MIRROR LAKE PAVING
MIRROR LAKE STATE PARK
DEPARTMENT OF NATURAL RESOURCES
BARABOO, WISCONSIN

TECHNICAL SPECIFICATIONS VOLUME 2
BID DOCUMENT

Division Project No. **24E7Z**

NOVEMBER 12, 2025

FOR
THE STATE OF WISCONSIN
DEPARTMENT OF ADMINISTRATION
DIVISION OF FACILITIES DEVELOPMENT
STATE OF WISCONSIN ADMINISTRATION BUILDING - 7TH FLOOR
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SECTION 02 05 00
COMMON WORK RESULTS FOR EXISTING CONDITIONS
BASED ON DFD MASTER SPECIFICATION DATED 6/24/2025

PART 1 - GENERAL

SCOPE
This Section provides information common to two or more technical specification sections or items that are of a general nature and not included in other sections. This section applies to ALL site work, as applicable. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Sections
- Referenced Organizations
- Referenced Documents
- Safety
- Permits
- Construction Limits
- Off-Site Storage
- Certifications and Inspections
- As-Built Drawings

PART 2 - MATERIALS
- Barricades, Signs, and Warning Devices
- Temporary Barrier Fencing

PART 3 - EXECUTION
- Maintenance of Site and Building Access/Egress
- Continuity of Existing Traffic/Parking and Traffic Control
- Survey and Staking
- Utility Locates
- Protection and Continuity of Existing Utilities
- Protection of Existing Work and Facilities
- Stormwater/Excavation Water Management

RELATED SECTIONS
Applicable provisions of Division 01, General Conditions of the General Prime Contractor Contract, and the Supplementary General Conditions shall govern work under this Section.

Related work specified elsewhere:

Section 02 32 00 – Geo Technical Investigation
Section 02 41 13 – Demolition

REFERENCED ORGANIZATIONS
Abbreviations of organizations referenced in these specifications are as follows:

AASHTO	American Association of State Highway and Transportation Officials
ACPA	American Concrete Pipe Association
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
FHA	Federal Highway Administration
EPA	Environmental Protection Agency
NEC	National Electric Code

NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories Inc.
WDNR	State of Wisconsin Department of Natural Resources
WISDOT	State of Wisconsin Department of Transportation

REFERENCED DOCUMENTS

SSHC - Where reference is made to the SSHSC, it shall mean the pertinent sections of the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications.

SSSWC - Where reference is made to the SSSWC, it shall mean pertinent sections of the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition.

BMPH - Where reference is made to the BMPH, it shall mean the Wisconsin Construction Site Best Management Practice Handbook, current edition as published by the WDNR. Method of measurement and basis of payment sections in referenced documents shall not apply.

SAFETY

Contractor is responsible for worksite safety.

Perform all work in accordance with applicable OSHA, state and local safety standards.

Contact Diggers Hotline at 1-800-242-8511 in accordance with statutory requirements. Request that non-member utilities and private utilities be located by the appropriate parties.

PERMITS

Unless otherwise noted in the Contract Documents, Contractor shall be responsible for obtaining and paying for all permits necessary to complete the work. Refer to Section 01 41 26.

CONSTRUCTION LIMITS

Construction limits are indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the DFD Project Representative. If construction activities extend beyond state property lines or construction easements, obtain all necessary approvals and permits from applicable municipalities.

The Contractor shall restore all disturbed areas in accordance with the drawings and specifications. If plans and specifications do not address restoration of specific areas, these areas will be restored to pre-construction conditions.

OFF SITE STORAGE

In general, the payments for materials stored off site will only be considered in instances where there is limited space available for storage on the site. Prior approval by the DFD Project Representative, together with the execution of an “Off-site Storage Agreement” will be required.

CERTIFICATIONS AND INSPECTIONS

Obtain and pay for all required sampling, testing, inspections, and certifications except those expressly listed as provided by the A/E or other third party in the Contract Documents. The Contractor shall upload documents to the State’s Project Management Information Software system (PMIS) within 3 business days of said work. Include copies of the certifications and documents in the O&M Manual.

AS-BUILT DRAWINGS
DFD will provide the Contractor with a suitable set of Contract Documents on which daily records of changes and deviations from contract shall be recorded.

PART 2 - MATERIALS

BARRICADES, SIGNS, AND WARNING DEVICES
Traffic barricades, traffic signs, and warning devices shall meet the requirements of applicable OSHA standards and the FHA Manual of Uniform Traffic Control Devices (MUTCD).

TEMPORARY BARRIER FENCING
Provide temporary barrier fencing as needed to perform all work in accordance with applicable OSHA standards, regulations, and the quality control plan.

UV stabilized high-density polyethylene barrier fence free of holes tears and other defects. Provide 4' tall fence in diamond or rectangular pattern. Fencing shall be "safety orange" color, unless otherwise noted. Posts for temporary plastic barrier fencing shall be 5' tall, minimum 12-gauge, galvanized metal posts.

PART 3 - EXECUTION

MAINTENANCE OF SITE AND BUILDING ACCESS/EGRESS
Unless otherwise shown or directed, maintain existing access and egress to the facility throughout construction. Maintain ANSI A117 compliant access for disabled persons, access and egress as indicated. Do not interrupt access and egress without prior written approval from the DFD Project Representative.

Provide specified barrier fencing, barricades, signage, and warning lights around all construction, staging, swing path of lift(s) and storage areas.

Provide minimum 5-foot-wide temporary covered walkways at single door building access/egress points affected by work activities. Provide minimum 7-foot-wide temporary covered walkways at double door building access/egress points affected by work activities.

CONTINUITY OF EXISTING TRAFFIC/PARKING AND TRAFFIC CONTROL
Do not interrupt or change existing traffic, delivery, or parking without prior written approval from the DFD Project Representative. When interruption is required, coordinate schedule with the Department of Natural Resources to minimize disruptions. When working in public right-of-way, obtain all necessary approvals and permits from applicable municipalities and WISDOT.

When Contractor's activities impede or obstruct traffic flow, Contractor shall provide traffic control devices, signs and flaggers in accordance with other Contract Documents and the current version of the MUTCD, or as shown on the Drawings.

SURVEY AND STAKING
A/E will provide benchmarks and control points for the project as requested by the Contractor if information is available and not already shown on the plans.

Contractor shall be responsible for transferring benchmarks, control points, lines and grades to the project site as necessary to complete work.

UTILITY LOCATES
Contact Diggers Hotline at 811 or 1-800-242-8511 in accordance with statutory requirements. Requests may also be made online at https://www.diggershotline.com/file-a-request. Request that non-member

utilities and private utilities be located by the appropriate parties. Coordinate utility locates with the Department of Natural Resources staff. If required, the contractor shall pay all costs associated with private utility locates if unable to be located and marked by Diggers Hotline or Owner.

Contractor shall include the costs for ***ALL*** underground utility locates in their bid if required. Locates shall include excavation, backfill, survey and pictures of existing utilities within the construction limits. Survey information shall include size, elevation, GPS location, materials and height and width of utility. Locates shall be authorized by DFD Project Representative.

PROTECTION AND CONTINUITY OF EXISTING UTILITIES

Verify the locations of any water, drainage, gas, sewer, electric, drainage, gas, sewer, electric, telephone/communication, fuel, steam lines or other utilities and site features which may be encountered in any excavations or other sitework. All lines shall be properly underpinned and supported to avoid disruption of service.

Do not interrupt or change existing utilities without prior written approval from the DFD Project Representative, affected utilities and users. Notify all users impacted by outages a minimum of 48 hours in advance of outage. Notification shall be provided in writing and describe the nature and duration of outages and provide the name and number of Contractor's foreman or other contact.

Any service connections encountered which are to be removed shall be cut off at the limits of the excavation and capped in accordance with the requirements of applicable codes and any specifications governing such removals.

PROTECTION OF EXISTING WORK AND FACILITIES

Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights, utilities, and all other such facilities that may be encountered or interfered with during the progress of the work. Take measures necessary to safeguard all existing work and facilities that are outside the limits of the work or items that are within the construction limits but are intended to remain. Report any damage to existing facilities to the DFD Project Representative immediately.

STORMWATER/EXCAVATION WATER MANAGEMENT

Control grading around structures, pitch ground to prevent water running into excavated areas.

Pits, trenches within building lines and other excavations shall be maintained free of water.

Provide trenching, pumping, other facilities required.

Notify Architect/Engineer if springs or running water are encountered in excavation; provide discharge by trenches, drains, pumping to point outside of excavation. Provide information to Architect/Engineer of points and areas where water will be discharged. At the Engineer's option, the Contractor shall drain the spring to the storm sewer system by the use of field tile.

Be responsible for control measures to prevent damage from flooding, erosion, and sedimentation to on-site and off-site areas.

END OF SECTION

SECTION 02 32 00
GEOTECHNICAL INVESTIGATION
BASED ON DFD MASTER SPECIFICATION DATED 11/21/13

PART 1 - GENERAL

SCOPE

This section provides information resulting from subsurface investigations completed at the site as part of this project. This section may contain information applicable to ALL sitework, and other technical specification sections, as well. All Contractors are expected to review this information as part of their duties to familiarize themselves with the site.

Results of the geotechnical investigation apply only to the locations at which data was collected, at the specific time it was collected. Geotechnical conditions may differ elsewhere on the site.

Prior to making additional investigations of his own using test pits, borings, or other methods; Bidder shall first gain permission from property owner and DFD Project Manager. Geotechnical investigations completed by Bidder shall comply with all applicable requirements of Division 01 through Division 33 of this project.

RELATED WORK

Applicable provisions of Division 01 govern work under this Section.

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

CGC, Inc.
Construction • Geotechnical
Consulting Engineering/Testing

February 1, 2023
C22589

Zach Freeman, PE
Kapur
4654 S Biltmore Lane
Madison, Wisconsin 53718

Re: Geotechnical Exploration Report
Proposed Roadway Improvements
Mirror Lake State Park
Baraboo, Wisconsin

Dear Mr. Freeman:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions along roads within Mirror Lake State Park, which are planned to be resurfaced, and to provide geotechnical recommendations regarding subgrade preparation and pavement design/construction. We are sending you an electronic copy of this report, and a paper copy can be provided upon request.

PROJECT AND SITE DESCRIPTION

We understand that roads within the Mirror Lake State Park in Baraboo, Wisconsin are proposed to be resurfaced. Roadway improvements may involve milling and overlaying the existing pavement or full-depth replacement, as well as potentially slurry sealing. It is understood that some ditch re-grading and culvert replacements are also planned in conjunction with the pavement rehabilitation.

SUBSURFACE CONDITIONS

Subsurface conditions for this study were explored by drilling 15 Standard Penetration Test (SPT) soil borings to planned depths of 5 ft below the existing pavement surface at locations selected and field-staked by Kapur personnel, who also provided ground surface elevations. The borings were drilled by America's Drilling Company (ADC; under subcontract to CGC) on January 9 to 11, 2023 using a truck-mounted CME-55 rotary drill rig equipped with hollow-stem augers and an automatic SPT hammer. The specific procedures used for drilling and sampling are described in Appendix A, and the boring locations are shown in plan on the Soil Boring Location Exhibit presented in Appendix B.

The subsurface profiles at the boring locations varied to some degree, but can be described, in general terms, by the following strata (in descending order):

2921 Perry Street, Madison WI 53713
Telephone: 608/288-4100
FAX: 608/288-7887

- ***Pavement layers*** including about 2.5 to 6 in. of *asphalt pavement* on top of about 3 to 8 in. of *base course*; underlain by
- Roughly 2 ft of medium dense to very dense ***granular fill*** in Borings 2 and 15; and/or
- About 1.5 to 4.5+ ft of loose to medium dense ***silt*** layers in Borings 10, 13 and 15; followed by
- Approximately 2 to 5+ ft of loose to medium dense ***sand*** strata with variable amounts of silt and gravel in the majority of the borings; over
- Medium dense to very dense, probable ***highly weathered to weathered sandstone bedrock*** to the maximum depths explored.

The silt layer encountered below the pavement section in Boring 10 was classified as *probable buried topsoil* (or *possible topsoil/organic fill*) due to the apparent organic nature of the soils (based on dark brown color). The sample taken from these soils was analyzed in our laboratory for its organic content via loss-on-ignition (LOI), with a result of 5.0%. For reference, soils with organic contents greater than 4% are typically considered organic. Organic soils should be considered moderately compressible in the short term, as well as susceptible to decomposition and further (secondary) settlement in the long term.

Groundwater was not encountered in the borings during or upon the completion of drilling. Groundwater levels should be expected to fluctuate based on seasonal variations in precipitation, infiltration, evapotranspiration, the level in Mirror Lake and other factors.

Refer to the individual soil boring logs, which also contain the laboratory test results and are attached in Appendix B, for a more detailed description of the subsurface conditions at each boring location.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration program, it is our opinion that the planned improvement areas generally appear suitable for the proposed pavement improvements. *However, additional steps (e.g., undercutting/replacement of unsuitable/lower-strength soils) may be required to develop a stable subgrade for pavement support.* Our recommendations for subgrade preparation as well as pavement design and construction are presented in the following subsections. General information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Slurry Sealing/Mill-and-Overlay

It is understood that pavement rehabilitation via slurry sealing or milling and overlaying the existing asphalt is being considered. The existing asphalt pavement was found to be between about 2.5 and 6 in. thick and generally underlain by about 3 to 8 in. of base course; as an exception, no discernible base course was present below the asphalt at B-12. The existing asphalt thicknesses were less than

typically recommended at about half the locations, and the existing base course thicknesses were also less than recommended values at the majority of the boring locations.

Depending on the condition of the existing pavement and with the less-than-recommended pavement section thicknesses in mind, the slurry-seal or mill-and-overlay approaches have the drawback that existing cracks that extend full-depth through the existing asphalt will likely propagate back up (i.e., reflective cracking) through the new surface over time. In addition, if the existing asphalt is partially milled, with only a marginal lower portion of the asphalt remaining, the remaining pavement may disintegrate/crack under construction traffic (i.e., paver and loaded dump trucks). The risk of reflective cracking must be acceptable to the owner if slurry sealing or milling and overlaying is planned. Note that if existing asphalt is milled/pulverized to the top of the base course, the milled asphalt can potentially be re-used as part of the base course for the new pavement *if grades can be raised slightly*.

Due to concerns of poor pavement performance following slurry sealing or milling and overlaying, we recommend a full-depth replacement of the pavement sections be considered, which is further discussed in the following subsections.

2. Soil Mapping

Using the United States Department of Agriculture – Natural Resources Conservations Services (USDA-NRCS) *Web Soil Survey* website, we identified an area of interest encompassing the project roads. The soils mapping for the project area is shown on the Soil Map, generated through the USDA-NRCS *Web Soil Survey* website, which is attached in Appendix E. The predominant soil series mapped within the project limits is Elevasil sandy loam (denoted ElB and ElD2 on the Soil Map), accounting for over 50% of the area. Table 1 includes key parameters for evaluating the soils' suitability for pavement support, which have been taken from published WisDOT references and are based on decades of WisDOT and AASTHO experience. Note that the parameters in the table are generally representative of the B horizon (e.g., the soil layer directly below the naturally occurring organic topsoil A horizon), and typically improve with depth. The soils are listed in order of ascending Design Group Index, with lower values indicating better pavement support.

Table 1 – Summary of Soil Properties

Soil Series	Symbols	Design Group Index, DGI	Frost Index, FI	Modulus of Subgrade Reaction, K Factor (pci)
Elevasil sandy loam	ElB, ElD2	0	0	300
Boone-Elevasil complex	1224F	0	0	300
Boone sand	BoC, BoD	0	0	300
Plainfield loamy sand	PfB, PfC, PfD	0	0	300
Winterfield-Evart complex	WiEvA	0	2	300
Pelkie loamy fine sand	PelA	0	2	300
Hixton silt loam	HxB2	14	3	150
Eleva variant sandy loam	EmA	14	3	125

The prevalent Elevasil and Boone soils are described as well drained to excessively drained and derived from sandstone bedrock. A typical profile in areas mapped as containing Elevasil and Boone soils includes shallow sand, fine sand, loamy sand and sandy loam strata over weathered to fairly hard/competent sandstone bedrock. The groundwater table in these areas is generally expected to remain more than 80 in. below the ground surface. The Hixton soils are of similar origin as the Elevasil and Boone soils, but may include finer-grained silt loam to fine sandy loam strata near the ground surface. The Plainfield soils have formed from glacial outwash and are also excessively drained, with the groundwater table more than 80 in. below the ground surface. However, deeper deposits of loamy sand, sand and stratified gravelly coarse sand to sand should be expected in areas mapped as Plainfield loamy sand.

Moderately well drained to somewhat poorly drained conditions and groundwater within about 12 to 42 in. below the ground surface should be expected in areas mapped as Winterfield-Evart complex, Pelkie loamy fine sand and Eleva variant sandy loam. These soils have formed from mixed sandy alluvium on flood plains (Winterfield-Evart and Pelkie) or loamy residuum weathered from sandstone on drainageways or depressions on hills (Eleva). While the typical Eleva profile is similar to the Elevasil and Boone soils, fairly deep deposits of fine sand to loamy fine sand, loamy sand, sand and stratified loamy fine sand to coarse sand may be encountered in areas mapped as containing Winterfield-Evart and Pelkie soils.

The soil mapping is in general agreement with the subsurface profiles encountered in the soil borings, with the exception of apparent fill which was encountered below the pavement section at isolated locations.

Based on the soil conditions encountered in the borings and described by the soil mapping, it is our opinion that pavement design will be controlled by the near-surface sandy soils having characteristics similar to the Elevasil, Boone, and Plainfield series in Table 1.

3. Pavement Subgrade Preparation

After removal of the existing pavement section, exposed subgrades are anticipated to largely consist of sand soils or weathered sandstone bedrock. However, silt or organic silt may also be present below the existing base course in isolated areas (e.g., near B-10 and B-13, or areas mapped as Hixton silt loam, which includes the location of B-13). Although existing base course thicknesses were generally less than typically recommended, the existing base course could also be left in-place, with additional base course added on top of the existing base course where necessary, provided final roadway grades can be slightly raised compared to existing.

Where organic soils are exposed at subgrade elevations, we recommend they be undercut and replaced below new pavement areas. We further recommend that granular subgrade soils and existing base course (if remaining in-place) be thoroughly recompacted using a vibratory smooth-drum roller. Note that silty subgrades will require static recompaction, as these soils are susceptible to disturbance from vibratory compaction methods. Recompacted subgrades (or base course) should then be proof-rolled with a heavy rubber-tired piece of construction equipment to check for soft/yielding areas. *Proof-rolling should not be performed within 48 hours of a rainfall exceeding ¼-inch.*

If soft/yielding areas are encountered, these soils should be selectively undercut (e.g., excavation below subgrade, EBS) and replaced with coarse aggregate [e.g., 3-in. dense graded base (DGB) or select crushed material (SCM), WisDOT *Standard Specification for Highway and Structure Construction*, Sections 305 and 312, respectively]. The thickness of the undercut/stabilization layer should be determined in the field during proof-rolling, and the required thickness of the layer will likely vary along the alignment. If long, continuous sections of soft/yielding soils are encountered, a geogrid [e.g., Tensar Type 1 or 2 (BX 1100 or 1200) or equivalents] could be considered to provide additional reinforcement, and potentially reduce the thickness of the aggregate stabilization layer.

Note that, since the pavement design parameters are based on the sandy soils prevalent within the project area, we recommend that the project budget include a generous contingency for improvement of isolated areas with silt subgrades. Subgrade improvements in these areas may involve an additional aggregate stabilization layer below the pavement base course, potentially over biaxial geogrid.

