, or vehicles shall be brought into secured areas without prior approval.
- D. Contractor shall maintain daily accounting of all tools and equipment entering and leaving secured areas.
- E. Work schedules shall be coordinated with facility operations so as not to interfere with inmate movement, emergency response routes, deliveries, or security operations.
- F. Work activities may be restricted to approved time periods as determined by Facility Administration.

PART 2 – PRODUCTS

2.01 CIPP LINER

- A. Liner shall consist of a resin-impregnated flexible tube capable of inversion or pull-in-place installation.
- B. Tube shall be manufactured from polyester felt, fiberglass reinforced tube, or approved equivalent.
- C. Finished liner shall provide a continuous, jointless, corrosion-resistant pipe.
- D. Liner shall conform to ASTM F1216.

2.02 RESIN

- A. Resin shall be polyester, vinyl ester, or epoxy suitable for sanitary sewer service.
- B. Resin shall provide corrosion resistance against sanitary wastewater and hydrogen sulfide environments.
- C. Resin system shall be compatible with the selected curing process.

2.03 SERVICE CONNECTION SEALS

- A. Hydrophilic or mechanical service connection seals may be utilized where indicated.
- B. Materials shall be compatible with wastewater exposure.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Clean all sewer lines designated for rehabilitation.
- B. Remove roots, debris, grease, mineral deposits, protruding taps, sediment, and obstructions.
- C. Obtain pre-installation CCTV inspection after cleaning.
- D. Submit CCTV recordings and inspection reports to the Engineer prior to lining operations.

3.02 FLOW CONTROL

- A. Maintain continuous sanitary sewer service throughout construction.
- B. Perform bypass pumping in accordance with Section 33 01 30.13.
- C. No interruption of sanitary service shall be permitted without prior written approval.
- D. Contractor shall prevent sanitary sewer overflows at all times.

3.03 INSTALLATION

- A. Install liner in accordance with ASTM F1216 and manufacturer's recommendations.
- B. Install liner by inversion or pull-in-place methods.
- C. Maintain sufficient pressure throughout curing to ensure complete contact with host pipe.
- D. Prevent liner wrinkles, folds, fins, blisters, dry spots, or defects.
- E. Ends of liner shall be sealed against infiltration.

3.04 CURING

- A. Cure liner utilizing hot water, steam, ultraviolet light, or approved equivalent.
- B. Monitor and record curing temperatures and pressures throughout the installation.
- C. Provide curing logs documenting the installation.

3.05 SERVICE REINSTATEMENT

- A. Reinstate all active service laterals utilizing robotic cutting equipment.
- B. Openings shall be neatly cut without damaging the host pipe or liner.
- C. Restore 100 percent of original service opening.

- D. Verify reopening by CCTV inspection.

3.06 FIELD QUALITY CONTROL

- A. Obtain samples as required by ASTM F1216.
- B. Perform flexural modulus and flexural strength testing by an independent laboratory.
- C. Laboratory results shall demonstrate compliance with design requirements.

3.07 POST-INSTALLATION CCTV

- A. Conduct post-installation CCTV inspection of all lined segments.
- B. Video shall clearly document:
 - 1. Entire length of liner.
 - 2. Service reinstatements.
 - 3. Pipe terminations.
 - 4. Defects or anomalies.
- C. Re-clean and re-inspect segments if visibility is inadequate.

3.08 ACCEPTANCE CRITERIA

The completed liner shall be free from:

- 1. Delamination.
- 2. Significant wrinkles.
- 3. Blisters.
- 4. Cracks.
- 5. Dry spots.
- 6. Resin washout.
- 7. Foreign inclusions.
- 8. Structural defects.

Defective installations shall be repaired or replaced at no cost to the Owner.

3.09 CLEANUP AND RESTORATION

- A. Remove all temporary facilities, bypass equipment, and construction debris.
- B. Restore disturbed pavement, gravel, landscaping, security fencing, and site features.
- C. Leave the facility in a condition equal to or better than existed prior to construction.

END OF SECTION - 33 01 32.71

SECTION 33 05 23.13 - UTILITY JACKING AND BORING

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Installation of steel casing pipe by the jack-and-bore method.
 - 2. Installation of water main, gravity sanitary sewer carrier pipe within steel casing.
 - 3. Construction of launch and receiving pits.
 - 4. Excavation support and worker-protection systems.
 - 5. Dewatering and groundwater control.
 - 6. Survey control and maintenance of line and grade.
 - 7. Existing utility locating, exposure, support, and protection.
 - 8. Casing spacers, end seals, restraints, tracer wire, and appurtenances.
 - 9. Carrier-pipe testing, disinfection, inspection, and acceptance.
 - 10. Settlement and surface-movement monitoring.
 - 11. Grouting of ground loss, abandoned bores, and other voids when required.
 - 12. Backfilling and restoration of disturbed areas.
 - 13. Record surveying and closeout documentation.
- B. Contractor shall provide all labor, supervision, materials, equipment, temporary construction, testing, and incidentals necessary for complete and accepted installations.
- C. Open-cut construction within the roadway, or other designated crossing limits is prohibited unless specifically authorized in writing by Owner, Engineer, and governing agency.
- D. Contractor is responsible for the means, methods, techniques, procedures, sequences, and safety of jack-and-bore operations.

1.02 DEFINITIONS

- A. Annular Space: Space between the outside of the carrier pipe and inside of the casing pipe.
- B. Carrier Pipe: Water main, sanitary force main, or gravity sanitary sewer installed within a casing pipe.
- C. Casing Pipe: Steel pipe installed by jacking and boring to create a structural sleeve through which the carrier pipe is installed.
- D. Ground Loss: Uncontrolled removal, displacement, or migration of soil beyond the intended casing excavation profile.
- E. Jack and Bore: Trenchless method in which steel casing is advanced by hydraulic jacking while soil is removed from within the advancing casing by auger or other approved mechanical means.
- F. Launch Pit: Excavation containing the jacking equipment, reaction structure, casing sections, and boring equipment.
- G. Receiving Pit: Excavation at the terminal end of the bore used to retrieve the cutting head and complete the installation.

1.03 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures.
- B. Section 01 45 00 - Quality Control.
- C. Section 01 78 39 - Project Record Documents.
- D. Section 31 10 00 - Site Clearing.
- E. Section 31 23 16 - Excavation.
- F. Section 31 23 19 - Dewatering.
- G. Section 31 23 23 - Fill.
- H. Section 31 23 33 - Trenching and Backfilling.

- I. Section 32 01 16 - Flexible Paving Rehabilitation.
- J. Section 33 11 00 - Water Utility Distribution Piping.
- K. Section 33 31 00 - Sanitary Utility Sewerage Piping.
- L. Section 33 34 00 - Sanitary Utility Sewerage Force Mains.

1.04 REFERENCE STANDARDS

- A. Comply with the latest adopted editions of the following unless a specific edition is required by the governing agency:
 - 1. ASTM A36/A36M - Carbon Structural Steel.
 - 2. ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 3. ASTM A139/A139M - Electric-Fusion-Welded Steel Pipe.
 - 4. ASTM A252 - Welded and Seamless Steel Pipe Piles.
 - 5. ASTM C1107/C1107M - Packaged Dry, Hydraulic-Cement Grout.
 - 6. ASTM D3034 - Type PSM Polyvinyl Chloride Sewer Pipe and Fittings.
 - 7. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 8. ASTM F477 - Elastomeric Seals for Joining Plastic Pipe.
 - 9. ASTM F679 - Polyvinyl Chloride Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - 10. ASTM F1417 - Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
 - 11. AWWA C200 - Steel Water Pipe, 6 Inches and Larger.
 - 12. AWWA C206 - Field Welding of Steel Water Pipe.
 - 13. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
 - 14. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings.
 - 15. AWWA C651 - Disinfecting Water Mains.
 - 16. AWWA C900 - Polyvinyl Chloride Pressure Pipe and Fabricated Fittings.
 - 17. ANSI/AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 18. ANSI/AWWA C151/A21.51 - Ductile-Iron Pipe.
 - 19. ANSI/AWS D1.1/D1.1M - Structural Welding Code, Steel.
 - 20. ANSI/ASSP A10.12 - Safety Requirements for Excavation.
 - 21. AREMA Manual for Railway Engineering, where applicable.
 - 22. OSHA requirements for excavation, confined spaces, lifting, and construction safety.
 - 23. Governing highway, railroad, utility, and permit-agency requirements.
- B. Where requirements conflict, comply with the more stringent requirement unless otherwise authorized in writing by Engineer and governing agency.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Obtain permits assigned to Contractor by the Contract Documents and comply with all applicable permit conditions.
- B. Coordinate jack-and-bore operations with:
 - 1. Owner.
 - 2. Engineer.
 - 3. MDOT
 - 4. Utility owners.
 - 5. Affected property owners.
 - 6. Emergency service providers where traffic or access may be affected.
- C. Provide advance notification in accordance with permit requirements. Where no notification period is stated, provide not less than 72 hours' notice before beginning setup, excavation, or boring operations.
- D. Do not begin jack-and-bore operations until:
 - 1. Required submittals have been accepted.

2. Required permits are in effect.
 3. Existing utilities have been marked and critical crossings exposed.
 4. Survey control has been established.
 5. Launch and receiving pits are properly supported.
 6. Required monitoring points have been installed.
 7. Baseline monitoring readings have been recorded.
 8. Required agency representatives and inspectors have been notified.
- E. Maintain traffic, emergency access, facility operations, utility service, and access to adjacent properties unless otherwise indicated or authorized.

1.06 QUALIFICATIONS

- A. Jack-and-bore operations shall be performed by a qualified specialty contractor meeting the following requirements:
1. Minimum five years of documented experience performing steel-casing jack-and-bore installations.
 2. Successful completion of at least five installations of comparable casing diameter, bore length, soil conditions, and carrier-pipe service during the previous five years.
 3. Experienced supervisory personnel continuously present while boring operations are underway.
- B. Welding shall be performed by welders qualified for the welding procedures and materials used.

1.07 GEOTECHNICAL AND EXISTING-CONDITION INFORMATION

- A. Review available geotechnical reports, boring logs, record drawings, utility information, and other subsurface information before submitting the work plan.
- B. Available subsurface information is provided in accordance with the Contract Documents and does not relieve Contractor from evaluating the suitability of the proposed means and methods.
- C. Consider groundwater, uncontrolled fill, cobbles, boulders, buried construction, existing utilities, and variable soil conditions when selecting equipment and planning the Work.
- D. Immediately notify Engineer when actual subsurface conditions materially differ from those indicated or when an obstruction prevents installation within specified tolerances.
- E. Do not change the planned alignment, grade, casing size, or installation method without written authorization.

1.08 ACTION SUBMITTALS

- A. Product Data:
1. Steel casing pipe.
 2. Casing spacers.
 3. Casing end seals.
 4. Carrier pipe and restrained-joint systems.
 5. Tracer wire and access points.
 6. Grout materials.
 7. Pipe joint lubricant.
 8. Proposed repair materials.
- B. Shop Drawings:
1. Casing diameter, wall thickness, length, material grade, and joint details.
 2. Carrier-pipe outside diameter at bells, couplings, restraints, and fittings.
 3. Casing-spacer dimensions, materials, load ratings, and spacing.
 4. End-seal details.
 5. Grout ports and venting arrangement where annular-space grouting is required.
 6. Carrier-pipe restraint and anchorage details.

7. Connections to existing or proposed piping.

1.09 INFORMATIONAL SUBMITTALS

- A. Jack-and-Bore Work Plan describing:
 - 1. Sequence of operations.
 - 2. Method of maintaining and verifying line and grade.
 - 3. Method of limiting excavation ahead of the casing.
 - 4. Procedures for preventing ground loss.
 - 5. Procedures for encountering obstructions.
 - 6. Utility protection and temporary support.
 - 7. Surface and structure monitoring.
 - 8. Carrier-pipe installation.
 - 9. Annular-space treatment.
 - 10. Contingency procedures for equipment failure, ground loss, settlement, heave, or abandoned bore.
- B. Settlement and Movement Monitoring Plan:
 - 1. Monitoring-point locations.
 - 2. Baseline survey procedures.
 - 3. Reading frequency.
 - 4. Measurement accuracy.
 - 5. Alert and stop-work thresholds.
 - 6. Notification procedures.
 - 7. Corrective-action procedures.
- C. Traffic-Control Plan.
- D. Testing procedures and proposed testing schedule.
- E. Submit proposed modifications to the accepted work plan before implementation, except for immediate actions required to protect persons or property.

1.11 PROJECT CONDITIONS

- A. Confirm horizontal and vertical locations of utilities within and adjacent to the proposed pits and bore alignment.
- B. Expose utilities by nondestructive methods where necessary to verify clearance.
- C. Do not interfere with or endanger traffic, railroad operations, utilities, drainage systems, structures, or adjacent property.
- D. Continuously support the ground at the advancing casing face to prevent loss of ground.
- E. Contractor is responsible for settlement, heave, ground loss, and damage resulting from its operations, except as otherwise provided by the Contract Documents.
- F. Conduct operations continuously once the casing enters the crossing influence zone, except when adding casing sections, welding, performing necessary equipment maintenance, or complying with an authorized stoppage.