Following development of a firm/stable base, fill placement to establish pavement subgrade elevations can proceed, as needed. Since generally minor site grading is expected, we recommend using additional base course to raise grades, where required. We recommend that fill be compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) following Appendix D guidelines. Periodic field density tests should be performed by CGC staff within the fill to document

the adequacy of the compaction efforts. New base course should be placed and compacted until deflection is no longer evident.

A "final" proof-roll should be performed prior to asphalt paving to check for soft/yielding conditions. Soft/yielding areas should be undercut/stabilized, as described above.

4. Pavement Design Parameters

The pavement design parameters contained herein assume a firm or stabilized subgrade is present or has been developed according to the recommendations and techniques discussed previously. The recommended design soil parameters outlined in Table 2, which are based on the wide-spread Elevasil, Boone and Plainfield soils, should be used in conjunction with anticipated traffic loads to develop the design pavement section. The following parameters are based on pavement design methods discussed in the WisDOT *Geotechnical Manual*:

TABLE 2 – Recommended Pavement Design Parameters

Soil Parameter	Recommended Design Values
USCS	SP/SP-SM/SM
AASHTO Classification	A-1/A-2/A-3
Frost Index, FI	F-0
Design Group Index, DGI	0
Soil Support Value, SSV	5.5
Subgrade Modulus, K (pci)	300

Note: These values are based on the following assumptions (based on WisDOT *Geotechnical Manual*):

1) The subgrade has been closely monitored.
2) The subgrade has been thoroughly and adequately compacted.
3) Wet zones have been dried, drained, or removed.
4) Pockets of dissimilar material have been removed, replaced or mixed to achieve a homogeneous subgrade.
5) Adequate subgrade drainage has been achieved.
6) Lower quality soils have been undercut, where encountered.

Assuming a firm/non-yielding subgrade is developed, including undercutting/stabilization of lower quality soils discussed previously, and assumed traffic loading conditions, consisting primarily of light passenger vehicles [e.g., up to 5 daily 18-kip Equivalent Single-Axle Loads (ESALs)], a typical flexible pavement design is 3.0 to 3.5 in. of asphalt pavement and 8 to 10 in. of dense graded base course.

However, the pavement design should be based on traffic count data, past local projects and the provided soil parameters. As previously stated, the inclusion of an additional aggregate stabilization layer and/or geogrid below the base course may be required where silty soils are present at subgrade elevations.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil-related difficulties that could be encountered on the site are discussed below:

- Earthwork construction during the late fall through early spring could be complicated as a result of wet weather and freezing temperatures. Fill/backfill should never be placed while frozen or on frozen ground.

- If the construction schedule requires that construction proceed during adverse weather, typically encountered during fall through spring, the contingency for undercutting disturbed soils should be increased.

- To the extent practical, traffic should be avoided on prepared subgrades to minimize disturbance.

- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.

- Based on observations made during the field exploration (as well as the subsurface information from the soil mapping), we generally do not anticipate that groundwater will be encountered during construction. However, water accumulating at the base of pavement subgrades as a result of precipitation or seepage should be quickly removed, with dewatering means and methods being the contractor's responsibility.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the pavement subgrades will be largely determined by the level of care exercised during pavement subgrade preparation. To check that subgrade preparation and pavement construction proceed in accordance with our recommendations, the following operations should be monitored by CGC or a qualified geotechnical engineer or field technician:

- Fill/backfill placement and compaction;
- Proof-rolling; and
- Asphalt placement.

* * * * *

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.

Tim F. Gassenheimer, PE
Senior Staff Engineer

Ryan J. Portman, PE
Consulting Professional/Field Supervisor

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Exhibit
Logs of Test Borings (15)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compaction Specifications
Appendix E - USDA-NRCS *Web Soil Survey* Soil Map and Legend

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Subsurface conditions for this study were explored by drilling 15 Standard Penetration Test (SPT) soil borings to 5 ft below existing roadway grades, which were sampled at 2.5-ft intervals to the planned termination depth. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D1586, and the specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

   The boring is extended downward, between samples, by a hollow-stem auger.

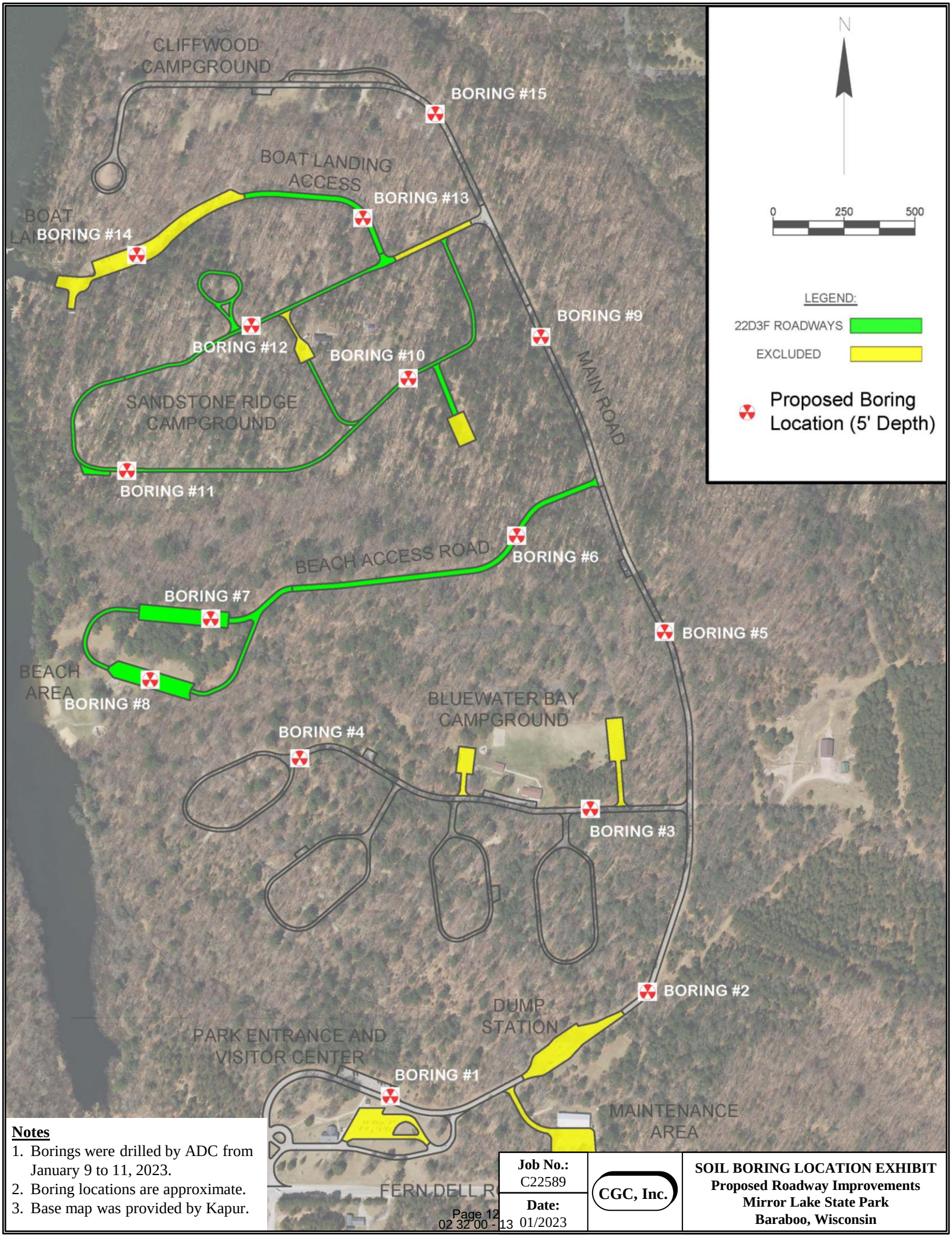
2. Standard Penetration Test and Split-Barrel Sampling of Soils
   (ASTM Designation: D1586)

   This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance. Recovered samples are first classified as to texture by the driller.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not completed for this project, as this task was not part of our work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the boreholes were backfilled in accordance with WDNR regulations, and the soil samples were delivered to our laboratory for visual classification and limited geotechnical laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer, including laboratory test results, along with a Soil Boring Location Exhibit and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

SOIL BORING LOCATION EXHIBIT
LOGS OF TEST BORINGS (15)
LOG OF TEST BORING-GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM



Notes

1. Borings were drilled by ADC from January 9 to 11, 2023.
2. Boring locations are approximate.
3. Base map was provided by Kapur.

Job No.: C22589	CGC, Inc.	**SOIL BORING LOCATION EXHIBIT** **Proposed Roadway Improvements** **Mirror Lake State Park** **Baraboo, Wisconsin**
Date: 01/2023		

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **1**
Surface Elevation (ft) **891.21**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						6± in. Asphalt Pavement / 8± in. Base Course					
1		16	M	23		Medium Dense, Brown Fine to Medium SAND, Some Silt, Little Gravel (SM)					
						Medium Dense, Tan Fine SAND, Trace Silt (SP)					
2		18	M	16							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/9/23** End **1/9/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **2**
Surface Elevation (ft) **894.49**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						3± in. Asphalt Pavement / 6± in. Base Course					
1		12	M	89		FILL: Very Dense, Brown to Tan Fine to Medium Sand, Little Silt, Trace Gravel					
						Medium Dense, Tan Fine SAND, Trace Silt (SP)					
2		18	M	22							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **3**
Surface Elevation (ft) **914.90**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						2.5± in. Asphalt Pavement / 4.5± in. Base Course					
						Medium Dense, Reddish Brown Silty to Clayey Fine SAND, Trace Gravel (SM/SC; Possible Fill or Highly Weathered Sandstone Bedrock)					
1		18	M	12							
2		18	M	21							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **4**
Surface Elevation (ft) **886.33**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						3± in. Asphalt Pavement / 6± in. Base Course					
1		12	M	15		Medium Dense, Tan Fine to Medium SAND, Little Gravel, Trace Silt (SP; Possible Highly Weathered to Weathered Sandstone Bedrock)					
						Dense, Yellowish Brown Fine to Medium SAND, Little Gravel, Trace Silt (SP; Probable Weathered Sandstone Bedrock)					
2		14	M	40							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/11/23** End **1/11/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **5**
Surface Elevation (ft) **919.88**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						3± in. Asphalt Pavement / 5± in. Base Course					
1		18	M	20		Medium Dense, Brown to Orange Brown Fine to Medium SAND, Little to Some Silt, Trace Gravel (SP-SM/SM; Possible Fill or Highly Weathered to Weathered Sandstone Bedrock)					
2		18	M	20		Medium Dense, Orange Brown to Light Gray Fine to Medium SAND, Trace Silt and Gravel (SP; Probable Highly Weathered to Weathered Sandstone Bedrock)					
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **6**
Surface Elevation (ft) **921.43**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE						VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
						3± in. Asphalt Pavement / 6± in. Base Course					
1		14	M	24		Medium Dense to Very Dense, Light Gray to Light Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM; Probable Weathered Sandstone Bedrock)					
2		5	M	50/5"							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **7**
Surface Elevation (ft) **891.74**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						4± in. Asphalt Pavement / 4± in. Base Course					
						Medium Dense, Brown Fine to Medium SAND, Some Silt, Trace Gravel (SM)					
1		18	M	13							
2		14	M	11							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **8**
Surface Elevation (ft) **872.44**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						2.5± in. Asphalt Pavement / 4± in. Base Course					
						Medium Dense, Tan to Yellowish Brown Fine SAND, Trace Silt (SP)					
1		18	M	12							
2		18	M	12							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **9**
Surface Elevation (ft) **925.42**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						3.5± in. Asphalt Pavement / 5± in. Base Course					
1		12	M	30		Dense to Very Dense, Tan to Reddish Brown Fine to Coarse SAND, Some Gravel, Trace Silt (SP; Probable Weathered Sandstone Bedrock)					
2		6	M	50/2"	5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **10**
Surface Elevation (ft) **902.45**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						4± in. Asphalt Pavement / 5± in. Base Course					
1		10	M	13		Medium Dense, Dark Brown Organic SILT, Some Sand, Little Gravel (OL; Probable Buried Topsoil or Fill)		13.3			5.0
						Loose, Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM)					
2		10	M	7							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/11/23** End **1/11/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **11**
Surface Elevation (ft) **874.13**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						4.5± in. Asphalt Pavement / 4.5± in. Base Course					
1		18	M	12		Medium Dense, Brown Fine SAND, Little Silt, Trace Gravel (SP-SM)					
						Medium Dense, Light Gray to Light Brown Fine to Medium SAND, Little Silt and Gravel (SP-SM; Probable Highly Weathered to Weathered Sandstone Bedrock)					
2		18	M	12							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/11/23** End **1/11/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **12**
Surface Elevation (ft) **916.31**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						5± in. Asphalt Pavement / no apparent Base Course					
						Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt, Little Gravel (SM)					
1	■	14	M	8							
2	■	18	M	26							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/11/23** End **1/11/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **13**
Surface Elevation (ft) **892.66**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						4± in. Asphalt Pavement / 3± in. Base Course					
						Medium Dense, Brown SILT, Little to Some Sand (ML)					
1		18	M	11							
						Loose, Reddish Brown/Brownish Gray (Mottled) SILT, Trace Sand (ML)					
2		14	M	9							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **14**
Surface Elevation (ft) **860.19**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						4.5± in. Asphalt Pavement / 4.5± in. Base Course					
1		10	M	42		Medium Dense to Dense, Tan to Reddish Brown Fine to Coarse SAND, Some Gravel, Trace Silt (SP; Probable Weathered Sandstone Bedrock)					
2		18	M	14							
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC Inc.

LOG OF TEST BORING

Project **Proposed Roadway Improvements**
Mirror Lake State Park
Location **Baraboo, Wisconsin**

Boring No. **15**
Surface Elevation (ft) **902.02**
Job No. **C22589**
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE No.	TYPE	Rec (in.)	Moist	N	Depth (ft)	VISUAL CLASSIFICATION and Remarks	qu (qa) (tsf)	W	LL	PL	LI
						4± in. Asphalt Pavement / 5± in. Base Course					
1		14	M	29		FILL: Medium Dense, Gray Gravelly Fine to Coarse Sand, Little Silt					
						Medium Dense, Reddish Brown/Brownish Gray (Mottled) SILT, Trace Sand (ML)					
2		10	M	17		Medium Dense, Tan to Yellowish Brown Fine to Coarse SAND, Some Gravel, Trace Silt (SP; Probable Weathered Sandstone Bedrock)					
					5	End of Boring at 5 ft Borehole Backfilled with Drill Cuttings; Surface Patched with Asphalt Cold Patch					

WATER LEVEL OBSERVATIONS

While Drilling ▽ **NW** Upon Completion of Drilling **NW**
Time After Drilling
Depth to Water ▼
Depth to Cave in

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

GENERAL NOTES

Start **1/10/23** End **1/10/23**
Driller **ADC** Chief **KD** Rig **CME-55**
Logger **DB** Editor **TFG**
Drill Method **2.25" HSA; Autohammer**

CGC, Inc.

LOG OF TEST BORING

General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12”	Larger than 12”
Cobbles	3” to 12”	3” to 12”
Gravel: Coarse	¾” to 3”	¾” to 3”
Fine	4.76 mm to ¾”	#4 to ¾”
Sand: Coarse	2.00 mm to 4.76 mm	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm	#200 to #40
Silt	0.005 mm to 0.074 mm	Smaller than #200
Clay	Smaller than 0.005 mm	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	“N” Value
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace	0% - 5%
Little	5% - 12%
Some	12% - 35%
And	35% - 50%

Consistency

Term	q_u-tons/sq. ft
Very Soft	0.0 to 0.25
Soft	0.25 to 0.50
Medium	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic	Less than 4%
Organic Silt/Clay	4 – 12%
Sedimentary Peat	12% - 50%
Fibrous and Woody Peat	More than 50%

Plasticity

Term	Plastic Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6” penetrations of the 2” split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30” and is seated to a depth of 6” before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

CS – Continuous Sampling
RC – Rock Coring: Size AW, BW, NW, 2”W
RQD – Rock Quality Designation
RB – Rock Bit/Roller Bit
FT – Fish Tail
DC – Drove Casing
C – Casing: Size 2 ½”, NW, 4”, HW
CW – Clear Water
DM – Drilling Mud
HSA – Hollow Stem Auger
FA – Flight Auger
HA – Hand Auger
COA – Clean-Out Auger
SS - 2” Dia. Split-Barrel Sample
2ST – 2” Dia. Thin-Walled Tube Sample
3ST – 3” Dia. Thin-Walled Tube Sample
PT – 3” Dia. Piston Tube Sample
AS – Auger Sample
WS – Wash Sample
PTS – Peat Sample
PS – Pitcher Sample
NR – No Recovery
S – Sounding
PMT – Borehole Pressuremeter Test
VS – Vane Shear Test
WPT – Water Pressure Test

Laboratory Tests

q_a – Penetrometer Reading, tons/sq ft
q_a – Unconfined Strength, tons/sq ft
W – Moisture Content, %
LL – Liquid Limit, %
PL – Plastic Limit, %
SL – Shrinkage Limit, %
LI – Loss on Ignition
D – Dry Unit Weight, lbs/cu ft
pH – Measure of Soil Alkalinity or Acidity
FS – Free Swell, %

Water Level Measurement

▽ - Water Level at Time Shown
NW – No Water Encountered
WD – While Drilling
BCR – Before Casing Removal
ACR – After Casing Removal
CW – Cave and Wet
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)		
		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)		
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)		
		SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)		
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more 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 of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

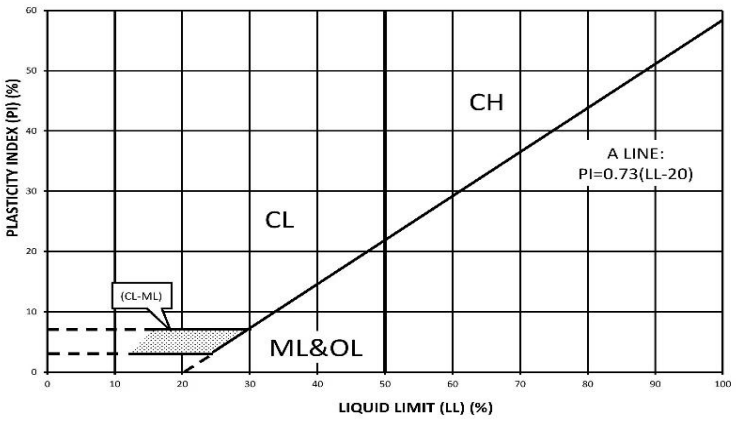
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limts below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limts above "A" line or P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with P.I. greater than 7	

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

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C
DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

READ THE FULL REPORT

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most

effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the confirmation-dependent recommendations included in your report. *Those confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and constructors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

ENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in the Geotechnical Business Council (GBC) of Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of GBC, for more information.

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Geotechnical Business Council
of the Geoprofessional Business Association
8811 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTION SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

Table 1
Gradation of Special Fill Materials

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55			
No. 40			5-20	8-28	10-35	75 (2)		
No. 100						15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction.*
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

Table 2
Compaction Guidelines

Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

Notes:

1. Based on Modified Proctor Dry Density (ASTM D 1557)

APPENDIX E

UNITED STATES OF AGRICULTURE – NATURAL RESOURCES CONSERVATION SERVICES *WEB SOIL SURVEY* MAP AND LEGEND

Soil Map—Sauk County, Wisconsin
(Mirror Lake State Park)

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Sauk County, Wisconsin
Survey Area Data: Version 21, Sep 6, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 13, 2020—Aug 16, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1224F	Boone-Elevasil complex, 15 to 45 percent slopes, rocky	14.2	5.5%
BoC	Boone sand, 6 to 12 percent slopes	29.6	11.5%
BoD	Boone sand, 12 to 30 percent slopes	10.1	3.9%
ElB	Elevasil sandy loam, 2 to 6 percent slopes	70.9	27.5%
ElD2	Elevasil sandy loam, 12 to 20 percent slopes, moderately eroded	60.4	23.4%
EmA	Eleva variant sandy loam, 0 to 3 percent slopes	4.3	1.7%
HxB2	Hixton silt loam, 2 to 6 percent slopes, moderately eroded	4.8	1.9%
PelA	Pelkie loamy fine sand, river valleys, 0 to 3 percent slopes, occasionally flooded	1.2	0.5%
PfB	Plainfield loamy sand, river valley, 1 to 6 percent slopes	36.7	14.2%
PfC	Plainfield loamy sand, 6 to 12 percent slopes	4.5	1.8%
PfD	Plainfield loamy sand, 12 to 30 percent slopes	3.6	1.4%
W	Water	13.6	5.3%
WiEvA	Winterfield-Evart complex, river valleys, 0 to 3 percent slopes, frequently flooded	3.9	1.5%
Totals for Area of Interest		**257.8**	**100.0%**

SECTION 02 41 13
DEMOLITION
BASED ON DFD MASTER SPECIFICATION DATED 5/20/2025

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the demolition of site work and such features as required in these specifications and on the drawings. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals
- Record Drawings
- Safety
- Permits
- Disconnection of Services
- Removal/Salvaging of Items

PART 2 - MATERIALS
- Equipment

PART 3 - EXECUTION
- Protection of Existing Work and Facilities
- Demolition
- Building Demolition
- Demolition Below Grade
- Demolition Backfill
- Drain Tile
- Transportation and Disposal of Demolition Waste

RELATED WORK

Applicable provisions of the General Conditions and Division 01 shall govern work under this section.

Related Work Specified Elsewhere:

- Section 01 74 19 – Construction Waste Management
- Section 31 22 16.15 – Roadway Subgrade Preparation
- Section 31 25 00 – Erosion Control
- Section 32 11 23.33 – Dense Graded Base

SUBMITTALS

For utilities or other services requiring removal or abandonment in-place, submit materials documenting completion of such work.

Submit record drawings.

Submit copies of records documenting recycling or disposal of demolition materials from the site.

RECORD DRAWINGS

Maintain record drawings showing actual locations of utilities and other features encountered, and any deviations from the original design. Show actual limits of removal and demolition.

SAFETY

Verify that all gas and electrical utilities have been abandoned or disconnected and associated hazards mitigated, prior to beginning any demolition.

Take all necessary precautions while dismantling piping containing gas, gasoline, oil or other explosive or toxic fluids or gases. Purge lines and contain materials in accordance with all applicable regulations. Store such piping outdoors until fumes are removed.

Maintain a clean and orderly site. Remove debris at end of each workday.

PERMITS

Unless otherwise noted, Contractor shall be responsible for obtaining and paying for all permits necessary to complete demolition work.

If necessary, file and maintain a copy of the Notification of Demolition and/or Renovation and Application for Permit Exemption (WDNR Form 4500-113) in accordance with the Wisconsin Administrative Code Chapter NR447. Any complete structure demolition or removal of load-bearing components will require filing.

DISCONNECTION OF SERVICES

Prior to starting removal and/or demolition operations, Contractor is responsible for and shall coordinate disconnection of all existing utilities, communication systems, alarm systems and other services.

Disconnect all services in a manner which insures continued operation in any facilities not scheduled for demolition.

Disconnect all services in a manner which allows for future connection to that service where applicable.

Disconnect services to equipment at unions, flanges, valves, or fittings wherever possible.

REMOVAL/SALVAGING OF ITEMS

Carefully remove all items that are scheduled to be salvaged.

Secure salvaged items to allow for future movement; provide pallets, skids and other devices as necessary. Secure all loose parts.

Provide crates, padding, tarps and other measures necessary to protect salvaged items during storage. Store items in a secure location, safe from vandalism, weather, dust and other adverse elements.

Where salvaged items are indicated to be turned over to Owner, deliver to location on property where designated by Owner.

Where indicated to be incorporated into new work, store the salvaged item in a secure location until the trade responsible for re-installation mobilizes equipment and/or storage facilities to the site, or otherwise accepts responsibility for the salvaged item.

PART 2 - MATERIALS

EQUIPMENT

Use Contractor's normal equipment for demolition purposes and which meets all safety requirements imposed on such equipment.

PART 3 - EXECUTION

PROTECTION OF EXISTING WORK AND FACILITIES

Take all measures necessary to safeguard all existing features and facilities which are outside the limits of the work.

Furnish and install fencing or other barriers as shown on the drawings or as otherwise necessary to protect existing features.

Verify the locations of, and protect, any buildings, structures, utilities, paved surfaces, signs, streetlights, utilities, landscaping and all other such facilities that are intended to remain or be salvaged.

Make such explorations and probes as necessary to ascertain any required protection measures that shall be used before proceeding with demolition.

Provide and maintain adequate catch platforms, warning lights, barricades, guards, weather protection, dust protection, fences, planking, bracing, shoring, piling, signs, and other items required for proper protection.

Provide protection for workmen, public, adjacent construction and occupants of existing building(s).

Report damage of any facilities or items scheduled for salvaging to the DFD Construction Representative.

Explosives shall not be used for demolition.

Keep streets, walks and all other adjacent paved areas clean and swept clear of dirt, mud and debris deposited as a result of this operation.

Protect surrounding area from dust. Control rodents, and other vermin associated with demolition operations.

DEMOLITION

Remove all equipment, fixtures and other materials scheduled for salvage prior to beginning demolition operations.

Demolish and remove all buildings and structures scheduled for demolition as shown on the drawings.

Abandon gas, electric and communication utilities in accordance with local utility company requirements, or applicable substantive requirements if considered private.

Carry out vehicle loading as necessary within the project boundaries or as defined or indicated on the drawings, but not in locations that block vehicular traffic on the streets or pedestrian traffic on adjacent public walks.

Conduct demolition operations and the removal of rubbish and debris in such a way that a minimum of nuisance dust is caused. Constantly sprinkle rubbish and debris with water if necessary to keep nuisance dust to a minimum.

Where necessary to prevent collapse of any construction, install temporary shores, underpinning, struts or bracing. Do not commence demolition work until all temporary construction is complete.

At all times during the execution of the work, provide, operate, and maintain all pumping equipment, suction and discharge lines in a number and capacity as required to keep all cellars and pits free of water from any source.

Masonry and concrete shall be demolished in small sections. Use braces and shores as necessary to support the inegrity of the building or structure and protect it from damage. Where limits of demolition are exposed in the finished work, cutting shall be made with saws, providing an absolutely straight line, plumb, true and square.

Operate equipment in a manner to minimize damage to concrete or asphalt which is to remain, and to keep dust and dirt to a minimum.

BUILDING DEMOLITION

Proceed with demolition in a systematic manner, from top of structure to ground. Complete demolition work above each floor or tier before disturbing supporting members on lower levels.

Neatly saw or cut joints at the limits of removal; whenever possible, locate cuts at existing joints.

Cut existing plaster with power saws equipped with plaster cutting blades and dust collection system.

Patch or repair any damaged surfaces or structural members at the limits of removal.

Remove structural framing members and lower to ground by hoists, derricks or other suitable means.

Remove all existing flooring in accordance with drawings. Leave exposed existing sub-flooring or surface in suitable condition to receive new finished flooring.

Locate demolition equipment and remove structure in a manner which avoids excessive loads to supporting walls, floors or framing.

Demolish and remove concrete slabs-on-grade, unless otherwise shown to remain.

DEMOLITION BELOW GRADE

Demolish foundation walls and other below grade features in accordance with the drawings. Unless otherwise noted, remove all below grade features to a point 4’ below adjoining existing grade, or proposed grade, whichever is lower. Any features abandoned 4’ and below must be documented and approved by the A/E and DFD Construction Representative.

DEMOLITION BACKFILL

Backfill and compact below grade areas and voids resulting from demolition of structures and other abandonment and demolition.

Backfilling shall not begin until demolition and abandonment has been approved and documented by the DFD Construction Representative.

Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen materials, trash and debris.

Backfill type, lift thickness and compaction requirements shall be in accordance with Section 31 20 00 – Earthmoving, Section 31 22 16.15 – Roadway Subgrade Preparation, or 32 11 23.33 – Dense Graded Base depending on the criteria.

DRAIN TILE

Carefully protect and/or replace drain tiles encountered during demolition which are necessary to maintain site drainage conditions. Immediately repair or replace any damaged drain tiles not scheduled for demolition. Report damage to the DFD Construction Representative. Repairs to drain tile or replacement drain tile shall be comparable or better than the existing drain tile system.

Test drain lines with water to assure free-flow before covering. Remove all identified obstructions, retest until satisfactory.

TRANSPORTATION AND DISPOSAL OF DEMOLITION WASTE

Transport and dispose of all demolition waste in accordance with local, state, and federal guidelines.

Recycle demolition waste whenever possible, or as otherwise required by the Contract Documents. See Section 01 74 19 – Construction Waste Management

Demolition waste shall be disposed of at a landfill or dumpsite designed and approved to accept the given waste.

Maintain records documenting the recycling and/or disposal of demolition waste. Record the description of material, date removed, quantity removed, method of transport and recycling/disposal destination.

END OF SECTION

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SECTION 03 30 10
CAST-IN-PLACE CONCRETE FOR SITE WORK
BASED ON DFD MASTER SPECIFICATION DATED 5/1/2025

PART 1 GENERAL

SCOPE
The work under this section consists of providing all work, materials, labor and supervision necessary to provide cast-in-place concrete as required for site concrete such as curb and gutter, steps, pavement, pole bases, and exterior flatwork and ancillary concrete. Included in the section are the following topics:

RELATED WORK
Applicable provisions of Division 01 govern work under this Section.

Related work specified elsewhere:
- 30 05 00 – Common Work Results for All Exterior Work
- 32 11 23.33 – Dense Graded Base

REFERENCES
Incorporated Guides and References
- American Concrete Institute (ACI):
  - ACI 304R – Guide for Measuring, Mixing, Transporting and Placing Concrete.
  - ACI 305R - Hot Weather Concreting.
  - ACI 306R – Cold Weather Concreting.
  - ACI 309R – Guide for the Consolidation of Concrete.
  - ACI 347 – Guide to Formwork for Concrete.
- State of Wisconsin, Department of Transportation (WisDOT):
  - Standard Specifications for Highway and Structure Construction (SSHSC)
  - Construction and Materials Manual (CMM)

SUBMITTALS

Mix Design: Submit mix design for review at least ten days prior to use. Mix design shall be derived from tests performed by a qualified testing laboratory or from previous tests performed on aggregate from same source.

Product Data: Submit product data for joint fillers, curing compound, admixtures, reinforcing, and all other concrete components.

Delivery Tickets: Submit delivery tickets to DFD Project Representative for each load of concrete delivered to project.

Test Reports: Submit reports for laboratory and field tests required under "Testing" article.

Joint Layout Plan: Submit a joint layout plan for approval prior to starting work.

Make submittals in accordance with Division 01.

QUALITY ASSURANCE

Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

Manufacturer certified according to National Ready Mixed Concrete Association's "Certification of Ready Mixed Concrete Production Facilities."

Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

TESTING

Contractor shall arrange and pay for concrete testing by a qualified testing agency, acceptable to State and independent of Contractor.

Testing agency shall test concrete to measure slump, entrained-air content, temperature, and compressive strength to determine compliance with specifications. Furnish test apparatus and cylinders, perform on-site sampling and testing, and have compressive strength cylinders tested by a qualified laboratory.

- On-site tests shall be performed under observation of A/E or DFD Project Representative unless waived.
- Perform slump, air content, and temperature tests prior to concrete placement each day, whenever there is a change in consistency of concrete, and when concrete cylinders are prepared. If measured slump, air content, or temperature falls outside specified limits, immediately check another portion of same batch. In event of a second failure, concrete shall be rejected.
- During progress of work, prepare at least three test cylinders per **100 cu yd** fraction thereof for each class of concrete placed each day. Identify samples, moist cure in accordance with ASTM C31, and ship samples to testing laboratory for one 7-day compressive strength test and two 28-day tests.
- Test procedures shall be in accordance with ASTM C31, C39, C143, C172, C231, and C1064.
- Cost of tests, including materials and transportation, shall be paid by Contractor and shall be considered incidental to the various items of concrete work.

The Quality Management Program (QMP) provisions of the referenced WisDOT SSHSC sections do not apply to this concrete work.

NOTIFICATION

Notify DFD and AE 48 hr. prior to placing any concrete.

PART 2 PRODUCTS

CONCRETE

Concrete shall be in accordance with WisDOT SSHSC, Section 501, for grade A, air entrained concrete.

CLASS	Min. Comp. Strength, PSI	Slump, In.	Min. Cement. Lbs/ Cu Yd	Max. Water-Cement Ratio	Air Content, % By Volume	Use
A	4,000 (28-day)	1-4, 2 ½ for slip form	565	0.45	6-8	Pavements, curbs, sidewalks, slabs, pole bases, manhole benches
HES	3,000 (3-day)	1-3	660	0.45	6-8	High Early

Use epoxy coated rebar unless otherwise specified.

REINFORCEMENT

Reinforcing Bars and Tie Bars: ASTM A615, Grade 60, deformed steel bars, epoxy-coated in accordance with ASTM A775, with less than 2 percent damaged coating in each 12-inch bar length.

FORMS

Forms may be either stationary or slip-form type. If slip forms are used, finished product shall be of quality equal to that produced by stationary forms.

Provide forms of steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects, extending full depth of concrete.

Use flexible spring steel forms or laminated boards to form radius bends as required.

Coat forms with a form release agent which will not discolor or deface surface of concrete.

EXPANSION JOINT FILLER

Expansion joint filler meeting requirements of WisDOT SSHSC, Subsection 415.2.

CURING COMPOUND

Curing compounds and curing agents meeting requirements of WisDOT SSHSC, Subsection 415.2.

ADMIXTURES

Admixtures to be used in the concrete mixture shall be submitted for approval as part of the mixture design. No other admixtures will be allowed except those listed without the A/E's approval.

Air-Entraining Admixture: ASTM C 260/C 260M.

Water reducing admixture shall conform to ASTM C494, Class A.

Other admixtures which do not adversely affect strength and durability of concrete may be used with permission of A/E, if used in strict accordance with manufacturer's instructions. Care shall be exercised to ensure that the admixture does not increase or decrease air content outside of allowable limits. Do not use salt or chemical anti-freeze admixtures.

PART 3 EXECUTION

PREPARATION FOR CONCRETE

Remove loose material from compacted subgrade. Proof-roll subgrade; give notice of unstable areas. Moisten subgrade to provide a uniformly damp condition.

Set clean forms to required grades and lines, rigidly braced and secured. Provide minimum concrete thicknesses as indicated on Drawings.

Check tolerances as follows (slip form methods shall produce equivalent results):

- Top of form: 1/8 in. in 10 ft.
- Alignment of vertical face: 1/4 in. in 10 ft.

Adjust manholes and utility structures to grade.

JOINTS

General: Form construction, expansion, 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.

- When abutting existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

Joint Layout: Provide a joint layout plan for approval by the AE.

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 expansion joints.

- Provide tie bars at sides of paving strips where indicated.
- Drill and epoxy tie bars where new concrete abuts existing concrete, as shown. If not shown, then provide two tie bars for curb and gutter and provide tie bars at 24” on center at other locations. Tie bars must be minimum of 18” with 6” embedment unless otherwise shown. Tie bars shall be minimum #4 size.
- Butt Joints: Provide butt joints for joints not subject to traffic. Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys for joints subject to traffic, except where doweled joints are designated. Embed keys at least 1-1/2 in. into concrete.

Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete radius points, catch basins, manholes, inlets, structures, existing concrete, other fixed objects, and where indicated.

- Locate additional expansion joints in curb and gutter at a maximum of 300 ft on center, unless otherwise indicated. Locate additional expansion joints in other concrete work at a maximum of 100 ft on center, unless otherwise indicated.
- Extend joint fillers full width and depth of joint.
- Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
- Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
- 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.

Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to one-fourth to one-third of the concrete thickness by forming or sawing.

- Formed Joints: Form contraction joints by using parting strips or by grooving to depth shown on details, or herein.
- Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- Locate joints in curbs and gutters at between 12 ft and 20 ft on center, unless otherwise shown. Joints in sidewalks shall be a distance equal to the sidewalk width, but no more than 7 ft on center.
- Locate joints in pavements as shown on the Drawings. Joints shall be continuous across slab, unless interrupted by an expansion joint. If not shown, then develop a joint layout plan.

CONCRETE PLACEMENT

Mix and place concrete in accordance with the following.

Place concrete in accordance with the most stringent of either ACI 304 or this section.

Concrete must be placed within the timeframe specified in WisDOT SSHSC 501. Retarders may be used if approved by the DFD Project Representative and AE.

Before placing concrete, remove debris, ice, snow, and other foreign materials from the subgrade or formwork.

Remove standing water from subgrade. Dry and compact subgrade in accordance with the requirements of Division 2. Do not place concrete on soft or frozen subgrade.

Place and secure steel reinforcement prior to placing concrete.

Position and secure expansion joint material, sleeves, waterstops and other embedded items prior to placing concrete. Place embedded items in accordance with the most stringent of either drawings or manufacturer recommendations.

Apply bonding agent to existing concrete surfaces requiring a bond with new concrete.

Convey concrete from truck to final position by method that will prevent separation. Unless otherwise approved, limit free fall of concrete to 4’ maximum height to avoid separation.

Place concrete continuously so that concrete is deposited on or adjacent to concrete that is still plastic. When placing of concrete is temporarily halted or delayed, provide construction joints.

Place concrete in lifts not exceeding 12”.

Consolidate concrete by mechanical vibration. Allow vibrator to penetrate the full depth of the slab or lift. Overlap previously vibrated areas by 25%.

After striking off and consolidating concrete, smooth surface by screeding and floating. Test surface for trueness with a 10 ft straightedge. Remove surface irregularities and refloat repaired areas to provide a continuous, smooth finish of uniform texture.

Work edges of slabs and formed joints with edging tool to form a 1/4 in. radius.

After floating and when excess moisture has disappeared, provide broom finish by drawing a fine-hair broom perpendicular to direction of travel.

After 24 hours, remove forms, clean ends of joints, and repair honeycombed areas by means approved by the AE.

CONCRETE CURB AND GUTTER

Concrete work shall meet the requirements of Division 3, and WisDOT SSHSC, Sections: 601 - Concrete Curb and Gutter.

Provide curb and gutter as shown on the drawings and transition to match adjacent existing curb and gutter.

Construct joints true-to-line with face perpendicular to surface. Construct transverse joints at right angles to centerline, unless otherwise shown.

When abutting to existing walks, align transverse joints with previously placed joints, unless otherwise shown.

Where curb and gutter are located adjacent to sidewalks, provide a continuous ½" thick expansion joint.

The location and type of joints in curb and gutter shall match joints in adjacent pavement whenever possible.

SIDEWALKS

Concrete work shall meet the requirements of Division 3, and WisDOT SSHSC, Sections: 602.

Provide Standard Duty concrete sidewalk with a minimum thickness shown on the plans for all sidewalks with little or no motorized vehicle traffic. If no thickness is shown on the plans, then provide a minimum of 6-inches.