PART 2 – PRODUCTS

2.01 STEEL CASING PIPE

- A. Provide new, unused, smooth-wall steel casing pipe conforming to the Contract Drawings and governing-agency requirements.
- B. Steel casing shall conform to ASTM A53/A53M Grade B, ASTM A139/A139M, ASTM A252, or another standard specifically indicated or accepted by Engineer and governing agency.
- C. Minimum yield strength shall be 35,000 psi unless a higher strength is required by design.
- D. Casing wall thickness shall be:

1. Not less than shown on the Drawings.
2. Not less than required by the governing agency.
3. Adequate for earth, live, railroad, construction, handling, and jacking loads.
4. Adequate to resist buckling and deformation during installation.
- E. Contractor may provide a thicker casing at no additional cost, subject to acceptance.
- F. Provide round casing free of defects, laminations, excessive interior weld reinforcement, sharp projections, or deformation that could interfere with carrier-pipe installation.
- G. Maximum casing ovality after installation shall not exceed 2 percent of nominal outside diameter unless a more restrictive limit is required by the carrier-pipe or spacer manufacturer.
- H. Provide casing with sufficient inside diameter to accommodate:
 1. Carrier-pipe bells, couplings, restraints, fittings, and tracer wire.
 2. Casing spacers.
 3. Carrier-pipe installation tolerances.
 4. Required annular clearance.
- I. Unless a larger casing is shown or required by the governing agency, provide the following minimum casing inside diameter:
 1. Carrier pipe less than 6 inches in nominal diameter: At least 4 inches greater than the maximum outside diameter of the carrier-pipe joint, coupling, or restraint.
 2. Carrier pipe 6 inches in nominal diameter and larger: At least 6 inches greater than the maximum outside diameter of the carrier-pipe joint, coupling, or restraint.
- J. Increase casing diameter where required to accommodate restrained joints, spacers, installation tolerances, or gravity-sewer grade control.
- K. Casing length shall be as shown and shall satisfy permit requirements. Unless otherwise shown, extend casing beyond pavement, shoulder, embankment, ditch, or railroad influence limits as required by the governing agency.

2.02 CASING JOINTS

- A. Join steel casing sections with continuous full-circumference butt welds.
- B. Prepare casing ends for field welding and maintain alignment during welding.
- C. Welding shall conform to AWWA C206 or accepted welding procedures.
- D. Welds shall:
 1. Develop required casing strength.
 2. Prevent intrusion of soil and groundwater during construction.
 3. Be finished on the interior where projections could interfere with boring equipment or carrier-pipe installation.
- E. Repair weld defects before advancing the casing.
- F. Spiral-welded casing is permitted only when accepted by Engineer and governing agency.

2.03 CASING SPACERS

- A. Provide manufactured casing spacers specifically designed for the carrier-pipe material, diameter, loading, and casing environment.
- B. Spacer components shall be noncorroding or corrosion resistant and shall not damage the carrier pipe.
- C. Spacer runners shall provide low-friction bearing surfaces.
- D. Stainless steel components shall be Type 304 minimum, or Type 316 where indicated for corrosive environments.
- E. Design spacers to:
 1. Position the carrier pipe at its required elevation.
 2. Prevent carrier-pipe contact with the casing.
 3. Maintain carrier-pipe line and grade.

4. Support the filled carrier pipe without excessive deflection.
 5. Prevent flotation or displacement during grouting, where applicable.
 6. Avoid point loading of PVC or other flexible pipe.
- F. Provide spacers:
1. Within 2 feet of each casing end.
 2. On each side of carrier-pipe joints, bells, couplings, or restraints where required by the spacer manufacturer.
 3. At intermediate spacing recommended by the carrier-pipe and spacer manufacturers.
 4. At a maximum spacing of 8 feet unless closer spacing is shown or required.
 5. At closer spacing where required to maintain gravity-sewer grade.
- G. Wood skids or blocking are not permitted unless specifically required by the governing-agency standard detail. Where wood skids are required, comply with the agency detail and provide corrosion-resistant bands.

2.04 CASING END SEALS

- A. Provide flexible, manufactured casing end seals compatible with the casing and carrier-pipe materials.
- B. Provide stainless steel bands and hardware.
- C. End seals shall:
1. Prevent entry of soil, debris, and animals.
 2. Accommodate anticipated differential movement.
 3. Avoid damaging loads on the carrier pipe.
 4. Conform to governing-agency requirements.
- D. Where permit requirements call for masonry bulkheads, provide bulkheads and drainage provisions in accordance with the approved detail.
- E. Do not permanently fill the annular space unless indicated or authorized.

2.05 WATER-MAIN CARRIER PIPE

- A. Provide carrier pipe of the material, diameter, pressure class, and joint type specified in Section 33 11 00 and shown on the Drawings.
- B. Carrier pipe within the casing shall have restrained joints.
- C. Extend restrained joints through the full casing length and for at least one complete pipe joint beyond each casing end unless the restraint design or Drawings require a greater length.
- D. Do not install thrust blocks inside the casing.
- E. Minimize joints within the casing.
- F. Verify that bells, glands, restraints, and couplings fit within the casing and spacers before installation.

2.06 GRAVITY SANITARY-SEWER CARRIER PIPE

- A. Provide sewer pipe of the material, diameter, stiffness, and joint type specified in Section 33 31 00.
- B. Provide watertight joints conforming to the applicable pipe and gasket standards.
- C. Select casing diameter, spacers, and installation methods to maintain the design sewer invert and slope independently of minor casing variation.
- D. Carrier pipe shall provide a continuous flowline without:
1. Sags.
 2. Reverse grade.
 3. Open or displaced joints.
 4. Excessive joint offset.
 5. Excessive deflection.
 6. Unacceptable standing water.

2.07 TRACER WIRE

- A. Provide tracer wire for nonmetallic water-main and force-main carrier pipe.
- B. Tracer wire shall be rated for direct burial and suitable for the installation method and service environment.
- C. Install wire continuously through the casing without splices inside the casing.
- D. Terminate wire at accessible test stations, valve boxes, or other locations shown.
- E. Test the completed tracer-wire system for electrical continuity and locating capability.

2.08 GROUT

- A. Grout used for abandoned bores, ground-loss remediation, or annular-space filling shall be one of the following, as accepted by Engineer:
 - 1. Flowable cementitious grout.
 - 2. Cellular grout.
 - 3. Controlled low-strength material.
 - 4. Other approved nonshrinking grout mixture.
- B. Grout shall:
 - 1. Be pumpable through the proposed equipment.
 - 2. Fill voids without segregation.
 - 3. Develop sufficient strength for the intended application.
 - 4. Avoid damage to or flotation of the carrier pipe.
 - 5. Comply with applicable permit requirements.
- C. Nonshrink equipment or structural grout shall comply with ASTM C1107/C1107M.

2.09 INCIDENTAL MATERIALS

- A. Provide joint lubricants recommended by the carrier-pipe manufacturer.
- B. Provide temporary caps, pulling heads, rollers, guides, lifting devices, bracing, and accessories required for a complete installation.
- C. Materials in contact with potable-water piping shall be suitable for potable-water service.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that permits, survey control, utility markings, pit locations, access, and staging areas are ready.
- B. Verify existing surface elevations and establish baseline conditions before disturbing the site.
- C. Confirm that the proposed casing alignment provides required clearances from utilities, structures, pavement, tracks, drainage facilities, and property improvements.
- D. Report conflicts or unsuitable conditions before beginning excavation.

3.02 SURVEY CONTROL

- A. Establish horizontal and vertical control outside areas subject to disturbance.
- B. Establish and maintain control for:
 - 1. Pit locations.
 - 2. Casing centerline.
 - 3. Casing invert or reference elevation.
 - 4. Carrier-pipe invert.
 - 5. Surface-monitoring points.
 - 6. Existing structures or tracks requiring monitoring.
- C. Check line and grade:

1. Before casing installation.
 2. During casing advancement at intervals established in the accepted work plan.
 3. At completion of casing installation.
 4. After carrier-pipe installation.
- D. Use survey equipment with accuracy appropriate for the specified installation tolerances.