Provide Heavy Duty concrete for concrete drives, fire lanes, handicap ramps, the concrete walk through driveways, and any pavement subject to vehicular traffic, with a minimum concrete pavement thickness as shown on the plans. If no thickness is shown on the plans, then provide a minimum of 7-inches.

Unless otherwise shown on the drawings, provide all walks with a cross slope of 1/4" per foot and scored contraction joints of width approximately equal to the length.

Provide expansion joints between the walk and the back of the abutting parallel curb. Provide expansion joints where abutting existing concrete pavements as directed by DFD Project Representative.

Dowel replacement concrete adjacent to existing slabs or to building walls or retaining walls with epoxy coated reinforcing rod set into the new slab 12" and into the structural wall 4" at 18" on centers.

Provide a boxed out square 12" larger than the casting, where manholes or valve boxes occur in a walk.

Unless otherwise noted, joint all replacement concrete work to match adjacent work. Generally provide square layout of joints, subject to the DFD Project Representative's approval. Consult with AE and DFD Project Representative before laying out joints for large areas and areas of intersecting walks.

Hand tool all joints outside of concrete pavement areas.

Remove and replace, at no cost to the Owner, any adjacent slabs not noted for removal, but which are broken or cracked by the Contractor's activities.

Contractor shall review sidewalk grades with the AE prior to concrete placement to verify that positive drainage will be provided. Contractor shall provide minor adjustment of sidewalk grades as requested by the AE to provide positive drainage. Minor adjustments of up to 3" +/- in elevation shall be considered incidental. Contractor shall be responsible for remedial actions required to provide positive drainage for all areas identified following placement of surface materials where this requirement has not been met.

CONCRETE PAVEMENT

Construct concrete pavement (roads, driveways, parking areas) per WisDOT SSHSC, Subsection 415.3. WisDOT SSHSC, Subsection 415.3 supersedes Part 3 of Section 03 30 10 if a discrepancy arises.

COLD WEATHER PLACING

Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified below.

1. When air temperature falls 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 60 deg F (50 deg F for heavy sections) and not more than 90 deg F at point of delivery.

- Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Verify forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.
- During seasons when atmospheric temperatures may be expected to drop below 40 deg F, concrete shall be protected by covering with impermeable paper and not less than 12 in. of loose dry hay or straw or thick insulating blankets. Retain covering for ten days.

HOT WEATHER PLACING

When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified below.

- Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated in total amount of mixing water.
- Cover reinforcing steel with water-soaked burlap if it becomes too hot to prevent steel temperature from exceeding the ambient air temperature immediately before embedment in concrete.
- Spray forms, reinforcing steel, and subgrade just before concrete is placed.
- Do not use set-control admixtures, unless approved by A/E.

CURING

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Cure formed and unformed concrete for seven days or until 75 percent of the required 28-day compressive strength is obtained, whichever is less.

For standard gray concrete, methods may include plastic sheets, constant wetting of surface with water, curing paper, or commercial curing compound. Apply curing compound at not less than 200 sq ft per gal in accordance with manufacturer's recommendations.

REPAIR AND PROTECTION

Analyze and repair defects or deficiencies per Section 424 of the WisDOT CMM. Repair or replace broken or defective concrete. Remove surface stains.

Exclude traffic from concrete until the specified curing period is complete (generally 7 days). Protect concrete from damage until Substantial Completion.

Prior to final inspection, sweep concrete and wash free of stains, dirt, and other foreign materials.

FIELD QUALITY CONTROL

Provide testing as described in Quality Assurance and Testing sections above.

Concrete Delivery Tickets: For each load delivered, collect and submit three copies of delivery tickets that include the reporting requirement of ASTM C94/C94M and include additional information as specified. Record jobsite addition of water or admixtures with a signature of person requiring the adjustment.

Compressive Strength Specimens: ASTM C31/C31M:

For strength specimens to be standard cured for acceptance of concrete, cast a set of cylinders and cure specimens at the jobsite in accordance with ASTM C31/C31M. Cast at least two specimens for each age that strength will be tested for information and additional reserve specimens as needed. Strength test results at the designated age shall be the average of two 6 × 12-in. or three 4 × 8-in. specimens.

If required, cast additional sets of cylinders for field-curing in accordance with ASTM C31/C31M

Transport specimens to the lab within 48 hours after casting and cure them in accordance with final curing requirements of ASTM C31/C31M until tested.

Compressive-Strength Tests: ASTM C39/C39M.

Test specimens for compressive strength at 7 days or at an alternative early age as required and one set at 28 days or at an alternate test age as designated for specified strength.
Acceptance of concrete shall be based on strength test results of standard cured cylinders in accordance with ASTM C31 and tested at 28 days in accordance with ASTM C39. Strength test results at the designated age shall be the average of two 6 × 12 inch or three 4 × 8 inch specimens.

When strength cylinders are made, tests of slump, air content, temperature and density shall be made and recorded with the strength test results.

Strength of each concrete class shall be deemed satisfactory when both of the following criteria are met:

The average of three consecutive compressive-strength tests equals or exceeds specified compressive strength.

Any individual compressive-strength test result does not fall below specified compressive strength, $f'c$:

by more than 500 psi when $f'c \leq 5000$ psi

by more than $0.1f'c$ when $f'c > 5000$ psi

When compressive strength tests fail to meet the provisions of (d), follow procedure in ACI 301 for evaluation of concrete strength tests.

When it is deemed necessary to evaluate the adequacy of concrete strength, at least 3 cores shall be obtained from the portion of the structure represented by the low strength tests. Cores shall be removed and conditioned in accordance with ASTM C42. The strength of cores shall comply with the following:

Average strength of 3 cores $\geq 0.85f'c$

Individual core strength $\geq 0.75f'c$

A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

Additional Tests:

Testing and inspecting agency to 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 Architect.

Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents. Concrete loads that do not meet the on-site field test criteria will be rejected.

END OF SECTION

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SECTION 07 92 00
JOINT SEALANTS

PART 1 – GENERAL

SCOPE

The work included under this Section shall include all labor, materials and equipment necessary to execute and complete joint sealants for applications herein specified and as shown on the drawings. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals
- Quality Assurance
- Delivery, Storage and Handling
- Project Conditions
- Warranty

PART 2 - MATERIALS
- Materials
- Urethane Joint Sealants
- Joint Sealant Backing
- Miscellaneous Materials

PART 3 - EXECUTION
- Preparation
- Application
- Sealant Installation
- Cleanup

RELATED WORK

Applicable provisions of Division 1 shall govern work of this section.

Section 03 30 10 – Cast In-Place Concrete for Site Work

SUBMITTALS

Product Data & Test Reports: For each joint-sealant product indicated.

Samples: For each kind and color of joint sealant required.

Joint-Sealant Schedule: Include the following information:

- Joint-sealant application, joint location, and designation.
- Joint-sealant manufacturer and product name.
- Joint-sealant formulation.
- Joint-sealant color.

Warranties

QUALITY ASSURANCE

Applicators shall be trained, experienced technicians thoroughly knowledgeable in the procedures of joint sealing.

Mix and apply sealants in strict accordance with the manufacturer's printed directions.

Do not use sealant materials that have been stored for a period of time exceeding the maximum recommended shelf life of the materials.

DELIVERY, STORAGE AND HANDLING

This Contractor shall furnish, deliver, unload and install all caulking and sealing compounds to the job site in unbroken, sealed containers bearing the manufacturer's mixing directions. Store materials in sealed containers in a dry protected area above the ground or floor.

PROJECT CONDITIONS

Examine drawings and verify that all joints are properly detailed and proportioned for expansion and/or control, as recommended in writing by the sealant manufacturer. Immediately notify the Architect/Engineer of any deviations.

Do not proceed with the installation of sealants under adverse weather conditions when joint to be sealed is damp, wet or frozen, or when temperatures are above or below manufacturer's recommended limitations.

Every attempt shall be made to apply sealants in a 72° Fahrenheit “neutral” temperature environment, when joints are at a median opening, so that the greatest efficiency of sealant to subsequent joint movement can be obtained.

WARRANTY

Sealant Warranty: Provide written warranty on Manufacturer’s standard form, signed by manufacturer and installer agreeing to, within warranty period of five years after date of substantial completion, replace/repair defective materials and workmanship defined to include: instances of leakage of water or air; failures in joint adhesion, material cohesion, abrasion resistance, strain resistance, or general durability; failure to perform as required; and the general appearance of deterioration in any other manner not clearly specified in manufacturer’s published product literature as an inherent characteristic of the sealant material.

Warranty Period: Five years from date of Substantial Completion.

PART 2 – MATERIALS

MATERIALS

Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

URETHANE JOINT SEALANTS

Urethane Joint Sealant: ASTM C 920.

Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Approved Sealants (Self-Leveling Polyurethane for Concrete Joints):

- BASF Building Systems: Masterseal SL 1
- Pecora: Urexpan NR-200
- Sika USA: Sikaflex-1c SL or 2c SL
- Tremco: THC-901
- Or Approved Equal

Type: Multi Component (M) or Single Component (S)
Grade: Pourable (P)
Class: 25.
Uses Related to Exposure: Traffic (T) and Mortar (M)

Approved Sealants (Polyurethane +/- 25% movement capability or other applications):

- BASF Building Systems: Masterseal NP 1
- Pecora: DynaTrol I-XL
- Sika USA : Sikaflex-1a.
- Tremco : Dymonic or Vulkem 116
- Or Approved Equal

Type: Single Component (S)
Grade: Nonsag (NS).
Class: 25, 35
Uses Related to Exposure: Nontraffic (NT) and Mortar (M).

JOINT SEALANT BACKING

Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

MISCELLANEOUS MATERIALS

Primer: As required, shall be colorless primer made by manufacturer of sealant compound and shall be specifically designed as prime coating for compound furnished.

Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

Joint Backing: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam, or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer. Provide size and shape or rod, which will control joint depth for sealant at bottom of joint, form optimum shape of sealant bead on backside, and provide a highly compressible backer to minimize possibility of sealant extrusion when joint is compressed. Size to be at least 1/3 larger diameter than width of joint.

Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 – EXECUTION

PREPARATION

Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

- Remove laitance and form-release agents from concrete.
- Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

APPLICATION

Joint Backing:
In joints where the depth of the joint exceeds the required depth of the sealant, install joint backing to provide backing and uniform depth of sealant. Place fine sand in joint to required level prior to placing joint backing to prevent backing from settling after applying joint sealant. Joint backing shall be installed with approximately 25% compression. Do not stretch, twist, puncture, or tear joint sealant backing. Butt joint backing material at intersections. Do not leave gaps between ends of sealant backings. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

Bond Breaker:
Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints. Sealant shall adhere only to the sides and not to the back of the joint so as to eliminate three-sided adhesion.

Sealant Installation Standard:
Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

Joints in general shall be ½" wide and ¼" to ½" deep.

Depth of sealant at the center of its cross section shall be uniform and approximately one-half width of sealant with no depth less than one-third the width. Depth of sealant at bond interface shall be uniform and approximately equal to the width of sealant with no depth less than three-quarters the width, except where a bond breaker is used. Back-up shall be subcaulking material or bond breaker tape.

Wherever a caulked joint is required between two surfaces at 90 degrees to one another, sealant shall be provided with proper quarter-round backing to obtain the reduced depth of the sealant required at the center of its cross section. Bond surface width shall be ¼" in this configuration.

Joints must be structurally sound, clean, dry and free of all loose aggregate, oil or other detrimental materials. Clean joints by wire brushing.

Prime (if required) according to manufacturer's instructions. Allow to dry. Control primer flow so that it does not extend beyond joint face.

Sealant work shall not interfere with weep holes for draining water.

SEALANT INSTALLATION

Self-Leveling Sealant - Mix and apply sealants in accordance with manufacturer's application manual and instructions, using hand guns or pouring from can, in clean, dry, properly prepared substrates. Fill joints from the bottom; avoid bridging of the joint which may form air gaps. Sealant will self-level to form a clean joint sealant surface.

Protect newly applied sealant from dirt and traffic overnight.

Polyurethane Sealant - Mix and apply sealants in accordance with manufacturer's application manual and instructions, using hand guns or pressure equipment, with proper nozzle size, in clean, dry, properly prepared substrates. Gun sealant into joint and against sides of joint to make uniform, filling from the deepest point to the surface. Avoid pulling of the sealant from the sides. Fill sealant space completely with sealant.

Tooling is required to ensure maximum adhesion and full contact with the interfaces of the joint. Tool joints to form smooth, uniform beads of slightly concave surfaces. Finished joints shall be straight, uniform, smooth and neatly finished. Remove excess sealant from adjacent surfaces, leaving work in a neat, clean condition. Smears will not be allowed! (Tooling agents shall only be used if recommended by the sealant manufacturer.) Finish internal corners with a coving tool.

Where an irregular surface or sensitive joint border exists, apply masking tape at the edge of the joint to ensure joint neatness and protection. Remove tape after sealant is applied.

Upon completion of the work, all joints shall be neat and watertight with sealant material securely bonded to the side of joints (interfaces) and unbonded to the back-up.

CLEAN UP

Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION

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SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL
BASED ON DFD MASTER ELECTRICAL SPEC DATED 12/26/23

PART 1 - GENERAL

The electrical work included in all other divisions is the responsibility of the contractor performing the division 26 work unless noted otherwise.

PROJECT OVERVIEW

This project consists of construction and demolition of (1) pit toilet building at Mirror Lake State Park in Baraboo, Wisconsin. The primary electrical work associated with the project is the reinstallation of new electrical service to the new building. The existing site underground feeds will be removed/modified accordingly.

SCOPE

The work under this section includes basic electrical requirements, which are applicable to all Division 26 sections. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - GENERAL
- Project Overview
- Scope
- Related Work
- Reference Standards
- Regulatory Requirements
- Quality Assurance
- Continuity of Existing Services and Systems
- Protection of Finished Surfaces
- Approved Electrical Testing Laboratories
- Sleeves and Openings
- Sealing
- State and/or User Agency Furnished Equipment
- Work by State and/or User Agency
- Intent
- Omissions
- Submittals
- Project/Site Conditions
- Work Sequence and Scheduling
- Work by Other Trades
- Offsite Storage
- Salvage Materials
- Certificates and Inspections
- Operating and Maintenance Data
- Record Drawings

PART 2 - PRODUCTS
- Identification

PART 3 - EXECUTION
- Excavation and Backfill
- Concrete Work
- Cutting and Patching
- Building Access
- Equipment Access
- Coordination
- Sleeves and Openings
- Housekeeping and Clean Up
- Agency Training

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCE STANDARDS
Abbreviations of standards organizations referenced in this and other sections are as follows:

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
ETL	Electrical Testing Laboratories, Inc.
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
ISA	Instrument Society of America
NBS	National Bureau of Standards
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
UL	Underwriters Laboratories Inc.
DSPS	Wisconsin Department of Safety and Professional Services

REGULATORY REQUIREMENTS
All work and materials are to conform in every detail to applicable rules and requirements of the Wisconsin State Electrical Code (SPS 316), the National Electrical Code (NFPA 70), other applicable National Fire Protection Association codes, the National Electrical Safety Code, and present manufacturing standards (including NEMA).

All Division 26 work shall be done under the direction of a currently licensed State of Wisconsin Master Electrician.

All Division 26 work shall comply with SPS 101.862 and SPS 305.40 for electrical wiring integral with pre-manufactured structures.

QUALITY ASSURANCE
Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space, and for obtaining the performance from the system into which these items are placed.

Manufacturer references used herein are intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

All materials, shall be listed by and shall bear the label of an approved Nationally Recognized Testing Laboratory (NRTL) as identified by the United States Occupational Safety and Health Administration (OSHA), per the OSHA Nationally Recognized Testing Laboratory Program. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by DFD, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system, shall be so labeled.

CONTINUITY OF EXISTING SERVICES AND SYSTEMS
No outages shall be permitted on existing systems except at the time and during the interval specified by the user agency and by the DFD Project Representative. The institution may require written approval. Any outage must be scheduled when the interruption causes the least interference with normal institutional schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours.

This Contractor shall restore any circuit interrupted as a result of this work to proper operation as soon as possible. Note that institutional operations are on a seven-day week schedule.

PROTECTION OF FINISHED SURFACES

Furnish one can of touch-up paint for each different color factory finish furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

APPROVED ELECTRICAL TESTING LABORATORIES

The following laboratories are approved for providing electrical product safety testing, listing and labeling services as required in these specifications:

A Nationally Recognized Testing Laboratory (NRTL) as identified by the United States Occupational Safety and Health Administration (OSHA), per the OSHA Nationally Recognized Testing Laboratory Program.

SLEEVES AND OPENINGS

Refer to Division 1, General Requirements, Sleeves and Openings.

SEALING

Sealing of sleeves/openings between conduits, cable trays, wireways, troughs, cablebus, busduct, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening.

WORK BY STATE AND/OR USER AGENCY

PCB equipment (other than light fixture ballasts) removal and disposal, if required, will be by the DFD under separate contract.

Electrical testing not described in these contract documents will be by the DFD under separate contract.

INTENT

The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the DFD's intent (as determined by the DFD Project Manager). Refer to the General Conditions of the Contract for further clarification.

It must be understood that the details and drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.

All sizes as given are minimum except as noted.

Materials and labor shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the DFD's and/or A/E's inspections, tests and approval from the commencement until the acceptance of the completed work.

Whenever a particular manufacturer's product is named, it is intended to establish a level of quality and performance requirements unless more explicit restrictions are stated to apply.

OMISSIONS

No later than ten (10) days before bid opening, the Contractor shall call the attention of the DFD to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

SUBMITTALS

Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Failure to do this may result in the submittal(s) being returned to the Contractor for correction and resubmission. Failing to follow these instructions does not relieve the Contractor from the requirement of meeting the project schedule.

On request from the DFD, the successful bidder shall furnish additional drawings, illustrations, catalog data, performance characteristics, etc.

Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

The submittals must be approved before fabrication is authorized.

Submit sufficient quantities of submittals to allow the following distribution:

Operating and Maintenance Manuals	2 copies
User agency	1 copy
A/E	1 copy
DFD Field Office	1 copy

PROJECT/SITE CONDITIONS

Install Work in locations shown on drawings, unless prevented by project conditions.

Prepare drawings showing proposed rearrangement of work to meet project conditions, including changes to work specified in other sections. Obtain permission of DFD before proceeding.

Tools, materials and equipment shall be confined to areas designated by the DFD and user agency.

WORK SEQUENCE AND SCHEDULING

Install work in phases to accommodate user agency's occupancy requirements. During the construction period coordinate electrical schedule and operations with DFD's Construction Representative.

WORK BY OTHER TRADES

Every attempt has been made to indicate in this trade's specifications and drawings all work required of this Contractor. However, there may be additional specific paragraphs in other trade specifications and addenda, and additional notes on drawings for other trades which pertain to this trade's work, and thus those additional requirements are hereby made a part of these specifications and drawings.

Electrical details on drawings for equipment to be provided by others are based on preliminary design data only. This Contractor shall lay out the electrical work and shall be responsible for its correctness to match equipment actually provided by others.

OFFSITE STORAGE

Prior approval by DFD and the A/E will be needed. The contractor shall submit Storage Agreement Form DOA-4528 to DFD for consideration of off-site materials storage. In general, building wire, conduit, fittings and similar rough-in material will not be accepted for off-site storage. No material will be accepted for off-site storage unless shop drawings for the material have been approved.

SALVAGE MATERIALS

No materials removed from this project shall be reused unless specifically noted otherwise. All materials removed shall become the property of and shall be disposed of by the Contractor.

CERTIFICATES AND INSPECTIONS
Obtain and pay for all required installation inspections, except those provided by the DFD, in accordance with the Wisconsin Administrative Code. Deliver originals of these certificates to the DFD's Project Representative.

The Electrical Contractor is responsible for coordination of DFD electrical inspections. Prior to the start of significant on-site electrical work, the contractor shall schedule a pre-installation meeting with the DFD Electrical Inspector to discuss the inspection requirements and review the contract requirements (also see Article 15 of the General Conditions). The Electrical Contractor shall be present when the DFD Electrical Inspector conducts the electrical inspections.

OPERATION AND MAINTENANCE DATA
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. Manufacturer’s wiring diagrams for electrically powered equipment.
2. All required passwords required to gain local access to equipment and controllers.

RECORD DRAWINGS
The Contractor shall maintain at least one copy each of the specifications and drawings on the job site at all times.

The DFD will provide the Contractor with a suitable set of contract drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.

The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.

At completion of the project, the Contractor shall submit the marked-up record drawings to the Architect/Engineer prior to final payment.

PART 2 - PRODUCTS

IDENTIFICATION
See Electrical section 26 05 53 – Identification for Electrical Systems.

PART 3 - EXECUTION

EXCAVATION AND BACKFILL
Perform all excavation and backfill work to accomplish indicated electrical systems installation unless noted otherwise.

CONCRETE WORK
The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

CUTTING AND PATCHING
Refer to Division 1, General Requirements, Cutting and Patching.

BUILDING ACCESS
Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

EQUIPMENT ACCESS

Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the General Contractor and reimburse the General Contractor for installation of those access doors.

COORDINATION

The Contractor shall cooperate with other trades and DFD in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the DFD, provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.

Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required. Coordinate the available fault current- equipment including control panels and internal components shall be rated to interrupt the available fault current.

SLEEVES AND OPENINGS

Conduit penetrations in new poured concrete horizontal construction requiring F and T rating: Form opening using hole form or core drill opening. Alternatively provide cast in place fire stopping devices/sleeves.

Conduit penetrations in new poured concrete horizontal construction requiring F rating but no T rating: Same as conduit penetrations in new poured concrete construction requiring F and T ratings except that schedule 40 steel pipe sleeves may also be used.

Conduit penetrations in new poured concrete horizontal construction that do not require F or T ratings: Provide schedule 40 steel pipe sleeve, form opening using hole form or core drill opening.

Where penetrating conduit weight is supported by floor, provide manufactured product or structural bearing collar designed to carry load.

HOUSEKEEPING AND CLEAN UP

The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4hours.

END OF SECTION

SECTION 26 05 02
ELECTRICAL DEMOLITION FOR REMODELING
BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/21

PART 1 - GENERAL

SCOPE
The work under this section includes the demolition associated with the construction of one (1) pit toilet and provisions for future lighting upgrades at Mirror Lake State Park in the city of Baraboo, Wisconsin. The primary electrical work associated with the project is the removal of a existing building and installation/reconnection of service to the new building. The existing site underground feeds will be removed/modified accordingly.

Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work

PART 2 - PRODUCTS
- Materials and Equipment

PART 3 - EXECUTION
- Examination
- Preparation
- Demolition and Extension of the Existing Electrical Work
- PCB Ballast Handling
- Lamp and PCB Ballast Disposal

RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS

MATERIALS AND EQUIPMENT
Materials and equipment for patching and extending work as specified in the individual Sections.

PART 3 - EXECUTION

EXAMINATION
Verify field measurements and circuiting arrangements as shown on Drawings.

Verify that abandoned wiring and equipment serve only abandoned facilities.

Verify whether or not PCB ballasts exist in light fixtures which will be disposed of. If PCB light fixture ballasts exist, then follow requirements in **PCB BALLAST HANDLING** and **LAMP AND PCB BALLAST DISPOSAL** below.

Demolition Drawings are based on casual field observation and/or existing record documents. Report discrepancies to the User Agency, Architect/Engineer and DFD Field Representative before disturbing existing installation.

Beginning of demolition means installer accepts existing conditions.

PREPARATION
Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

Coordinate utility service outages with the User Agency, DFD Field Representative, and Architect/Engineer. Also, if applicable, coordinate utility service outages with the local Utility Company.

Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations and follow the safe working practice requirements of NFPA 70E.

Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from the User Agency and DFD Field Representative at least 48 hours before partially or completely disabling system. Minimize outage duration. If required, make temporary connections to maintain service in areas adjacent to work area.

DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

Remove, relocate, and extend existing installations as necessary, to accommodate new construction and to meet all requirements of these specifications. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

Remove abandoned wiring to source of supply.

Remove exposed abandoned conduit and abandoned conduit above accessible ceiling finishes, unless noted otherwise on drawings. Cut conduit flush with walls and floors, and patch surfaces. If certain conduits and boxes are abandoned but not scheduled for removal, they shall be shown on the "As Built Drawings".

Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and wiring servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

Disconnect and remove abandoned panelboards and distribution equipment.

Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

Provide revised typed circuit directory in panelboards that have circuits removed.

Repair adjacent construction and finishes damaged during demolition and extension work.

Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

Provide supplemental support for conduits that are routed through demolition area, and are to remain. Supplemental support shall be added so that the conduit meets the support requirements of electrical specification section 26 05 33.

PCB BALLAST HANDLING

Generally, all high power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain polychlorinated biphenyl (PCB) compounds in their capacitors. The Contractor shall inspect all ballasts in all light fixtures and take the actions described below.

The disposal of all ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the responsibility of the Contractor. If the PCB content is <u>not</u> stated on the ballast label, the ballast shall be handled as a PCB ballast.

All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off. However, before removal, all PCB ballasts shall be carefully inspected for leaks. <u>If a ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) the ballast must be handled per EPA and DNR PCB regulations.</u> Basically, this means the ballast is to be carefully removed from the fixture and placed in an approved drum. See paragraph below for the drum specifications. The person removing the ballast from the fixture shall wear protective gloves, eye protection, and protective clothing as necessary.

If the fixture has also been contaminated, it must be cleaned to less than 10 micrograms/100 square centimeters contamination before disposal. This cleaning must be done by an approved PCB contractor and is not considered a part of this contract. Contact DFD for contractor approval before commencing with the cleanup.

The PCB ballasts shall then be placed in US DOT approved drums (barrels). The contractor may furnish their own drums or obtain them from **Veolia ES Technical Solutions (800-255-5092 or 262 255-6655**). The quantity and size of the drums will be determined by the contractor at the time of construction, 30 and 55 gallon drums are typically available.

These PCB drums shall be placed in storage with the cover that came with the barrels, in a location within a building, as designated by the Building Manager or DFD Field Representative. The drums are not to be placed outside where they are exposed to weather.

THESE PCB BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE CONTRACTOR. To do so would be a violation of DNR and DOT hazardous waste regulations and may result in a fine to the Contractor.

The Contractor shall label and mark the PCB storage drums with EPA approved PCB labels and the storage area with signs, marks and lines to meet the regulations of Wisconsin Code NR 157 – Management of PCBs and Products Containing PCBs.

The Contractor shall also provide approved PCB absorbent materials to be stored immediately adjacent to the drum storage area. Do not place loose absorbent material in the drums.

The Contractor shall provide to the DFD Field Representative, in written form, a total count of these ballasts (or their total weight by drum) and where they are stored.

See Lamp and PCB Ballast Disposal instructions below.

LAMP AND PCB BALLAST DISPOSAL

All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA and DNR during the disposal process. As a result, regulations have been issued covering the handling and disposal of all lamps. Lamps which have been removed from service for disposal shall be handled as follows by the Contractor:

The Contractor shall very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken. The Contractor will be charged the cost difference between disposal of broken and unbroken lamps, for all lamps broken in excess of 1% of the total lamps removed in the project.

The contractor shall contact **Veolia ES Technical Solutions (800-255-5092 or 262-255-6655)** to coordinate the storage and pickup of disposed lamps and PCB ballasts. The contractor may furnish their own containers or obtain them from **Veolia ES Technical Solutions**. Removed lamps and PCB ballasts shall be placed in containers by the contractor, marked with the number and type of lamp and PCB ballast, and placed in storage at a location on the user agency's property. The contractor shall label the area as "Hazardous Material Storage". The contractor shall make arrangements for pickup of the lamps and PCB ballasts with **Veolia ES Technical Solutions**, shall provide a count of all stored lamps and PCB ballasts, and shall fill out any required forms.

When making disposal arrangements with **Veolia ES Technical Solutions**, the contractor shall make sure to notify them of the DFD project number, DFD project name and DFD Project Manager, for invoicing purposes. Invoicing from **Veolia ES Technical Solutions**, shall be sent to the DFD Project Manager for direct charge payment from the project (lamp and PCB ballast disposal costs to be paid by DFD), and shall indicate the proper DFD project number, name, and PM.

The contractor shall coordinate the lamp and PCB ballast disposal with the DFD Field Representative.

END OF SECTION

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SECTION 26 05 04
CLEANING, INSPECTION, AND TESTING OF ELECTRICAL EQUIPMENT
BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/23

PART 1 - GENERAL

SCOPE

The work under this section includes the required cleaning, inspection, adjustment, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this contractor for this project. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work

PART 2 - PRODUCTS
- Not Used

PART 3 - EXECUTION
- General Inspection and Cleaning of All Electrical Equipment
- Grounding Systems
- Metering and Instrumentation
- Panelboards
- Cables

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

Inspect for physical damage and abnormal mechanical and electrical conditions.

Any item found to be out of tolerance, or in any other way defective as a result of the required inspection or testing, shall be reported to the DFD. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.

Compare equipment nameplate information with the latest single line diagram and report any discrepancies.

Verify proper auxiliary device operation and indicators.

Check tightness of accessible bolted electrical joints. Use torque wrench/ screw driver method.

Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.

Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.

Clean All Equipment:
- Vacuum inside of panelboards, switchboards, switchgear, transformer core and coils, bus ducts, MCC's, and the exterior of all Communications and Electronic Safety and Security hardware and equipment.
- Loosen attached particles and vacuum them away.
- Wipe all insulators with a clean, dry, lint free rag.
- Clean insulator grooves.
- Re-vacuum inside surfaces as directed by the DFD Construction Representative or Inspector

Inspect equipment anchorage.

Inspect equipment and bus alignment.

Check all heater elements for operation and control.

Lubricate nonelectrical equipment per manufacturer's recommendations.

GROUNDING SYSTEMS

Inspect the ground system for adequate termination at all devices.

METERING AND INSTRUMENTATION

Examine all devices for broken parts, damage and wire connection tightness.

Verify the electronic meter is connected properly and displaying proper voltage and power quantities.

Inspect nameplate information for compatibility with one-line drawings.

Verify the instrument transformer connections with the system requirements.

Verify tightness of all bolted connections and assure adequate clearances exist from primary circuits to secondary circuit wiring and to grounds.

Verify that all required grounding and shorting connections exist and that those connections make good contact; i.e. sufficient surface area, good cleanliness, and proper pressure.

Verify proper primary and secondary fuses and required sizes.

PANELBOARDS

Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory.

Vacuum clean the panelboard enclosure.

CABLES

600 Volt cable:

- Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections.
- Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor terminations to manufacturer's recommendations.
- Perform a 1000 Vdc megger test on all secondary cables from the substation transformers to the secondary switchboards and on all switchboard feeders.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
BASED ON DFD MASTER ELECTRICAL SPEC DATED 12/22/21

PART 1 - GENERAL

SCOPE
The work under this section includes furnishing and installing required wiring and cabling systems including pulling, terminating and splicing. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- References
- Submittals
- Project Conditions

PART 2 - PRODUCTS
- General
- Building Wire
- Service Entrance Conductors
- Aboveground Wire for Exterior Work
- Underground Wire for Exterior Work
- Wiring Connectors

PART 3 - EXECUTION
- General Wiring Methods
- Wiring Installation in Raceways
- Wiring Connections and Terminations
- Field Quality Control
- Wire Color
- Branch Circuits
- Construction Verification Items

RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

Section 26 05 33 – Raceway and Boxes for Electrical Systems.
Section 26 05 53 – Identification for Electrical Systems.
Section 26 08 00 - Commissioning of Electrical.
Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCES
SPS 316- Electrical

SUBMITTALS
Submit product data: Provide for each cable assembly type.

Submit factory test reports: Indicate procedures and values obtained.

Submit shop drawings for modular wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.

Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

PROJECT CONDITIONS
Verify that field measurements are as shown on Drawings.

Conductor sizes are based on copper.

Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required for project conditions.

Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

GENERAL

All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.

All conductors shall be copper. Aluminum conductors size #1/0 and larger may be substituted for copper and used for phase and neutral conductors for transformer feeders, switchboard feeders, and panelboard feeders. All ground conductors shall be copper.

The following requirements shall be met when aluminum conductors are used:

Aluminum alloy conductors shall be compact stranded conductors of a recognized Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy).

It is the responsibility of the contractor to increase the size of the conduit, wire gutter, or enclosure, if necessary, to accommodate the aluminum conductors and meet allowable code requirements.

It is the responsibility of the contractor to increase the size of the aluminum conductor and associated termination lugs to match the ampacity of the copper conductor circuit shown on the Drawings.

The contractor shall submit a feeder schedule to the Engineer for all conductor substitutions indicating the aluminum conductor wire size and the conduit size. The contractor shall not begin the installation until written approval is granted by the Engineer.

All aluminum conductors shall terminate on a mechanical screw-type connector or mechanical compression-type connector. Connector shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with aluminum and copper conductors, and sized to accept aluminum conductors of the required ampacity. When using compression-type connectors, the lugs shall be marked with wire size, die index, number and location of crimps and shall be suitably color-coded. Using a suitable stripping tool, remove insulation from the required length of the conductor. Wire brush the conductor and apply a Listed joint compound. Tighten or crimp the connection per the connector manufacturer’s recommendation. Wipe off any excess joint compound.

When terminating aluminum conductors to aluminum bus, prepare a mechanical screw-type or compression-type connection. Bolts shall be anodized alloy and conform to current ANSI and ASTM chemical and mechanical property limits. Nuts shall be aluminum alloy and conform to current ANSI standards. Washers shall be flat aluminum alloy, Type A plain, standard wide series conforming to current ANSI standards. Lubricate and tighten the hardware per manufacturer’s recommendations.

When terminating aluminum conductors to copper bus, prepare a mechanical screw-type or compression-type connection. Bolts shall be plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to current ASTM standard or SAE grade 5. Nuts shall conform to current ANSI standards. Washers shall be steel, Type A plain, standard wide series conforming to current ANSI standards. Belleville conical spring washers shall be of hardened steel, cadmium plated or silicone bronze. Lubricate and tighten the hardware per manufacturer’s recommendations.

The final tightening torque shall be recorded for all aluminum conductor mechanical screw-type connections and provided in report form, in the completed O&M manuals.

The contractor shall perform an infrared survey of all aluminum conductor connections after the installation is complete and in normal service. Infrared surveys shall be performed during periods of maximum possible loading with at least 30% of rated load of the equipment being inspected. All connections with elevated temperatures shall be corrected by the contractor. The infrared survey results shall be provided in report form, in the completed O&M manuals.

No copper-to-aluminum transitions permitted when splicing onto existing copper feeders.

Insulation shall have a 600 volt rating.

All conductors shall be stranded.

Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

BUILDING WIRE
Description: Single conductor insulated wire 90 degree C.

Insulation: Type XHHW-2 insulation.

SERVICE ENTRANCE CONDUCTORS
Description: Single conductor or multi-conductor insulated wire. 90 degree C sized at the 75 degree C table.

Insulation: Type USE-2, XHHW-2 insulation for service entrance conductors routed from exterior source to exterior termination location.
Type XHHW-2 insulation for services entrance conductors routed from exterior source to interior termination location.

ABOVEGROUND WIRE FOR EXTERIOR WORK
Description: Single conductor insulated wire, 90 degree C.

Insulation: Type XHHW-2 insulation.

UNDERGROUND WIRE FOR EXTERIOR WORK
Description: Stranded single or multiple conductor insulated wire, 90 degree C.

Insulation: Type USE-2, XHHW-2, RHW-2 insulation.

This wiring shall be used in all underground feeder and branch circuit applications, except THHN/THWN-2 is permitted when run in a concrete-encased ductbank.

WIRING CONNECTORS
Split Bolt Connectors: Not acceptable.

Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment terminals. Not approved for splicing.

Twist Type Wire Connectors: Solderless twist type spring connector (wire-nut) with insulating cover for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller. The manufacturer's wire fill capacity must be followed. Use Silicone filled twist type spring connectors in all wet location areas.

Mechanical Spring Actuation Connectors: Toolless type spring actuation connector (push-in) with spacers for copper wire splices and taps. Use for conductor sizes 12 AWG and smaller. The manufacturer's wire fill capacity must be followed. Use in interior, dry locations only.

All wire connectors used in underground or exterior pull boxes or hand holes shall be gel filled twist connectors or a connector designed for damp and wet locations. Gel filled twist type connectors can be used for copper conductor sizes 6 AWG and smaller for site lighting applications. The manufacturer's wire fill capacity must be followed.

Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps. Connector must be installed with a crimper tool listed for use with the manufacturer and type of compression connector.

Insulation Piercing Connectors: Molded insulated body, copper teeth, wrench tightened, UL 486B Listed. May be used only for connection of a tap conductor in run and tap type applications when main conductor is 8 AWG and larger.

PART 3 - EXECUTION

GENERAL WIRING METHODS

All wire and cable shall be installed in conduit.

Do not use wire smaller than 12 AWG for power and lighting circuits.

All phase, neutral and ground conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductors for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

Ground conductor size shall be increased per NEC 250.122(B) when phase and phase/neutral conductors are increased in size.

Make conductor lengths for parallel conductors equal.

Splice only in junction or outlet boxes.

No conductor less than 10 AWG shall be installed in exterior underground conduit.

Identify ALL low voltage wire, 600V and lower, per section 26 05 53.

Neatly train and lace wiring inside boxes, equipment, and panelboards.

WIRING INSTALLATION IN RACEWAYS

Pull all conductors into a raceway at the same time. Use Listed water or silicone based wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary. Wax based lubricants are not allowed. Pulling lubricant is not required for low friction type products where the cable manufacturer recommends that cables be pulled without lube.

Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

Completely and thoroughly swab raceway system before installing conductors.

Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

Manufacturers maximum pulling tensions shall be not be exceeded and individual pulls shall not exceed 270 degrees.

In high ambient spaces, mechanical rooms, utility rooms and exterior exposed conduit, 90 degree C, XHHW-2 conductors shall be utilized.

WIRING CONNECTIONS AND TERMINATIONS

Splice only in accessible junction boxes.

Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.

All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

Use solderless twist type spring connectors (wire nuts) with insulating covers for copper wire splices and taps, 10 AWG and smaller or toolless type actuation connectors (push-in) with spacers for copper wire splices and taps, 12 AWG and smaller. Use mechanical or compression connectors for wire splices and taps, 8 AWG

and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the wiring.

Thoroughly clean wires before installing lugs and connectors.

At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

FIELD QUALITY CONTROL

Field inspection and testing will be performed under provisions of Section 26 05 04.

Additional testing as follows shall be performed if aluminum conductors are used:

Feeders terminated with aluminum conductors shall be tested with a thermal imager and recorded.

Conductors shall be closely checked for loose or poor connections, and for signs of overheating or corrosion.

Test procedures shall meet NETA guidelines.

Test results and report shall be provided to the engineer and included in O&M manual under AL conductors/ tests.

Contractor shall correct all deficiencies reported in the test report.

WIRE COLOR

General:

Solid colored insulation is required for all THHN/THWN-2 wire. For other wire types use colored wire or identify wire with colored tape at all terminals, splices and boxes. Wire shall be colored as indicated below.