3.03 UTILITY VERIFICATION AND PROTECTION

- A. Contact the applicable utility locating system before excavation.
- B. Verify critical utility crossings using test holes, vacuum excavation, or other nondestructive methods.
- C. Support and protect utilities exposed by launch or receiving pits.
- D. Immediately notify utility owner and Engineer of damage or unanticipated conflicts.
- E. Repair utilities damaged by Contractor operations in accordance with utility-owner requirements and at no additional cost to Owner.

3.04 LAUNCH AND RECEIVING PITS

- A. Locate pits as shown or accepted in the work plan.
- B. Construct pits large enough to:
 1. Accommodate equipment and casing sections.
 2. Maintain safe working clearances.
 3. Provide required reaction capacity.
 4. Permit carrier-pipe installation.
 5. Avoid interference with utilities and structures.
- C. Provide sheeting, shoring, bracing, trench boxes, or engineered support systems complying with applicable safety requirements.
- D. Design the launch-pit reaction structure for the maximum anticipated jacking force with an appropriate factor of safety.
- E. Prevent pit instability, base heave, boiling, piping, and uncontrolled groundwater inflow.
- F. Maintain pits free of standing water and loose material.
- G. Do not allow dewatering to cause settlement, migration of fines, or loss of support beneath pavement, tracks, utilities, or structures.

3.05 SETTLEMENT AND MOVEMENT MONITORING

- A. Install monitoring points at locations required by the accepted monitoring plan and governing agency.
- B. Record baseline elevations and positions before pit excavation and boring.
- C. Monitor during:
 1. Pit excavation.
 2. Dewatering.
 3. Casing advancement.
 4. Carrier-pipe installation.
 5. Grouting.
 6. Pit backfilling.
- D. Increase monitoring frequency when movement trends approach the established alert threshold.
- E. Immediately suspend affected operations when:
 1. Movement exceeds the accepted stop-work threshold.
 2. Ground loss is observed.
 3. Pavement cracking, heave, settlement, track movement, utility movement, or structural distress occurs.
 4. Governing agency directs Work to stop.
- F. Unless the governing agency establishes more restrictive limits:
 1. Surface settlement exceeding 1 inch requires immediate corrective action.

2. Measurable railroad track movement requires immediate suspension of operations and notification of the railroad representative.
3. Movement affecting safe traffic, drainage, utility operation, or structural integrity is unacceptable regardless of magnitude.

G. Submit monitoring records at the frequency stated in the accepted monitoring plan.

H. Repair settlement, heave, pavement damage, utility damage, and other movement caused by the Work at no additional cost to Owner.

3.06 DEWATERING

- A. Dewater pits and work areas.
- B. Maintain groundwater at an elevation that permits stable excavation and safe operations.
- C. Use filtered dewatering systems where necessary to prevent migration of soil fines.
- D. Dispose of water in accordance with applicable permits and environmental requirements.
- E. Do not discharge sediment-laden water to storm drains, surface waters, sanitary sewers, or adjacent property without authorization.

3.07 JACK-AND-BORE INSTALLATION

- A. Install casing by simultaneously jacking the casing and mechanically excavating soil from within the casing.
- B. Advance casing continuously on the established line and grade.
- C. Maintain positive control of the cutting head.
- D. Do not allow the auger or cutting head to advance beyond the leading edge of the casing in a manner that creates unsupported excavation.
- E. Keep excavation diameter as close as practicable to the casing outside diameter.
- F. Do not use water jetting, uncontrolled pneumatic excavation, or other methods that could cause ground loss unless expressly authorized.
- G. Remove spoil from inside the casing without disturbing surrounding soil.
- H. Continuously observe:
 1. Jacking pressure.
 2. Advancement rate.
 3. Spoil volume and character.
 4. Casing alignment.
 5. Groundwater inflow.
 6. Surface-monitoring points.
 7. Adjacent utilities and structures.
- I. Stop operations immediately upon evidence of:
 1. Ground loss.
 2. Excessive spoil removal.
 3. Sudden reduction or increase in jacking resistance.
 4. Surface settlement or heave.
 5. Casing buckling or deformation.
 6. Utility movement.
 7. Loss of line or grade control.
 8. Unsafe conditions.
- J. Notify Engineer and governing agency before resuming operations.
- K. Do not realign casing by uncontrolled excavation outside the casing profile.
- L. Repair damaged casing welds, buckling, splits, or deformation before continuing.

3.08 OBSTRUCTIONS AND ABANDONED BORES

- A. If an obstruction prevents continued installation:
 1. Stop operations.

2. Stabilize the excavation and casing.
 3. Notify Engineer and governing agency.
 4. Submit a proposed corrective procedure.
- B. Do not remove, cut, drill through, or displace an unknown utility or structure.
- C. Where an unsuccessful bore is abandoned:
1. Fill casing and associated voids with approved grout.
 2. Seal casing ends.
 3. Restore affected areas.
 4. Provide surveyed coordinates and elevations of the abandoned casing.
 5. Comply with governing-agency requirements.
- D. Do not begin a replacement bore until its alignment and procedure have been accepted.

3.09 CASING INSTALLATION TOLERANCES

- A. Install casing to permit carrier-pipe construction at the line and grade shown.
- B. Water Main and Sanitary Force Main:
1. Maximum horizontal deviation: 6 inches per 100 feet unless the Drawings or permit requires a more restrictive tolerance.
 2. Maximum vertical deviation: 0.20 feet, provided minimum cover, utility clearance, drainage, and connection requirements remain satisfied.
- C. Gravity Sanitary Sewer:
1. Maximum horizontal deviation: 3 inches per 100 feet unless otherwise indicated.
 2. Maximum vertical deviation: 0.05 feet.
 3. Maintain design slope and hydraulic performance.
 4. Tolerance shall not permit sags, reverse grade, ponding, insufficient cover, or unacceptable connection elevations.
- D. Where agency requirements are more restrictive, agency requirements govern.
- E. Casing outside specified tolerance may be accepted only after Contractor demonstrates that carrier pipe can be installed to the required line and grade without reducing structural integrity, serviceability, hydraulic performance, or required clearance.
- F. Acceptance of a casing deviation does not relieve Contractor from satisfying carrier-pipe performance requirements.

3.10 CASING CLEANING AND INSPECTION

- A. After boring is complete:
1. Remove augers, spoil, water, slag, debris, and projections.
 2. Inspect casing for deformation, buckling, joint failure, and interior obstructions.
 3. Verify casing length, alignment, grade, and end elevations.
 4. Verify that casing is unobstructed throughout its length.
- B. Do not install carrier pipe until casing has been accepted for carrier-pipe installation.
- C. Repair or replace unacceptable casing at no additional cost where the deficiency results from Contractor operations.

3.11 CARRIER-PIPE INSTALLATION

- A. Install carrier pipe without damaging pipe, coatings, linings, bells, gaskets, restraints, spacers, or tracer wire.
- B. Use pulling or pushing equipment that distributes loads without overstressing the pipe.
- C. Do not drag unprotected pipe across casing edges or abrasive surfaces.
- D. Install spacers in accordance with accepted Shop Drawings and manufacturer recommendations.
- E. Verify spacer orientation before inserting each carrier-pipe section.
- F. Join carrier pipe in accordance with the applicable piping specification.

- G. Do not field modify pipe, bells, restraints, spacers, or casing without authorization.
- H. Maintain required clearance between carrier pipe and casing.
- I. Cap carrier-pipe ends during construction to prevent entry of soil, water, animals, and debris.

3.12 WATER-MAIN AND FORCE-MAIN INSTALLATION

- A. Install restrained joints throughout the casing and beyond casing ends as specified.
- B. Verify joint engagement and restraint assembly before advancing each pipe section.
- C. Install tracer wire continuously through the casing.
- D. Do not locate an unrestrained joint inside the casing.
- E. Avoid permanent high points or low points that interfere with air release, drainage, or system operation.
- F. Connect to adjacent piping without imposing excessive stress on the carrier pipe or casing system.

3.13 GRAVITY SANITARY-SEWER INSTALLATION

- A. Establish the required carrier-pipe invert independently from the casing invert.
- B. Adjust spacer height and spacing to maintain design grade.
- C. Survey carrier-pipe invert elevations at:
 - 1. Each casing end.
 - 2. Accessible intermediate points.
 - 3. Upstream and downstream connection points.
- D. Provide a continuous gravity flowline free of reverse slope and unacceptable sags.
- E. Do not force pipe joints beyond manufacturer-permitted angular deflection.
- F. Where completed carrier pipe does not meet line, grade, testing, or CCTV requirements, remove and reinstall or replace the pipe.

3.14 CASING END CLOSURES

- A. Clean casing and carrier-pipe surfaces before installing end seals.
- B. Install manufactured end seals or bulkheads as shown and in accordance with permit requirements.
- C. Do not damage tracer wire or impose concentrated loads on the carrier pipe.
- D. Provide drainage or leakage-relief provisions where required by the governing agency.
- E. Do not conceal casing ends until the installation has been inspected.

3.15 ANNULAR-SPACE AND GROUND-LOSS GROUTING

- A. Do not grout the annular space between carrier pipe and casing unless shown, required by permit, or authorized by Engineer.
- B. Where annular-space grouting is required:
 - 1. Secure carrier pipe against flotation and displacement.
 - 2. Provide injection and vent ports.
 - 3. Place grout in controlled stages.
 - 4. Monitor grout pressure and volume.
 - 5. Prevent damage to carrier pipe, joints, spacers, end seals, pavement, utilities, and structures.
 - 6. Confirm grout placement does not alter carrier-pipe line and grade.
- C. Pressure grout exterior voids caused by ground loss where directed.
- D. Submit grout placement records documenting:
 - 1. Grout mixture.
 - 2. Placement location.
 - 3. Volume placed.
 - 4. Placement pressure.
 - 5. Placement time.
 - 6. Observed response.

3.16 WATER-MAIN TESTING AND DISINFECTION

- A. Test completed water main in accordance with Section 33 11 00 and applicable AWWA requirements.
- B. Perform hydrostatic pressure and leakage testing.
- C. Repair leaks or defects and repeat testing until accepted.
- D. Disinfect potable-water mains in accordance with AWWA C651 and governing utility requirements.
- E. Flush the main and obtain acceptable bacteriological test results before placing the water main into service.
- F. Test tracer wire for electrical continuity and locating capability.

3.18 GRAVITY-SEWER TESTING AND INSPECTION

- A. Perform low-pressure air testing in accordance with ASTM F1417 and Section 33 31 00.
- B. Perform deflection testing of flexible pipe following the waiting period specified in Section 33 31 00.
- C. Maximum allowable deflection shall comply with Section 33 31 00 and governing utility requirements.
- D. Clean the sewer before CCTV inspection.
- E. Provide post-installation CCTV inspection of the carrier pipe and adjacent connections.
- F. CCTV acceptance requires:
 - 1. No cracks, fractures, breaks, or visible pipe damage.
 - 2. No open, separated, displaced, or improperly assembled joints.
 - 3. No excessive joint offset.
 - 4. No visible infiltration.
 - 5. No debris, grout, or foreign material.
 - 6. No excessive deflection.
 - 7. No reverse grade.
 - 8. No standing water indicating an unacceptable sag.
 - 9. Unobstructed flow area throughout the installation.
- G. Where a quantitative standing-water criterion is not established elsewhere, Engineer will evaluate ponding based on design slope, pipe diameter, CCTV evidence, and governing utility requirements.
- H. Correct and reinspect deficient installations at no additional cost to Owner.

3.19 FINAL SURVEY AND RECORD DOCUMENTS

- A. Provide a post-installation survey showing:
 - 1. Horizontal coordinates of casing ends.
 - 2. Casing end elevations.
 - 3. Carrier-pipe invert or centerline elevations at casing ends.
 - 4. Gravity-sewer connection and accessible intermediate invert elevations.
 - 5. Launch and receiving pit limits.
 - 6. Abandoned casing locations, if any.
 - 7. Tracer-wire access points.
 - 8. Deviations from the Contract Drawings.
- B. Incorporate survey information into Project Record Documents.
- C. Submit monitoring records, testing reports, CCTV files, weld records, grout records, and permit closeout documentation.

3.20 BACKFILLING AND RESTORATION

- A. Remove boring equipment, temporary supports, debris, and excess material.
- B. Backfill launch and receiving pits in accordance with Section 31 23 33.

- C. Compact backfill to specified densities.
- D. Restore:
 - 1. Pavement.
 - 2. Curbs.
 - 3. Sidewalks.
 - 4. Shoulders.
 - 5. Ditches.
 - 6. Drainage systems.
 - 7. Railroad facilities.
 - 8. Utilities.
 - 9. Fencing.
 - 10. Landscaping.
 - 11. Other disturbed improvements.
- E. Restoration shall comply with governing-agency requirements and the Contract Documents.
- F. Repair settlement occurring during the correction period where attributable to the Work.

3.21 ACCEPTANCE

- A. Jack-and-bore installation will not be accepted until:
 - 1. Casing is installed within applicable tolerances or an authorized deviation has been accepted.
 - 2. Casing is structurally sound and unobstructed.
 - 3. Carrier pipe is installed and undamaged.
 - 4. Gravity sewer meets line, grade, testing, deflection, and CCTV requirements.
 - 5. Pressure pipe passes required testing.
 - 6. Potable-water main is disinfected and has acceptable bacteriological results.
 - 7. Tracer wire passes continuity and locating tests.
 - 8. Casing spacers and end seals are installed.
 - 9. Grouting is complete where required.
 - 10. Monitoring demonstrates stable surface and structure conditions.
 - 11. Damage, settlement, and heave have been corrected.
 - 12. Restoration is complete.
 - 13. Record documents and test reports have been submitted.
 - 14. Permit conditions have been satisfied.