In new facilities, use black and red for single phase circuits at 120/240 volts. Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on the fixture and Listed as a System.

Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.

Neutral Conductors: White for 120/240V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.

Branch Circuit Conductors: Three or four wire home runs shall have each phase uniquely color coded.

Feeder Circuit Conductors: Each phase shall be uniquely color coded.

Ground Conductors: Green colored insulation for THHN/THWN-2 wire. For other wire types use green colored wire or identify wire with green tape at both ends and at all access points, such as panelboards, motor starters, disconnects and junction boxes. When isolated grounds are required, contractor shall provide green with yellow tracer.

BRANCH CIRCUITS

The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All single-phase branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/23

PART 1 - GENERAL

SCOPE

The work under this section includes grounding electrodes and conductors, equipment grounding conductors, and bonding for Electrical and Communications systems. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- References
- Performance Requirements
- Submittals
- Project Record Documents
- Regulatory Requirements

PART 2 - PRODUCTS
- Rod Electrode

PART 3 - EXECUTION
- Examination
- General
- Medium Voltage System Grounding
- Less Than 600 Volt System Grounding
- Communication System Grounding
- Field Quality Control
- Identification and Labeling
- Construction Verification Items
- Warranty

All hardware, cables and related termination and support hardware shall be furnished, installed, wired, tested, labeled, and documented by the Contractor, as detailed in this and related sections.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 26 08 00 - Commissioning of Electrical.
Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCES

ANSI/IEEE 81 (Latest edition) - Guide to Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System
ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems
UL 467 Electrical Grounding and Bonding Equipment
IEEE 837 - IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
TIA-607-C - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

PERFORMANCE REQUIREMENTS

Grounding System Resistance:
- Equipment Rated 500 KVA and Less: 10 ohms maximum at building service entrance.
- Equipment Rated 500 to 1000 KVA: 5 ohms maximum at building service entrance.
- Equipment Rated more than 1000 KVA: 3 ohms building service entrance.
- Communications Ground Busbars: 5 ohms maximum.

Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations. Perform fall-of-potential test in accordance with ANSI/ IEEE 81 on main grounding electrode system.

Testing of grounding system resistance is to be witnessed by the DFD Electrical Inspector or Construction Representative.

Provide test report of grounding system overall resistance and resistance of each electrode in final O&M manuals and noted on record documents.

SUBMITTALS
Product Data: Provide data for grounding electrodes and connections.

Provide samples of ground labels.

Test Reports: Indicate overall resistance to ground and resistance of each electrode.

Manufacturer's Instructions: Include instructions for preparation, installation and examination of exothermic connectors.

PROJECT RECORD DOCUMENTS
Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors as installed including recorded ground resistance test results.

REGULATORY REQUIREMENTS
Conform to requirements of NFPA 70.

Furnish products listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

PART 2 - PRODUCTS

ROD ELECTRODE
Material: Copper-clad steel.

Diameter: 3/4 inch (19 mm) minimum.

Length: 10 feet (3.5 m) minimum. Rod shall be driven at least 9' 6" deep.

CONDUCTORS
Material: Stranded copper (aluminum not permitted).

Grounding Electrode Conductor: Bare seven-strand conductors. Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.

Foundation Electrodes: As shown on drawings.

Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used at the same facility.

Branch Circuit Equipment Ground shall be proportionately increased in size when routed with phase conductors increased in size.

BUS/BUSBAR
Material: Copper (aluminum not permitted).

Size:
- All Power systems: 1/4" X 2", length as needed (24” minimum).
- Telecommunications Main Ground Busbar (TMGB): 1/4" x 4" x 20" long (minimum).
- Telecommunications Grounding Busbar (TGB): 1/4" x 2" x 12" long (minimum).

Busbars:
- Be pre-drilled to accommodate two-hole lugs.
- 3/8” stud hole size; hole spacing per TIA-607-C.
- Incorporate insulators and stand-off brackets that electrically isolate busbar from mounting surface.

Provide main ground busbar located adjacent to main electrical service equipment to terminate all ground conductors. Refer to DFD grounding detail 26 05 26-1.

PART 3 - EXECUTION

EXAMINATION
Verify that final backfill and compaction has been completed before driving rod electrodes.

GENERAL
Install Products in accordance with manufacturer's instructions.

Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them. Attach grounds permanently before permanent building service is energized.

All grounding conductor connections to Busbars shall be via two hole lugs.

Terminate each grounding conductor on its own terminal lug. Sharing a single lug by multiple conductors is not allowed.

All grounding electrode conductors and individual grounding conductors shall be installed in SCH 80 PVC conduit, in exposed locations.

Each grounding electrode conductor shall be labeled at each terminated end as to system served and location of second termination.

LESS THAN 600 VOLT ELECTRICAL SYSTEM GROUNDING

Supplementary Grounding Electrode: Use driven ground rod on exterior of building.

Provide code sized copper grounding electrode conductor from electrical room ground bus to secondary switchboard ground bus, each separately derived system neutral, secondary service system neutral to street side of water meter, building steel, ground rod, and any concrete encased electrodes. Provide bonding jumper around water meter. Provide physical protection as required.

Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

Install ground grid under access floors. Construct grid of #4 AWG bare copper wire installed on 72 inch centers both ways. Bond each access floor support pedestal to grid.

Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to under floor ground grid. Use #4 AWG bare copper conductor.

FIELD QUALITY CONTROL
Inspect grounding and bonding system conductors and connections for tightness and proper installation.

Testing of grounding system resistance is to be witnessed by the DFD Electrical Inspector or Construction Representative. Provide test report of grounding system resistance in final O&M manuals and noted on record drawings.

Provide resistance test at each electrical and telecommunications Busbar to ground.

IDENTIFICATION AND LABELING
Label Grounds at point of termination.

Label for Bus Bars and Ground Bars shall be engraved laminate or Pre-printed (manufactured) plastic and include the following:

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING MANAGER.

Provide additional labeling of each individual terminated ground conductor at bus bar identifying installed source per NEC 250.52 A 1-7.

Label for TBB connection at TMGB and TGB(s) shall be engraved laminate or Pre-printed (manufactured) plastic and include the following:

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER.

CONSTRUCTION VERIFICATION
Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

Record locations of all electrical and telecommunications grounding electrodes, busbars and grounding conductors as installed including recorded ground resistance test results.

WARRANTY
See Division 1, General Conditions, and General Requirements.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/23

PART 1 - GENERAL

SCOPE
The work under this section includes conduit and equipment supports, straps, clamps, steel channel, etc., and fastening hardware for supporting electrical work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals
- Quality Assurance

PART 2 - PRODUCTS
- Support Channel
- Conduit Supports
- Threaded Rod
- Hardware

PART 3 - EXECUTION
- Installation

RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 26 05 53 – Identification for Electrical Systems

SUBMITTALS
Product Data: Provide data for support channel.

QUALITY ASSURANCE
Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

SUPPORT CHANNEL
Epoxy Painted
Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS Grade 33, then painted with water born epoxy applied by a cathodic electro-deposition process.

All fittings and hardware shall be zinc plated in accordance with ASTM B633 (SC3 for fittings, SC1 for threaded hardware).

Hot-dip Galvanized Steel
Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 and shall be hot-dip galvanized after fabrication in accordance with ASTM A123.

Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A907 SS, Grade 33, and hot-dip galvanized after fabrication in accordance with ASTM A123.

All hardware shall be stainless steel Type 304 or chromium zinc ASTM F1136 Gr. 3.

All hot-dip galvanized after fabrication products must be returned to point of manufacture after coating for inspection and removal of all sharp burrs.

Stainless Steel
All strut, fittings and hardware shall be made of AISI Type 304 or Type 316 stainless steel as indicated.

CONDUIT SUPPORTS
Conduit clamps, straps, supports, etc., shall be steel or malleable iron.

One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.

Bar joist conduit/box hangers: Spring Steel Clips with Snap-Close Clamps (Conduit Supports): Conduit clamps shall pivot a full 360 degrees and shall snap close around the conduit. Push-in type conduit clamps are not allowed. Spring clips shall require a hammer to install onto supporting surface.

Stud wall applications: Spring Steel Clips with Push-in or Snap-Close Conduit Clamps (Conduit Supports): Conduit clamps shall pivot a full 360 degrees. Spring clips shall require a fastener to install onto stud.

Box/conduit hanger with rod/wire clip (a.k.a. antlers): One assembly provides support for electrical box and conduit from drop wire or rod. Conduit clamps shall snap close around the conduit.

Spring Steel Clip products shall be provided with corrosion resistance and be warranted against failure from corrosion for a period of ten (10) years from date of manufacture.

THREADED ROD
Minimum sized threaded rod for supports shall be 3/8” for trapezes and single conduits 1-1/4” and larger, and ¼” for single conduits 1” and smaller.

HARDWARE
Corrosion resistant, or as noted for each product above.

PART 3 - EXECUTION

INSTALLATION
Fasten hanger rods, conduit clamps, and outlet-, junction-, and pull-boxes to building structure using pre-cast insert system, preset inserts, beam clamps, or expansion anchors.

Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.

Powder-actuated fasteners are not permitted.

Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit.

Do not fasten to suspended ceiling systems.

Do not drill structural steel members unless approved by DFD.

In wet locations, mechanical rooms, and electrical rooms, install free-standing electrical equipment on 3.5-inch (89 mm) concrete pads.

Install surface-mounted cabinets and panelboards with a minimum of four anchors. At all cabinet and panelboard locations on concrete or concrete block walls, and at ALL locations below grade, provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8” Uni-strut or 3/4” painted fire-retardant plywood is acceptable). In above-grade equipment rooms that have drywall walls, the cabinets and panelboards may be mounted to the drywall if backing is provided in the stud walls behind the equipment.

Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

Support Channel

Use one of the following types of support channel as appropriate for the installed environment:

- Indoor: Epoxy Painted Steel, Hot-dipped Galvanized Steel, or as noted on the drawings.

- Exterior and wet locations: Hot-dipped Galvanized Steel or Stainless Steel, as appropriate for the environment or as noted on the drawings. Type 316 stainless steel shall be used for Food Service type environments. Epoxy painted support channel shall not be used for exterior installations.

- Manholes, steam pits, steam tunnels, or corrosive environments: Stainless Steel Type 316.

- Field cuts: File and de-bur cut ends of support channel and paint to prevent rusting. For epoxy-painted support channel, paint cut ends to match the original color. For hot-dipped galvanized support channel, spray cut ends with cold galvanized paint.

Support Wires

Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be secured at both ends (e.g., the ceiling structure at the top and the ceiling grid at the bottom) per NEC 300.11(A).

Compressed-air power-actuated fasteners may ONLY be used for the installation of separate ceiling wires required for support of conduits and aircraft cable hung light fixtures.

Support wires shall be identified per specification section 26 05 53.

Spring Steel Clip Conduit Supports for 30 amp or less branch circuits

Spring steel clips with snap-close clamps may be used to support conduit/ box from bar joist (steel truss) systems.

Stud wall applications: Spring steel clips with push-in or snap-close conduit clamps may be used to support conduit in interior metal stud wall applications. Use screw fasteners to install conduit clamp onto stud.

Conduit/box hanger with rod/wire clip (a.k.a. antlers) and multi conduit/box support systems: Above suspended ceiling only.

END OF SECTION

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
BASED ON DFD MASTER ELECTRICAL SPEC DATED 11/18/24

PART 1 - GENERAL

SCOPE

This section describes the products and execution requirements relating to furnishing and installing raceways and boxes and related systems as part of a raceway system for electrical and other low-voltage systems for the project. Included are the following topics:

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 26 08 00 - Commissioning of Electrical.
Section 26 05 26 – Grounding and Bonding for Electrical Systems
Section 26 05 29 – Hangers and Supports for Electrical Systems.
Section 26 05 34 -- Underground HDPE Pathways for Electrical Systems
Section 26 27 02 – Equipment Wiring Systems.
Section 26 27 26 – Wiring Devices.

REFERENCES

Wisconsin Administrative Code SPS 316 - Electrical

ANSI/SCTE 77-2017 – Specifications for Underground Enclosure Integrity

SUBMITTALS

Boxes - provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

Conduits in Concrete Slabs Above Grade - provide proposed conduit routing and sizing to Structural Engineer prior to approval of installation to verify structural integrity and fire rating of concrete slab.

PART 2 - PRODUCTS

GENERAL

All steel fittings and conduit bodies shall be galvanized.

All conduit transitional fittings shall be listed for installed application.

Condulet fittings shall be threaded rigid entering condulets.

No cast metal or split-gland type fittings permitted.

All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.

Mogul-type condulets 2 inch (50 mm) and larger, shall be permitted.

C-condulets shall not be used in lieu of pull boxes.

All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

RIGID METAL CONDUIT (RMC) AND FITTINGS

Conduit: Heavy wall threaded, galvanized steel.

Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

Conduit: Galvanized Steel, threaded.

Fittings and Conduit Bodies: Use all Steel threaded fittings and conduit bodies.

Expansion Fittings/Expansion Joints: Expansion Fittings shall be Internal Grounding type and shall not rely on external bonding jumpers to maintain grounding continuity between raceway components.

ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

Conduit: Steel, Unthreaded thin wall galvanized tubing.

Fittings: All steel, compression or set screw type. No push-on or indenter types permitted.

Transitional fitting: ½-1”: All steel and malleable iron; 1 ¼” and above: All steel, Malleable iron and Die cast where not subjected to physical damage and with project specific DFDM electrical inspector approval.

Conduit Bodies: All steel conduit bodies.

LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC) AND FITTINGS
Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.

Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

ELECTRICAL NONMETALLIC TUBING (ENT) AND FITTINGS
Conduit: ENT (smurf tube), UL listed and NEC recognized.

Fittings: One piece quick connect fittings for 1/2 inch to 1 inch size and schedule 40 cemented fittings for larger size. When installed in concrete, fittings shall be suitable for damp locations and shall be concrete–tight, stub-ups and stub-downs kits shall meet manufacturer's recommendations.

RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS
Conduit: Rigid non-metallic conduit, Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90^0 C conductors. Schedule 80 for locations exposed to physical damage or as required.

Fittings and Conduit Bodies: NEMA TC 2, Listed.

HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) AND FITTINGS
See specification Section 26 05 34 -- Underground HDPE Pathways for Electrical Systems

CONDUIT SUPPORTS
See specification Section 26 05 29.

CONDUIT WATER SEALANT
Description: Conduit sealant used to prevent water from entering buildings via conduits.

Sealant shall seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayflate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

Manufacturer names and catalog numbers are used to develop quality and performance requirements only. Products manufactured by others may be acceptable provided they meet or exceed the specifications.

PULL AND JUNCTION BOXES
Interior Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot-welded joints and corners.

Interior Sheet Metal Boxes larger than 12 inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover. Boxes 9 square-feet or larger shall have hinged covers and a single cover shall not exceed 10 square-feet.

Interior Sheet Metal Boxes connected to an exterior underground raceway, shall have a drain fitting located in the bottom.

Exterior Boxes and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain-tight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.

Box extensions and adjacent boxes within 48 inches of each other are not allowed for the purpose of creating more wire capacity.

Junction boxes 6 inch-by-6 inch or larger size shall be without stamped knock-outs.

Wireways shall not be used in lieu of junction boxes.

IN GRADE HANDHOLES AND BOXES
Handholes and Boxes: Polymer- Concrete.

Handhole and Box Covers: Polymer- Concrete.

Handhole and box bottoms: Open.

Handholes and boxes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

Handhole and cover Assembly Load Rating: ANSI/SCTE Tier8 or better.

Covers: Weatherproof, secured by tamper-resistant locking devices with non-skid finish.
Cover Label: [BLANK][ELECTRIC][SIGNAL]COMMUNICATIONS][FIBER OPTICS][other]

Units shall be designed – typically with a flared wall and footed base – to prevent frost heaving.

OUTLET BOXES
Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.

Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.

Concrete Ceiling Boxes: Concrete type.

Cast Boxes: Cast ferroalloy or aluminum, deep type, gasketed cover, threaded hubs.

PART 3 - EXECUTION

CONDUIT SIZING, ARRANGEMENT, AND SUPPORT
EMT is permitted to be used in sizes 4 inch (100 mm) and smaller for power and low-voltage systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.

Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch (16 mm) minimum except **all homerun conduits shall be 3/4 inch (21 mm),** or as specified elsewhere. **Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three current-carrying conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.**

Arrange conduit to maintain 6'-8" clear headroom and present a neat appearance.

Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

Maintain minimum 6 inch (150 mm) clearance between conduit and piping. Maintain 12 inch (300 mm) clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.

Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.

Support and fasten metal conduit at a maximum of 8 feet (2.4 m) on center.

Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.

Conceal all conduits except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical rooms.

Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.

For indoor and exposed exterior conduits, no continuous conduit run shall exceed 100 feet (30 meters) without a junction box.

For exterior below grade conduits, no continuous conduit run shall exceed 250 feet (75 meters) without hand hole, manhole or pull box without project specific DFDM electrical inspector approval.

All conduits installed in exposed areas shall be installed with a box offset before entering box.

CONDUIT INSTALLATION

Cut conduit square; de-burr cut ends.

Conduit shall not be fastened to the corrugated metal roof deck nor drywall or suspended ceiling grids. Bring conduit to the shoulder of fittings and couplings and fasten securely.

Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

Threads cut in the field, and factory threads of conduit and nipples not coated with corrosion protection, shall be coated with an approved electrically conductive compound per NEC 300.6.

Corrosion inhibitor, when used in the food service environment, shall be approved for Food Service locations.

Terminate all conduit (except for terminations into conduit bodies) using conduit hubs, or connectors with one locknut, or utilize double locknuts (one each side of box wall).

Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 26 05 26 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.

Provide insulated bushings where raceways contain 4 AWG or larger conductors.

Use pendants supported from swivel hangers in exposed ceiling/ structure locations where necessary to mount boxes supporting luminaires and wiring devices. Installation method shall comply with NEC 314.23 (H).

Install no more than the equivalent of the following for building:

Three 90 degree bends between boxes for electrical systems.

Two 90 degree bends between boxes for communications and other low voltage systems. Note: Offsets shall be considered 90 degrees.

No single bend may exceed 90 degrees.

Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch (50 mm) size unless sweep elbows are required.

Bend conduit according to manufacturer's recommendations. Torches or open flame shall not be used to aid in bending of PVC conduit.

Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.

Provide 1/8 inch (3 mm) nylon pull string in empty conduit, except sleeves and nipples.

Install listed expansion-deflection fitting or other approved means shall be used where a raceway crosses a structural joint for expansion, contraction or deflection, used in buildings, bridges, parking garages or other structurers.

Install expansion joints where direct-buried conduit is subject to Earth Movement by settlement or frost per NEC 300.5(J), especially where conduit exits the ground exposed and enters a box, cabinet, or enclosure attached to a building or structure.

Install expansion fitting in exterior PVC conduit runs per NEC table 352.44 utilizing a minimum temperature change of 120 degree F.

Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.

Where conduit passes between areas of differing temperatures such as into or out of cool rooms, freezers, unheated and heated spaces, buildings, etc., provide condulet or box with duct seal or other means to prevent the passage of moisture and water vapor through the conduit.

Route conduit through roof openings for piping and ductwork where possible.

Use NRTL listed metallic grounding clamps when terminating conduit to cable tray.

Ground and bond conduit under provisions of Section 26 05 26.

Conduit is not permitted in any slab topping of two inches (50 mm) or less.

Conduits in Concrete Slab Above Grade: Provide proposed conduit routing and sizing to Structural Engineer for approval prior to installation to verify structural integrity and fire rating of concrete slab.

Maximum Size Conduit in Concrete Slabs Above Grade: 1 inch (25 mm). Do not route conduits to cross each other in slabs above grade. Minimum conduit spacing shall be 6 inches on center.

PVC conduit in concrete pole bases shall transition to galvanized rigid metal conduit 12 inches before it enters a concrete pole base. Inside the pole base, the elbow shall be galvanized rigid metal conduit. From the elbow, the conduit shall transition back to PVC as it continues up and out the top of the concrete pole base.

PVC conduit shall transition to galvanized rigid metal conduit before it enters a foundation wall or up through a concrete floor.

PVC conduit shall be allowed without need of transition to galvanized rigid metal conduit up through concrete floor and concrete equipment pads for pad mounted transformers and switchgear. Provide a PVC connector and bushing, or bell-ends, on each conduit entry. Coordinate conduit installation with submittals and shop drawings for transformers and switchgear.

Identify conduit under provisions of Section 26 05 53.

All Aluminum conduits shall not be in direct contact with concrete.

All conduit installed underground (exterior to building) shall be buried a minimum of 24 inches below finished grade, whether or not the conduit is concrete encased. Install warning tape 12" below finish grade over all buried conduits. Underground warning tape shall be detectable, 2” wide minimum, 5 mil thickness, containing a foil core. Tape color shall be red and labeled with the words "CAUTION-BURIED ELECTRIC LINE BELOW" as manufactured by Presco or similar.

Conduits penetrating underground foundation walls: Individual conduits or each conduit as part of a ductbank penetrating underground foundation walls (excluding manholes) shall be sealed against water intrusion into the building.

Clean PVC conduit with solvent, and dry before application of glue. The temperature rating of glue/cement shall match weather conditions. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturer’s recommendations.

CONDUIT INSTALLATION SCHEDULE

Conduit other than that specified below for specific applications shall not be used.

- Horizontal Directional Drilling (Directional Boring) Installations: HDPE conduit.

- Underground Installations That Do Not Penetrate Foundation Walls: Rigid metal conduit, or PVC conduit.

- Underground Installations Emerging from Grade: Buried conduit emerging from grade shall be Rigid metal conduit extending from the minimum cover distance of 24 inches below grade to the conduit termination point above grade. Refer to DFD detail.

- Underground Installations Under Concrete Slab: Rigid metal conduit or Schedule 40 PVC conduit.

- Underground Installations Emerging through Concrete Slab: Rigid metal conduit.

- Concealed in Poured Concrete Walls: Rigid Metal Conduit, PVC conduit, or Electrical Nonmetallic Tubing (ENT).

- Concealed in Concrete Block Walls: Electrical metallic tubing, PVC conduit. Electrical Nonmetallic Tubing (ENT).

- Within Concrete Slab: Rigid Metal conduit or PVC conduit.

- Emerging from Within Concrete Slab: Rigid Metal conduit.

- Exposed Outdoor Locations: Rigid Metal conduit, Intermediate Metal conduit.

- Wet Interior Locations: Exposed: Rigid metal conduit

- Concealed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing, PVC conduit (Ground conductor).

- Exposed Dry Interior Locations: Rigid metal conduit, Intermediate metal conduit, Electrical metallic tubing.

- Motor and equipment connections: Liquidtight flexible metal conduit (LFMC) in all locations except in Mechanical equipment plenum spaces where Flexible Metal Conduit (FMC) shall be utilized. Minimum length shall be one foot (300 mm); maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

- Luminaire: Refer to specification section 26 51 13.

HIGH DENSITY POLYETHYLENE CONDUIT (HDPE) INSTALLATION

See specification Section 26 05 34 -- Underground HDPE Pathways for Electrical Systems

COORDINATION OF BOX LOCATIONS

Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.

Conduit and boxes shall not be fastened to the metal roof deck. If conduit and boxes are required to be located and installed on roof decks, the conduit and boxes are required to be spaced minimum 1-5/8 inch off the lowest part of the metal roof decking material, per NEC 300.4 (E).

It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.

In case of any question or argument over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.

The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch (450 mm) by 24 inch (600 mm) access doors. Boxes must be installed within 12" from edge of the access door.

Locate and install to maintain headroom and to present a neat appearance.

Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

Boxes installed in the building envelop shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and locations per IEC 502.4.3.

PULL AND JUNCTION BOX INSTALLATION

Pull boxes and junction boxes shall be minimum 4 inches square (100 mm) by 2 1/8 inches (54 mm) deep for use with 1 inch (25 mm) conduit and smaller. On conduit systems using 1 1/4 inch (31.75 mm) conduit, minimum junction box size shall be 4 11/16 inches square by 2 1/8 inches deep.

Where used with raceway(s) containing conductors of 4 AWG or larger, pull box shall be sized as required unless otherwise noted on the drawings.

Where used with raceway(s) containing conductors on systems over 600V, size pull box per NEC 314 Part IV unless otherwise noted as larger on the drawings.

Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install DFD approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.

Provide Pull and Junction boxes for communications and other low voltage applications (a) in any section of conduit longer than 100 feet, (b) where there are bends totaling more than 180 degrees between pull points or pull boxes and (c) wherever there is a reverse bend in run. Locate boxes on straight section of raceway (e.g. do not use boxes in place of raceway bends).

Support pull and junction boxes independent of conduit.

IN GRADE HANDHOLES AND BOXES

Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

Unless otherwise indicated and detailed, support units on a level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.25 mm) sieve and compacted to same density as adjacent undisturbed earth.

Elevation: In finished areas, set so cover surface will be flush with finished grade.

Unless approved by DFD review staff, handholes and boxes shall **NOT** be installed in paved or concrete drives or walks.

Units shall be selected with depth sufficient to allow for conductor bending/ wire management and allow sufficient conduit elevation above compacted bed to prevent water infiltration in conduit.

Provide four (4) sets of the tool(s) required to access tamper resistant locking covers. In addition, provide the tool(s) model number to allow for ordering of additional sets. Tools and bits, shall be turned over to owners representative, prior to project closeout.

Provide conduit sealant to seal conduits against water and gas intrusion, such as Polywater® FST™-250 Foam Duct Sealant, Raychem RDSS Rayflate Duct Sealing System, or approved alternate. Sealant shall be re-enterable, shall be compatible with the conduit and conductor types being used, and shall comply with NEC 225.27, 230.8, and 300.5(G).

OUTLET BOX INSTALLATION

Do not install boxes back-to-back in walls. Provide minimum 6 inch (150 mm) separation, except provide minimum 24 inch (600 mm) separation in acoustic-rated walls.

Power:

Recessed (1/4 inch maximum) outlet boxes in masonry, concrete, tile construction, or drywall shall be minimum 4 inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes. A single gang box can be used in drywall and masonry, for a single device location, when a single conduit enters box.

Shallow 4 inch square by 1 1/2 inch deep boxes can be used as device boxes for power provided the box and plaster ring is sized for installed device and conductors.

Provide knockout closures for unused openings.

Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches (300 mm) of box.

Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Sectional boxes may only be used with the pre-approval of the State of Wisconsin DFD Electrical Inspector for remodeling applications where it is impractical to install multi-gang boxes. Provide non-metallic barriers to separate wiring of different voltage systems.

Install boxes in walls without damaging wall insulation.

Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

Ceiling outlets shall be 4 inch square, minimum 2 1/8 inch (54 mm) deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.

In inaccessible ceiling areas, position outlets and junction boxes within 6 inches (150 mm) of recessed luminaire, to be accessible through luminaire ceiling opening.

Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.

Surface wall outlets shall be 4 inch (100 mm) square with raised covers for one and two gang requirements. For three gang or larger requirements, use gang boxes with non-overlapping covers.

Outlet Box adjustable ring and depth device applications:

Provide box extenders for boxes that are set too far back in the wall due to un-anticipated wall finishes. Place the box extender over the existing box face to make the box face flush with the wall finish.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION

SECTION 26 05 34
UNDERGROUND HDPE PATHWAYS FOR ELECTRICAL SYSTEMS
BASED ON DFD MASTER SPECIFICATION DATED 03/01/21

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete directional drilling, testing and other work, as required in these specifications, on the drawings, and as otherwise deemed necessary to complete the work.

Included are the following topics:

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 26 08 00 - Commissioning of Electrical.

Section 02 32 00 – Geo Technical Investigation
Section 30 05 00 – Common Work Results for All Exterior Work
Section 31 25 00 – Erosion Control
Section 31 20 00 – Earthmoving
Section 31 23 16.13 – Trenching

SUBMITTALS

Submit shop drawings, catalog data, and manufacturer's technical data showing complete information on resin, pipe and fittings material composition, physical properties, and dimensions of the new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings if damaged. Furnish a certificate of compliance with specified pipe material requirements.

Provide written drilling plan outlining proposed equipment and construction methods, including the following:

- Detailed description of the procedures including construction techniques to provide the access required to install the pipeline
- Dimensioned drawings of any proposed changes in the pipe alignment or profile

- Literature describing in detail the drilling system to be used, including drill steering and locating system.
- Drawings showing: Layout of boring and receiving locations and associated equipment at each location, grade and alignment control system details, groundwater control provision of drilling equipment.
- Qualifications and experience record of the drilling superintendent and machine operators.
- Drilling fluid generation and management

Provide a directional drilling contingency plan that accounts for the following:
- Unforeseen obstructions that stop or delay the progress of drilling equipment
- Deviation from planned line and grade in excess of allowable tolerances
- Loss of drilling fluid
- Damage to other utilities
- Soil settlement or heaving

Provide written copies of quality assurance test results and reports performed by or for the contractor.

Within 48 hours of completing the pilot hole for each run of pipe, provide the log of the drilling operation and guidance system records documenting the line and grade of that pilot hole to the DFD Construction Representative and the AE. Note the location of any utilities or difficult drilling that was encountered.

AS-BUILT DOCUMENTS
Provide printed record of actual horizontal and vertical location of installed pipe from borehole survey instrumentation in addition to marked up drawings.

PART 2 - PRODUCTS

CONDUIT, FITTINGS AND SPLICES
Conduit
Schedule 80

Continuous length smooth-wall HDPE conduit for electrical applications per ASTM F2160.

Conduit shall be listed by a Nationally Recognized Testing Laboratory (NRTL).

Color:
- Power – Black or Black with red stripes.
- Communications -- Orange

Fittings and Splices
See PART 3.
Couplings and Fittings shall be listed.

Marking
Each length of pipe and each fitting shall be clearly and durably marked on their outer surface with their manufacturing details.

Marking shall include Material Type, listing and the date of manufacture.

Fittings shall be clearly and durably marked, including manufacturer's name or trademark, material type, class of pipe, listing and a date or code of manufacture..

Spacing of labeling on pipe shall not exceed 10-feet.

TRACER WIRE
Tracer wire shall be #10 stainless steel wire with 45 mil HDPE jacket.

Alternately, tracer wire may be embedded in conduit wall.

DRILLING FLUID
ANSI/NSF 60 (Drinking Water Treatment Chemicals – Health Effects) certified bentonite-based drilling fluid.

PART 3 - EXECUTION

GENERAL
Comply with the requirements of applicable specification sections for the utility line being installed.

Conduct any necessary field surveys, subsurface investigations and geotechnical investigations necessary to complete the work.

Locate all known utilities located adjacent to or crossing the utility line being installed. Excavate to expose utilities prior to initiating drilling and as required to verify applicable clearances. Clearance shall meet applicable code requirements and the requirements of the directional drilling process.

Locate and verify the clearance of known structures and foundations/footings located adjacent to or crossing the utility line being installed.

EXCAVATION, BACKFILL AND COMPACTION
Excavate insertion and receiving pits, and other access points as necessary to complete the work.

CONDUIT INSTALLATION
HDPE conduit may only be used in horizontal directional drilling applications. Installation must be in accordance with NFPA 70 National Electrical Code and be direct buried or encased in concrete.

HDPE shall not be routed such that it is exposed above grade.

Storage and handling of polyethylene pipe shall not result in damage to or deformation of the pipe. Protect polyethylene pipe from long-term exposure to temperature fluctuations and sunlight.

Prepare pipe on a relatively smooth surface, free of sharp rocks, sticks, or debris. Utilize cribbing, pipe stands, rollers, or other equipment as necessary to support the pipe.

Lift and move piping using ropes, slings, or straps. Do not use unprotected chains, hooks, or clamps to lift pipe.

When lifting and moving pipe, provide a minimum of two points of support. Do not support pipes at butt-fused joints.

Sections of pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and rejoined at the Contractor's expense.

Plug all pipes at end of each workday. Provide a watertight plug to prevent entry of foreign materials into the pipe.

DRILLING

Drilling methods shall generally consist of drilling a pilot hole the length of the bore, followed by reaming and pullback of the pipeline. Ream borehole multiple times, as necessary. The equipment and methods used to complete the bore and install piping shall be determined by the Contractor, but subject to the Contract Documents.

The drill staging area shall be kept neat and orderly and disturb as little area as possible. The pipe staging area shall disturb as little area as needed to accommodate workers and equipment, and to string, fuse, and inspect the pipe.

Install all pulleys, rollers, bumpers, alignment control devices and other equipment required to support and protect the new pipe from damage during installation.

Utilize a drilling fluid cleaning/recycling system. Entry and exit pits shall be sized and constructed to completely contain drilling fluid.

Install boring to line and grade shown on drawings. Alignment shall be within tolerances specified in applicable utility specification sections.

Borehole survey instrumentation shall be used to monitor line and grade of the pilot hole. Contractor shall maintain records documenting the line and grade of the pilot hole.

Contractor shall notify the DFD Project Representative upon completion of the pilot hole to observe alignment prior to reaming and pullback.

JOINING PIPE

Joints between lengths of conduit and between conduit and couplings, fittings and boxes shall be by an approved method using either Heat Fusion, Electrofusion or listed Mechanical Fittings. Glue and/or solvents are NOT approved.

Any joining method employed shall be in accordance with manufacturer recommendations.

The tensile strength at yield of the butt-fusion joints shall not be less than the pipe.

REAM AND PULLBACK

Back-ream Pilot hole reamed to accommodate pipe. Select reamer size and number of passes required.

Pull pipe back using swivel to prevent torsion of pipe.

Monitor tension forces on pipe during pullback. Do not exceed maximum stresses recommended by the pipe supplier.

Support pipeline during pullback operations. Provide supports/rollers in accordance with manufacturer’s recommendations. Supports and rollers shall allow for free movement of the pipeline and prevent damage to the pipe.

Use a drilling fluid in conjunction with the installation of the pipe to fill the annular space around the installed pipeline. Contractor is responsible for determining the type of fluid to use.

Properly dispose all excess drilling fluid and slurry material recovered from the hole during drilling operations and displaced by the pipe during installation.

Unless otherwise noted on the drawings, terminate and cap carrier pipe 5’ above the proposed ground surface.

TRACER WIRE

General

Install Tracer Wire (unless embedded in conduit wall) during pullback operations.

Terminate Tracer Wire at conduit end points and at all intermediate pull points in a fashion as to make it available for locating.

Allow the manufacturer's recommended amount of time for cooling and relaxation due to tensile stressing prior to connecting pipe to adjacent pipe sections, fittings, or structures, or backfilling of the insertion pit. Provide sufficient excess length of new pipe at insertion pits to allow for cooling and relaxation.

Continuity Testing:

Test continuity of the Tracer Wire using an ohmmeter prior to demobilizing.

Tracer Wire Resistance shall be no greater than 105% of the specified unit resistance times installed length.

Conduct testing in the presence of the DFD Project Representative unless this requirement is waived.

Provide a written report describing equipment used, test methods, and detailed test results.

In the event of a failed test, make all necessary repairs required to provide a tracer wire system that complies with the performance requirements of this section.

END OF SECTION

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SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS
BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/23

PART 1 - GENERAL

SCOPE
The work under this section includes the requirements relating to the furnishing and installation of Identification for Electrical Systems. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals

PART 2 - PRODUCTS
- Materials

PART 3 - EXECUTION
- General
- Box Identification
- Power, Control and Signal Wire Identification
- Wiring Device Identification
- Support Wire Identification
- Nameplate Engraving for Electrical Equipment
- Panelboard Directories

RELATED WORK
Applicable provisions of Division 1 shall govern work under this section.

Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
Section 26 05 23 – Control-Voltage Electrical Power Cables
Section 01 91 01 or 01 91 02 – Commissioning Process

SUBMITTALS
Include schedule for nameplates.

Prior to installation, the contractor shall provide samples of all label types planned for the project. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8 1/2" x 11" sheets, explaining their purposed use.

PART 2 - PRODUCTS

MATERIALS
Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED.

Wire Labels: All wiring labels shall be white/transparent nylon or vinyl, self-laminating, wraparound type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.

Tape (wiring phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase. Embossed tape shall not be permitted for any application.

Nameplates: Engraved multi-layer laminated plastic. See Electrical Equipment Identification in the Execution section for nameplate color and size requirements.

See Box Identification and Wiring Device Identification sections for allowed usage of permanent marker.

PART 3 - EXECUTION

GENERAL
Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent. Install all labels firmly as recommended by the label manufacturer. Labels shall be installed plumb and neatly on all equipment.

Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.

Provide all warning labels to electrical equipment as required per NEC 110.16 and 110.21. Provide available fault current labeling to service equipment as required per NEC 110.24.

BOX IDENTIFICATION

All junction and pull boxes shall be identified by color, based on the following color scheme:

Power Systems	**Color(s)**
Secondary Power – 208Y/120V, 240/120V	White

Other Systems not identified above, boxes shall be left in natural finish and be further identified as shown on drawings or approved shop drawings.

The means of junction and pull box identification shall be as follows:

1. Boxes 8" Square or Smaller – Concealed (Above Accessible Ceilings).
   - Color identified utilizing fully painted covers. If box contains power wiring, the box shall be further identified with circuit numbers and source panel designation, using machine-generated adhesive label or neatly hand-written permanent marker.
2. Boxes 8" Square or Smaller – Exposed.
   - Color identified utilizing fully painted covers. If box contains power wiring, the box shall be further identified with circuit numbers and source panel designation, using machine-generated adhesive label or engraved nameplate.
3. Boxes Larger than 8" Square – Concealed (Above Accessible Ceilings).
   - Color identified utilizing 4" x 4" minimum-sized painted patch, or color-correct machine-generated adhesive label. If box contains power wiring, the box shall be further identified with circuit numbers and source panel designation using machine-generated adhesive label or neatly hand-written permanent marker. Letter height shall be ½" minimum.
4. Boxes Larger than 8" Square – Exposed.
   - Color identified utilizing 4" x 4" minimum-sized painted patch, or color-correct engraved nameplate. If box contains power wiring, the box shall be further identified with circuit numbers and source panel designation using engraved nameplate. Letter height shall be ½" minimum.

POWER, CONTROL AND SIGNALING WIRE IDENTIFICATION

Provide wire labels on each conductor in panelboard gutters, all boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control and signaling wires.

All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated, including wiring used for temporary purposes.

WIRING DEVICE IDENTIFICATION

Wall switches, receptacles, occupancy sensors, photocells, poke-through fittings, access floor boxes, and time clocks shall be identified with circuit numbers and panelboard source (ex. Panel ABC-3). In exposed areas, identifications should be made inside of device covers, unless directed otherwise. Use machine-generated adhesive labels, or neatly hand-written permanent marker.

SUPPORT WIRE IDENTIFICATION

Support wires that are installed in addition to the ceiling grid support wires to provide secure support for raceways, cables assemblies, boxes, cabinets, and fittings shall be distinguishable from the ceiling grid support wires per NEC 300.11(A). This identification shall be either approximately 6 inches of fluorescent orange paint, or orange tape flags 3/4 inches high-by-2 inches wide (minimum) within 12 inches of the bottom of the support wires.