END OF SECTION 33 05 23.13

**SECTION 33 31 19 - OWNER-FURNISHED, CONTRACTOR-INSTALLED SANITARY LIFT
STATION EQUIPMENT AND PVC SEWER PIPE****PART 1 – GENERAL****1.01 SUMMARY**

- A. Furnish all labor, supervision, tools, rigging, equipment, transportation within the site, ancillary materials, testing, startup, commissioning, training, and incidentals necessary to inventory, protect, install, connect, test, commission, and place into operation Owner-furnished sanitary lift station equipment and PVC sewer piping materials.
- B. Equipment and materials have been procured by the Owner and are currently stored onsite.
- C. Work includes, but is not limited to:
 - 1. Inventory and condition assessment.
 - 2. Protection of stored materials.
 - 3. Installation of PVC sanitary sewer pipe.
 - 4. Installation of PVC force main pipe.
 - 5. Installation of sanitary lift station equipment.
 - 6. Electrical and instrumentation connections.
 - 7. Functional testing.
 - 8. Startup.
 - 9. Commissioning.
 - 10. Operator training.
 - 11. Documentation and record drawings.

1.02 RELATED SECTIONS

- A. Section 33 30 00 – Sanitary Sewerage Utilities.

1.03 REFERENCES

- A. ASTM D3034.
- B. ASTM F679.
- C. ASTM D1785.
- D. ASTM F477.
- E. ASTM D3212.
- F. ASTM F1417.
- G. AWWA C600.
- H. AWWA C605.
- I. ANSI/HI Standards.
- J. NEC.
- K. Local utility and regulatory requirements.

1.04 OWNER-FURNISHED MATERIALS

- A. Owner-furnished materials may include:
 - 1. Submersible sewage pumps.
 - 2. Pump guide rail systems.
 - 3. Pump discharge assemblies.
 - 4. Control panels.
 - 5. VFDs.
 - 6. SCADA equipment.
 - 7. Level transmitters.
 - 8. Float controls.

9. ATS.
 10. PVC gravity sewer pipe.
 11. PVC force main pipe.
 12. Pipe fittings.
 13. Mechanical couplings.
 14. Restrained joint hardware.
 15. Appurtenances.
- B. Equipment and materials are currently stored at the project site.

1.05 CONTRACTOR RESPONSIBILITIES

- A. Review all available manufacturer information.
- B. Verify inventory and condition of Owner-furnished materials.
- C. Provide all labor and ancillary materials required for installation.
- D. Protect Owner-furnished equipment and materials from damage.
- E. Coordinate startup and commissioning.
- F. Provide training.

1.06 SUBMITTALS

- A. Equipment and Material Inventory Report.
- B. Condition Assessment Report.
- C. Training Agenda.
- D. Functional Testing Reports.
- E. Commissioning Report.
- F. Manufacturer Service Reports.
- G. Record Drawings.
- H. O&M Documentation.

1.07 QUALITY ASSURANCE

- A. Install equipment in accordance with manufacturer recommendations.
- B. Manufacturer technical representatives shall participate where required by warranty provisions.

1.08 WARRANTY

- A. Contractor shall warrant installation workmanship for one year following Final Acceptance.
- B. Damage resulting from Contractor handling, installation, testing, or startup activities shall be corrected at no additional cost to Owner.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED EQUIPMENT AND MATERIALS

- A. Furnished by Owner.
- B. Stored onsite.
- C. Quantities and equipment types are shown on the Contract Drawings and Owner inventory records.

2.02 CONTRACTOR-FURNISHED MATERIALS

Provide all materials necessary for complete installation, including:

- A. Stainless steel hardware.
- B. Anchor bolts.
- C. Non-shrink grout.
- D. Joint lubricant.
- E. Pipe supports and hangers.

- F. Electrical conduit.
- G. Conductors.
- H. Control wiring.
- I. Sealants.
- J. Miscellaneous metals.
- K. Temporary supports.
- L. Installation accessories.

2.03 GROUT

- A. Non-shrink hydraulic grout conforming to ASTM C1107.

2.04 FASTENERS

- A. Stainless steel Type 304 minimum unless otherwise noted.

2.05 INSTALLATION ACCESSORIES

- A. Furnish all miscellaneous materials required for a complete installation.
- B. No separate payment shall be made for incidental accessories.

PART 3 – EXECUTION

3.01 INVENTORY AND CONDITION ASSESSMENT

- A. Prior to installation, inventory all Owner-furnished equipment and materials.
- B. Verify:
 - 1. Equipment identification.
 - 2. Model numbers.
 - 3. Pipe diameters.
 - 4. Pipe class.
 - 5. Quantities.
 - 6. Accessories.
 - 7. Spare parts.
- C. Inspect all materials for:
 - 1. Cracks.
 - 2. UV degradation.
 - 3. Distortion.
 - 4. Corrosion.
 - 5. Water damage.
 - 6. Missing components.
 - 7. Bell damage.
 - 8. Improper storage conditions.
- D. Submit reports prior to beginning installation.

3.02 PROTECTION OF OWNER-FURNISHED MATERIALS

- A. Contractor shall assume responsibility for protection of materials following completion of inventory.
- B. Continue manufacturer-required storage maintenance.
- C. Protect materials from environmental damage and construction operations.

3.03 PVC SEWER PIPE INSTALLATION

- A. Install gravity sanitary sewer and force main pipe in accordance with Contract Documents and manufacturer recommendations.

- B. Inspect pipe prior to installation.
- C. Do not install damaged material.
- D. Install:
 - 1. Sewer pipe.
 - 2. Force main pipe.
 - 3. Fittings.
 - 4. Adapters.
 - 5. Mechanical couplings.
 - 6. Restrained joints.
- E. Install pipe to specified line and grade.
- F. Replace contractor-damaged materials at no cost to Owner.

3.04 LIFT STATION EQUIPMENT INSTALLATION

- A. Verify foundation readiness.
- B. Install pumps, guide rails, valves, and controls in accordance with manufacturer instructions.
- C. Maintain alignment and required service clearances.
- D. Verify stored equipment has not deteriorated prior to installation.
- E. Repair damage caused during installation.

3.05 GROUTING AND ANCHORAGE

- A. Install equipment anchorages.
- B. Grout equipment bases.
- C. Verify alignment after grout curing.

3.06 ELECTRICAL AND INSTRUMENTATION CONNECTIONS

- A. Complete all required power, control, communication, instrumentation, and SCADA connections.
- B. Integrate:
 - 1. Pumps.
 - 2. Control panels.
 - 3. VFDs.
 - 4. SCADA.
 - 5. Alarms.
 - 6. Level controls.
 - 7. Generator.
 - 8. ATS.

3.07 TESTING

Perform:

- A. Pump rotation testing.
- B. Motor insulation testing.
- C. Level control testing.
- D. Alarm testing.
- E. SCADA testing.
- F. Generator testing.
- G. ATS testing.
- H. Valve testing.
- I. Pipe acceptance testing.
- J. Operational testing.

3.08 STARTUP

- A. Perform startup in accordance with manufacturer requirements.
- B. Verify:
 - 1. Pump operation.
 - 2. Alternation sequences.
 - 3. Level controls.
 - 4. Generator operation.
 - 5. ATS operation.
 - 6. Alarm operation.
 - 7. SCADA functionality.
- C. Correct deficiencies before commissioning.

3.09 COMMISSIONING

- A. Commission the completed sanitary sewer and lift station system.
- B. Verify integrated operation of all equipment.
- C. Simulate:
 - 1. High wet-well conditions.
 - 2. Utility power loss.
 - 3. Pump failure.
 - 4. Communication failure.
 - 5. Generator operation.
- D. Operate the lift station continuously for a minimum of four hours under simulated conditions.
- E. Submit commissioning report.

3.10 OPERATOR TRAINING

- A. Provide a minimum of sixteen (16) hours of owner training.
- B. Include classroom and hands-on instruction.
- C. Training topics:
 - 1. Pump operation.
 - 2. Pump removal and installation.
 - 3. Valve operation.
 - 4. Control panel functions.
 - 5. Alarm response.
 - 6. VFD operation.
 - 7. SCADA operation.
 - 8. Generator operation.
 - 9. ATS operation.
 - 10. Maintenance procedures.
 - 11. Troubleshooting.
 - 12. Emergency response procedures.

3.11 PERFORMANCE REQUIREMENTS

- A. Pumps shall operate without excessive vibration, noise, leakage, cavitation, or overheating.
- B. Sewer and force main piping shall pass all specified acceptance testing.
- C. SCADA, controls, alarms, generator, and ATS systems shall function properly.
- D. All piping connections shall be watertight.
- E. Contractor shall repair or replace deficiencies resulting from installation activities.
- F. Final Acceptance shall require:
 - 1. Successful testing.
 - 2. Successful startup.
 - 3. Successful commissioning.

4. Completed operator training.
 5. Submission of required documentation.
- G. Entire system shall operate under automatic control for thirty (30) consecutive calendar days without unresolved operational deficiencies prior to Final Acceptance.
- No separate payment shall be made for material inventory, handling, storage protection, startup support, testing, commissioning, training, manufacturer coordination, corrective work, or documentation. All costs shall be included in the Contract Lump Sum price.

END OF SECTION 33 31 19

SECTION 33 1415 - SITE WATER DISTRIBUTION PIPING

PART 4 - GENERAL

4.1 SUMMARY

A. Section Includes:

1. Water-distribution piping and related components outside the building for domestic water service and terminated 5 ft. from building . Terminate water-service piping with appropriate fitting for extension by Divisions 21 and 22.

4.2 DEFINITIONS

- A. CDA: Copper Development Association.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.

4.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

4.4 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals:
 1. Field quality-control reports.

4.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of product indicated.

4.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:

1. Ensure that piping, valves, meters, backflow prevention devices, and fire hydrants are dry and internally protected against rust and corrosion.
 2. Protect threaded ends and flange faces against damage.
 3. Set piping, valves, meters, backflow prevention devices, and fire hydrants in best position for handling and to prevent rattling.
- B. During Storage: Use precautions for piping, valves, meters, backflow prevention devices, and fire hydrants according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle products if size requires handling by crane or lift. Rig products to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

4.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service in accordance with requirements indicated:
1. Notify Construction Manager no fewer than [**two**] **<Insert number>** days in advance of proposed interruption of service.
 2. Do not proceed with interruption of water-distribution service without Construction Manager's written permission.

PART 5 - PRODUCTS

5.1 PERFORMANCE REQUIREMENTS

- A. Comply with standards of authorities having jurisdiction for domestic water-service piping, including materials, installation, testing, and disinfection.
- B. Piping materials to bear label, stamp, or other markings of specified testing agency.

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- D. Comply with ASTM F645 for selection, design, and installation of thermoplastic water piping.
- E. All piping and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372 or are certified in compliance with NSF 61/NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

5.2 PIPING MATERIALS

- A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and service sizes.
- B. Potable-water piping and components comply with NSF 14, NSF 61, and NSF 372

5.3 COPPER TUBE AND FITTINGS

- A. Annealed-Temper Copper Tube: ASTM B88, Type K .
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- D. Wrought-Copper Unions: ASME B16.22.

5.4 PE PIPE AND FITTINGS

- A. PE, ASTM Pipe: ASTM D2239, SDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than **160 psig**.
 - 1. Molded PE Fittings: ASTM D3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

5.5 GATE VALVES

- A. Gate Valves - AWWA, Cast Iron:
 - 1. Source Limitations: Obtain gate valves - AWWA, cast iron, from single manufacturer.
 - 2. Gate Valves - Nonrising Stem, Resilient Seated: Cast- or ductile-iron body and bonnet, with bronze or cast- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - a. Standards: AWWA C509 or AWWA C515.
 - b. Minimum Pressure Rating: 200 psig.

- c. End Connections: Mechanical joint, flanged, threaded, or push on.
- d. Interior Coating: Complying with AWWA C550.

5.6 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.
 - 1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

PART 6 - EXECUTION

6.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Section 31 2000 "Earth Moving."

6.2 PIPING APPLICATIONS

- A. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
- B. Do not use flanges or unions for underground piping.
- C. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- D. Underground water-service piping **NPS 3/4 to NPS 3** to be any of the following:
 - 1. Soft copper tube, ASTM B88, Type K ; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. PE, ASTM pipe; **molded PE fittings; and heat-fusion joints.**

6.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM Global, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, **metal**-seated gate valves with valve box.

6.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Provide a continuous bare copper or aluminum tracer wire not less than 0.10 inch in diameter in sufficient length over each separate run of nonmetallic pipe.

6.5 INSTALLATION OF PIPING

- A. Water-Main Connection:

1. Tap water main in accordance with requirements of water utility company and of size and in location indicated.

- B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve in accordance with MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

- C. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
4. Install corporation valves into service-saddle assemblies.
5. Install manifold for multiple taps in water main.
6. Install curb valve in water-service piping with head pointing up and with service box.

- D. Install PE pipe in accordance with ASTM D2774 and ASTM F645.

- E. Extend **water-service** piping and connect to water-supply source and building **water-piping** systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate **water-service** piping at building wall until building **water-piping** systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building **water-piping** systems when those systems are installed.

- F. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in architectural details.

- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- H. Comply with Section 22 1116 "Domestic Water Piping" for potable-water piping inside the building.

6.6 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools and procedures recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
 - 2. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners in accordance with fitting manufacturer's written instructions.

6.7 INSTALLATION OF VALVES

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.
- D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves : Install each underground curb valve with head pointed up and with service box.

6.8 CONNECTIONS

- A. Connect water-distribution piping to **existing water main**.
- B. Connect water-distribution piping to interior **domestic water** piping.
- C. Ground equipment in accordance with Section 26 0526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring in accordance with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

6.9 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
 - 1. Increase pressure in 50 psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

6.10 IDENTIFICATION

- A. Install continuous underground **detectable** warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 31 2000 "Earth Moving."

6.11 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for three hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

1.2 ACTION SUBMITTALS

- A. Product Data: For fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression.

- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

A. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 797 and UL Category Control Number FJMX.
 - 2) Material: Steel.
 - 3) Exterior Coating: Zinc
 - 4) Interior Coating: Zinc
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch
 - 2) Colors: As indicated on Drawings.

2.3 TYPE EPEC RACEWAYS AND FITTINGS

A. Schedule 40 Electrical HDPE Underground Conduit (EPEC-40):

1. Applicable Standards:

- a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
- b. General Characteristics:
 - 1) Reference Standards: UL 651A and UL Category Control Number EAZX.
 - 2) Dimensional Specifications: Schedule 40.
- c. Options:
 - 1) Minimum Trade Size: 3/4 inch.

2.4 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ENT: Comply with NEMA TC 13 and UL 1653.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Rigid HDPE: Comply with UL 651A.
- F. Continuous HDPE: Comply with UL 651B.
- G. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- H. RTRC: Comply with UL 1684A and NEMA TC 14.
- I. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- J. Fittings for LFNC: Comply with UL 514B.
- K. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- L. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Flanged-and-gasketed type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- F. Gangable boxes are prohibited.
- G. Cabinets:
 - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Bell Type with no knock-outs.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Pull-Box Prototype Test: Test prototypes boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

4. Where direct-buried conductors, raceway, or cables are subject to movement by settlement or frost, direct-buried conductors, raceway, or cables shall be arranged so as to prevent damage to the enclosed conductors or to equipment connected to raceways.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC,.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 4. Damp or Wet Locations: GRC.
 5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use Compression fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
 - 3. Conduit shall be surface mounted within 12" of boxes, cameras, and enclosures
 - 4. Conduit installed below 10 feet after finish floor shall be secured with two-hole clamps, spaced at 36 inches maximum.
 - 5. Tamper proof security hardware, and two-hole clamps are required where raceway is below 10 feet in secured areas.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

- a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 3.4 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage and deterioration.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.

- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Compression fittings
 - 2. Two-Hole straps mounted five feet on center.
 - 3. Tamper-proof Security Hardware.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 3/8 inch in diameter.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION IN NON SECURED AREAS

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 7. To Light Steel: Sheet metal screws.
 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- F. Support conduit within 12 inches of enclosures to which attached.
- G. Boxes shall have independent supports.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.
- D. Support conduit within 12 inches of enclosures to which attached.
- E. Boxes shall have independent supports.

END OF SECTION 260529

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in cabinets.

1. Install bus horizontally, on insulated spacers 2 inches minimum from housing.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Cabinets: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Flexible raceway runs.

- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each ground rod and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
 3. Manhole Grounds: 10 ohms.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.2 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

PART 2 - PRODUCTS – Not Used.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 260500

SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Work includes all electrical items and systems shown on the contract drawings and specified herein.
- B. Unless specifically dimensioned, the work shown on the drawings is diagrammatic, and is intended only to show general arrangement.
- C. Include in the work all accessories and devices necessary for the intended operation of any system, whether or not specifically shown or specified.

1.2 STANDARDS OF QUALITY

- A. The specifications establish the standard of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number.
- B. Where one product only is specifically identified by name of manufacturer's model number, the Contractor shall base his bid on the use of the name product. Where multiple names are used, the Contractor shall base his bid on the use of any of those products named.
- C. The Contractor may submit with his bid, the names of products which are proposed as substitutions for products named in specifications. Each proposed substitution shall be accompanied by a written sum of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause.
- D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide complete data adequate for the Engineer's evaluation of the proposed substitution.
- E. When the equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, etc. Such additional costs shall be identified at the time such substitutions are proposed.

1.3 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations.
 - 1. Submittals
 - 2. Maintenance Manuals
 - 3. Rough-ins
 - 4. Electrical Installations

1.4 SUBMITTALS

- A. The Contractor shall review, approve and submit shop drawings, with promptness so as to cause no delay in his work or in that of others. No submissions will be accepted by the Engineer without the signed review and approval of the Contractor.
- B. The Contractor shall check and verify pertinent field measurements, quantities of equipment and materials required.
- C. Submittals shall be identified by reference to the drawings, sections of specifications, or equipment symbols to which they relate.
- D. Shop drawings, when required, shall include:
 - 1. Verification of information given in Contract Documents such as performance, dimensions, weight, materials, construction, types, models, manufacturer, etc.
 - 2. Equipment layouts drawn to scale as may be required.
 - 3. Wiring diagrams and schematics for equipment.
 - 4. Any special construction conditions.
 - 5. Other information/data as may be requested.
- E. All submittals shall identify the specific details of the product or assembly. All optional features being proposed shall be so noted, or the submittal will be rejected.
- F. Review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specification. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
- G. For items being resubmitted, clearly identify changes made from the initial submittal requested by the Engineer. The Engineer will review only those changes requested and identified by the Contractor.

1.5 MAINTENANCE MANUALS

- A. Prepare maintenance manuals including the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.7 PERMITS, FEES, AND CERTIFICATES OF APPROVAL

- A. Contractor shall acquire all permits and certificates.
- B. Contractor shall provide all labor and instruments required for tests and cleaning of systems.
- C. Whenever tests are required, three (3) copies of the test reports shall be submitted to the Engineer.
- D. Tests may be observed by the Engineer or his representative. Notify the Engineer a minimum of three weeks in advance of the test dates.

1.8 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

- A. In the absence of specific instruction in the technical specifications, equipment and installation shall conform to the following applicable codes, standards and regulations, latest editions:
 - 1. American Society for Testing Materials (ASTM).
 - 2. American National Standard Institute (ANSI).
 - 3. Underwriter's Laboratories, Inc. (UL).
 - 4. American Welding Society Code (AWSC).
 - 5. Local Building, Electrical, and Fire Codes.
 - 6. National Electrical Code (NEC).
 - 7. Service Rules and Regulations of Local Electrical Utility Company.
 - 8. National Electrical Manufacturer's Association (NEMA).
 - 9. U.S. Department of Health & Human Services "HRS-M-HF" 84-1.
 - 10. Occupational Safety and Health Act (OSHA).
 - 11. National Fire Protection Association (NFPA).
 - 12. Americans with Disabilities Act (ADA).

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with requirements of the actual equipment to be connected.

3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate electrical systems, equipment, and materials installation with other building components.
 2. Verify all dimensions by field measurements.
 3. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 4. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 5. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
 6. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 7. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
 8. Install access panel or doors where units are concealed behind finished surfaces.
 9. Install systems, material, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 10. Coordinate all electrical requirements with other trades and their shop drawings prior to installing conduit, wire, switches and breakers. Notify engineer of any discrepancies between document and actual supplied equipment.

3.3 CUTTING AND PATCHING

- A. General: Performing cutting and patching in accordance with the following requirements:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover work to provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the contract documents.
 - d. Upon written instruction from the Engineer, uncover and restore work to provide for Engineer observation of concealed work.

END OF SECTION 260010

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