ELECTRICAL EQUIPMENT IDENTIFICATION

Nameplates for all panelboards, circuit breakers, disconnect switches, and transformers shall be based on the following color scheme:

Power Systems	Color(s)
Secondary Power – 208Y/120V, 240/120V	Black letters on White background

Provide nameplates of minimum letter height as scheduled below:

All Panelboards (Distribution, Branch, Sub-feed, and Feed-Through), Switchboards and Motor Control Centers: 1 inch (25 mm); identify equipment designation (same designation used by the main distribution center). 1/2 inch (13 mm); identify voltage rating, source and room location of the source.

Panelboards serving NEC 700, 701 or 702 loads shall identify which branch they serve.

Both panels in a double tub application shall be labeled.

Circuit Breakers, Switches, and Motor Starters in Distribution Panelboards, Switchboards and Motor Control Centers: 1/2 inch (13 mm); identify circuit number and load served, including location.

Individual Disconnect Switches, Enclosed Circuit Breakers, and Motor Starters: ½ inch (13 mm); identify voltage, source and load served.

PANELBOARD DIRECTORIES

Typed directories for panelboards shall be covered with clear plastic and shall have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

END OF SECTION

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SECTION 26 05 73
SHORT CIRCUIT/COORDINATION STUDY
AND
ARC FLASH RISK ASSESSMENT
BASED ON DFD MASTER SPECIFICATION DATED 09/03/24

PART 1 - GENERAL

SCOPE

The electrical contractor shall retain the services of an independent third party firm, or the equipment manufacturer's technical services group, to perform a short circuit/coordination study and arc flash risk assessment as described herein.

Preliminary studies shall be submitted to the A/E prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture to ensure the characteristics and ratings of the proposed overcurrent devices will be satisfactory. The final submittal shall capture any changes in circuit lengths, wire sizes, additional loads, etc. that may occur during the construction project.

The studies shall include all portions of the electrical distribution system from the normal power source or sources, and emergency/standby sources, down to and including the smallest OCPD in the distribution system (for short circuit calculations). Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

The firm should be currently involved in medium- and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered professional engineer in the State of Wisconsin. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the A/E for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

The study and assessment shall be performed on SKM Dapper, Captor and PowerTool software or EasyPower product suite software.

Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference Standards
- Data Collection for the Study
- Submittals

PART 2 - PRODUCTS
- Not Used

PART 3 – EXECUTION
- Short Circuit and Coordination Study
- Field Settings
- Arc Flash Risk Assessment

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Section 26 24 16 – Panelboards
Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCE STANDARDS

Standards listed in the IEEE "Buff Book", latest edition
National Fire Protection Association (NFPA) 70E, latest addition
IEEE 1584 – Guide for Performing Arc Flash Calculations

DATA COLLECTION FOR THE STUDY

The contractor shall provide the required data for preparation of the studies. The engineer performing the system studies shall furnish the contractor with a listing of the required data immediately after award of the contract.

The contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

SUBMITTALS

THIRD PARTY QUALIFICATIONS

Submit qualifications of individual(s) who will perform the work to the A/E for approval prior to commencement of the studies.

PRELIMINARY REPORT

Submit a draft of the studies to the A/E for review prior to delivery of the final study to the Owner. Make all additions or changes as required by the reviewer.

For building construction projects, submit a draft of the studies to the A/E for review prior to A/E approval of project electrical switchgear, panelboard and generator shop drawings.

FINAL STUDY REPORT

Provide studies in conjunction with equipment submittals to verify equipment ratings required.

The results of the power system studies shall be summarized in a final report and provided in the following formats. Provide (2) bound hard copies of the final report. Provide (2) electronic copies (on CD) of the final report and one-line diagrams in PDF format. Provide (2) electronic copies (on CD) of the final report in MS Word format and the one-line diagrams in CAD format.

Also provide (2) electronic copies (on CD) of all files generated by the SKM or EasyPower software for all scenarios evaluated in the studies. The files shall permit the studies to be opened, reviewed or updated by any user of the analysis software used for the studies.

The report shall typically include the following sections:

I. Overview
II. Short Circuit Study
    - SC-1 Purpose
    - SC-2 Explanation of Data
    - SC-3 Assumptions
    - SC-4 Analysis of Results
    - SC-5 Recommendations
    - SC-6 Fault Analysis Input Report from Software Program
    - SC-7 Fault Contribution Report
III. Protective Device Coordination Study
    - PDC-1 Purpose
    - PDC-2 Explanation of Data
    - PDC-3 Assumptions
    - PDC-4 Analysis of Results
    - PDC-5 Recommendations (Including NEC 700-32 Requirement)

PDC-6 Results from Software Program
PDC-7 Example Drawings

IV. Arc Flash Study
ARC-1 Purpose
ARC-2 Explanation of Data
ARC-3 Assumptions
ARC-4 Analysis of Results
ARC-5 Recommendations
ARC-6 Arc Flash Evaluation Report from Software Program

V. Prioritized Recommendations and Conclusions

VI. Appendices
APP-1 One-line Diagrams from Software Program
APP-2 AutoCAD One-line Diagrams
APP-3 Protective Device Summaries from Software Program
APP-4 Reference Data
APP-5 Sample Work Permit Form
APP-6 Copy of Warning Labels, including study date

The above sections shall include the following items in detail:

- Obtain available fault current from the local utility company.

- Short circuit studies shall evaluate the available fault current at each bus (each change of impedance), including all three-phase motors.

- Coordination study recommendations for relay settings, breaker settings, and motor protection settings.

- Recommendations for improving the coordination and/or load distribution, as well as ground fault requirements.

- Worst case Arc Flash values (highest incident energy) for project specific scenarios (low short circuit and high short circuit for each possible power supply source).

- Arc flash values for two maintenance cases, which define the arc flash values available at the equipment that would be available if the instantaneous trip of the upstream circuit breaker is set at a minimum value. This is recommended if someone has to work on live equipment.

- IEEE standard one-line diagram with equipment evaluation and circuit breaker settings that clearly define the system data and are easy to interpret. The diagrams should include the bus names and references used in the studies.

- Recommendations to reduce the arc flash incident energy in all areas that are subject to 8 calories per square centimeter or greater of available incident energy.

- Condition of Maintenance information for any existing equipment included in the study.

- Prioritized report summarizing all recommendations from this study. This shall include observed NEC code violations and their corrective action.

- The contractor shall provide a one-line diagram that meets IEEE/ANSI standard 141, mounted on 24” x 36” (minimum) Styrofoam backboard. This one-line diagram shall be mounted in each electrical room.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

SHORT CIRCUIT AND COORDINATION STUDY

The short circuit, coordination, and arc flash hazard studies shall be performed using SKM Dapper, Captor and PowerTool for Windows software or EasyPower product suite Windows based software packages. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault currents.

In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.

Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage fuse characteristics, circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.

Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.

Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.

Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines.

When Current Limiting fuses are utilized as part of the distribution system, the current limiting characteristics shall be accounted for when doing calculations downstream. Manufacturer’s data utilizing maximum fault current- Apparent RMS Symmetrical Current that the fuse will let through during fault conditions shall be used. If modeling software does not take this into account, values shall be manually entered prior to doing calculations.

Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not property rated for fault conditions.

Provide settings for the chiller motor starters or obtain from the mechanical contractor, include in the study package, and comment.

When an emergency generator is provided, include phase and ground coordination of the generator protective devices, to meet NEC 700.32 requirements. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.

For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.

FIELD SETTINGS

The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device coordination study and arc flash risk assessment.

Necessary field settings and adjustments of devices and minor modifications to equipment to accomplish conformance with the approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

ARC FLASH RISK ASSESSMENT

As part of the short circuit and coordination study, arc flash risk assessment shall be included. The study shall include the following:

1. Determine and document all possible utility and generator/emergency sources that are capable of being connected to each piece of electrical gear. Calculations shall be based on highest possible source connection.

2. Calculations to conform to National Fire Protection Association (NFPA) 70E recognized means of calculation standards. All incident energy units shall be calculated in calories per square centimeter.

3. Provide recommended boundary zones and personal protective equipment (PPE) based on the calculated incident energy and requirements of NFPA 70E for each piece of electrical gear.

Electrical Contractor shall provide warning labels as required by OSHA based upon the results of the arc flash risk assessment. At a minimum, the labeling shall contain the following information: nominal system voltage, arc flash boundary, limited approach boundary, restricted approach boundary, available incident energy and the corresponding working distance or the arc flash PPE category, minimum arc rating of clothing, and study date. Label shall also include the name or logo and the phone number of the company performing the study.

Arc flash warning labels shall be affixed to all electrical equipment that is likely to require examination, adjustment, servicing or maintenance while energized. This includes, but is not limited to, medium-voltage switchgear, transformers, switchboards, panel boards, three-phase disconnect switches, transfer switches, motor control centers, motor controllers, and three-phase motor disconnect switches.

END OF SECTION

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SECTION 26 08 00
COMMISSIONING OF ELECTRICAL
BASED ON DFD MASTER SPECIFICATION DATED 03/01/21

PART 1 - GENERAL

SCOPE
This section includes commissioning forms for construction verification and functional performance testing. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Submittals

PART 2 - PRODUCTS
- (Not Used)

PART 3 – EXECUTION
- Commissioning Forms
  - CV-26 05 19 Low-Voltage Electrical Power Conductors and Cables
  - CV-26 05 26 Grounding and Bonding for Electrical Systems
  - CV-26 05 33 Raceways and Boxes for Electrical Systems
  - CV-26 24 16 Panelboards

RELATED WORK
Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCE
Applicable provisions of Division 1 shall govern work under this section.

SUBMITTALS
Reference the General Conditions of the Contract for submittal requirements.

Reference Section 01 91 01 or 01 91 02 Commissioning Process for Construction Verification Checklist and Functional Performance Test submittal requirements.

PART 2 – PRODUCTS

(Not Used)

PART 3 – EXECUTION

COMMISSIONING FORMS
Commissioning forms are to be filled in as work progresses by the individuals responsible for installation and shall be completed for each installation phase.

Provide a description of the work completed since the last entry, the percentage of the total work completed for the system for that area and the step of installation or finalization.

Circle Yes or No for each commissioning form item. If the information requested for an item does not apply to the given stage of installation for the system, list it as “N/A”. Explain all discrepancies, negative responses or N/A responses in the negative responses section.

Once the work is 100% complete and the responses to each item are complete and resolved for a given commissioning forms group, mark as complete, initial and date in the spaces provided.

Provide copies of the commissioning forms to the commissioning agent 2 days prior to construction progress meetings.

CV-26 05 19 – Low-Voltage Electrical Power Conductor and Cables

Equipment Identification/Tag: _______
Location: _________________________

A) CONDUCTOR AND CABLING PULLING CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)						
				1)	2)	3)	4)	5)	6)	7)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:	_______________			DATE:	_______________	

Question Details

1) Conductor and cabling sized to maintain less than a 3% voltage drop for rated length and ampacity of circuit.
2) Conductors and cabling coloring match specification requirements for given voltage, wire gauge, and leg of circuit.
3) Conduits swabbed to remove foreign material prior to pulling cables.
4) All cables pulled though conduit at the same time, with pulling lubricant used to ease pulling tensions.
5) Excess cable provided at each termination and splice point for purpose of multiple terminations or splices to be performed.
6) Emergency power conductors and cabling pulled in separate conduits from normal power systems.
7) Outdoor cables not to be terminated within 8 hours to be properly sealed and protected from moisture intrusion until termination.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

B) CONDUCTOR AND CABLE TERMINATIONS & SPLICES CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)							
				1)	2)	3)	4)	5)	6)	7)	8)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:	_______________			DATE:	_______________		

Question Details

1) Installed lugs match the pads on the equipment to which the cable will be mounted.
2) All lug terminations are connected per connection torque valve as recommended by the manufacturer.
3) Splices made only in accessible junction boxes.
4) All conductors and cables cleaned prior to termination.
5) All splices made so that the electrical resistance of the splice does not exceed the equivalent resistance of 2’ of conductor.
6) Solderless spring type pressure connectors with insulating covers used for all wires splices and taps of conductors and cabling 10AWG and smaller.
7) Mechanical or compression connectors used for all wire splices and taps of conductors and cabling 8 AWG and larger.
8) Uninsulated conductors and connectors taped with electrical tape equivalent to 150% of the insulation value of the conductor.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

C) TESTING & FINALIZATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)				
				1)	2)	3)	4)	5)
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:		_____		DATE: _____

Question Details

1) All exposed conductors and cabling has been visually inspected for physical damage and any damaged conductors and cabling has been replaced.
2) Conductors and cabling jacket and insulation are in good condition.
3) All cable terminations have been checked for proper tightness and clearances per specification and manufacturer recommendations and any adjustments necessary have been made.
4) For aluminum conductors and cabling all specified acceptance tests have been performed on all cables, terminations, and splices and are approved prior to energizing.
5) All splices and terminations are to be tagged within 2” to 4” of splice or termination and in accordance with specification requirements.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

CV-26 05 26 – Grounding and Bonding for Electrical Systems

Equipment Identification/Tag: _______
Location: ________________________

A) GENERAL GROUNDING AND BONDING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	
❑ CHECKLIST GROUP COMPLETE				INITIALS:	______________				DATE:	______________			

Question Details

1) Mechanical connections accessible for inspection and checking, with no insulation of connections.
2) Ground connection surfaces cleaned and all connections made permanent.
3) Grounds attached permanently before permanent building service is energized.
4) Grounding electrode conductors installed in PVC conduit or rigid galvanized steel conduit and bonded at both ends to the grounding electrode conductor with an approved grounding fitting.
5) Grounding electrode is correct size and length.
6) Grounded conductor run to each service disconnecting means and its enclosure.
7) Separate insulated equipment grounding conductor installed with phase conductors within each raceway.
8) All metallic systems (water, gas, sprinkler, etc.) and lightning protection system bonded to ground system.
9) System bonded within 5’ from point of entry into building to at least two of the following: metal underground water pipe, metal frame of building, concrete encased

electrodes, ground ring, (underground local systems such as storage tanks, conduit, or piping), ground rod installed 8’ deep or at 45-degree angle and distanced a minimum of 6’ apart., ground plate buried 2-1/2’ deep.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

B) MEDIUM VOLTAGE GROUNDING AND BONDING INSTALLATION CHECKS

		%		Questions (See details below)								
Date	**Description of Work Performed**	**Complete**	**Initials**	**1)**	**2)**	**3)**	**4)**	**5)**	**6)**	**7)**	**8)**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
				YES NO	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	**YES NO**	
❑ **CHECKLIST GROUP COMPLETE**				**INITIALS:**	______________				**DATE:**	______________		

Question Details

1) Ground bus installed 18" above finished floor with insulated standoffs 36” on center, completely around the perimeter of the room (vault) containing the high voltage switchgear and unit substation.
2) Six ground rods provided equally spaced around high voltage switchgear room and connected to ground bus with 4/0 copper.
3) Separate 4/0 copper conductors provided from ground bus to, XO terminal of each transformer, each high voltage switch ground bus, and secondary service equipment ground bus.
4) Full size 600V copper THHN/THWN or XHHW-2 grounding conductor provided in each conduit, raceway or enclosure which contains high voltage conductors, and terminated at ground bus of equipment containing high voltage terminations.
5) Each enclosure containing high voltage parts (switches, fuses, transformers, pull boxes, etc.) bonded to room ground bus with 4/0 copper conductor.
6) All conduits containing high voltage conductors or secondary service conductors bonded to penetrated enclosures using grounding bushing and #4 copper conductor.
7) #10 stranded wire provided from each termination shield drain wire to ground bus within enclosure.
8) Ground rod provided in each section of each secondary switchboard with 4/0 copper wire connection to ground rod and to switchgear ground bus.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

C) LOW VOLTAGE (<600V) GROUNDING AND BONDING INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO			
❑ CHECKLIST GROUP COMPLETE				INITIALS:	_______________				DATE:		_______________		

Question Details

1) Code sized copper grounding electrode conductor provided from secondary switchboard ground bus, each separately derived system neutral, secondary service system neutral to street side of water meter, building steel, ground rod, and any concrete encased electrodes.
2) Bonding jumper provided around water meter.
3) Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor bonded in raceways and cables, receptacle ground connectors, and plumbing systems.
4) Separate insulated equipment grounding conductor provided within each raceway.
5) Ground wire provided from each device to the respective enclosure.
6) Communications system grounding conductor provided at point of service entrance and connected to building common grounding electrode system.
7) Telecommunications and audio visual systems installed with an isolated grounding system with only one ground point at the electrical service entrance for the building per specification requirements.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

CV-26 05 33 – Raceway and Boxes for Electrical Systems

Equipment Identification/Tag: _____
Location: _____

A) CONDUIT & FITTINGS PRE-INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below) 1)	2)
				YES NO	YES NO
				YES NO	YES NO
				YES NO	YES NO
				YES NO	YES NO
				YES NO	YES NO
				YES NO	YES NO
				YES NO	YES NO
				YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS: _____	DATE: _____

Question Details

1) Conduit type and material in accordance with specification requirements for given application and location.
2) Conduit sufficiently sized to accommodate cabling and fill requirements of contract document.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

B) CONDUIT & FITTINGS INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:		_______________			DATE:		_______________		

Question Details

1) Conduit support spacing complies with specification requirements.
2) All conduit supported independently of piping, ductwork, equipment, cable tray or other conduit.
3) Bends in conduit minimized with required bends conforming to specification requirements and no more than an equivalent of three 90 degree bends between boxes.
4) Moisture traps are avoided as much as possible. When unavoidable, a junction box is provided with drain fitting at conduit low point.
5) All equipment requiring maintenance is accessible.
6) Minimum 6” clearance between conduit and piping, and 12” clearance between conduit and heat sources such as flues, steam pipes, and heating appliances is provided.
7) No continuous conduit run exceeds 100’ without a junction box.
8) Expansion-deflection joints installed where conduit crosses building expansion joints.
9) Where conduit passes between areas of differing temperatures, listed conduit seals are provided.
10) At end of work day suitable conduit caps or other approved seals provided for incomplete work to protect installed conduit against entrance of dirt and moisture.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

C) RACEWAY & GUTTER INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below) 1)	2)	3)	4)	5)	6)	7)	8)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:	______________				DATE:	______________	

Question Details

1) Raceway and gutter support spacing and methods comply with specification requirements.
2) All raceways supported independently of piping, ductwork, equipment, cable tray or other conduit.
3) Suitable insulating bushings and inserts provided at connections to outlets and corner fittings.
4) All equipment requiring maintenance is accessible.
5) Expansion-deflection joints installed where conduit crosses building expansion joints.
6) Oil tight gutters included gaskets at each joint.
7) Rain-tight gutters are installed in horizontal position only.
8) At end of work day suitable caps or other approved seals provided for incomplete work to protect installed raceways and gutters against entrance of dirt and moisture.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

D) JUNCTION, PULL AND OUTLET BOXES INSTALLATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)								
				1)	2)	3)	4)	5)	6)	7)	8)	9)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:	______________				DATE:	______________		

Question Details

1) Boxes provided in locations as per contract documents, Engineer's direction or as necessary for splicing and terminations.
2) Box type and material in accordance with specification requirements for given application and location.
3) No outlet box located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
4) All boxes supported independently of conduit, piping, ductwork, equipment, or cable tray.
5) No outlet boxes installed back-to-back in walls, and minimum 6" separation between all boxes, except for installations in acoustic walls where a minimum 24" separation between boxes is provided.
6) All boxes are accessible, and where installation is inaccessible, 18" by 24" access door has been provided.
7) Mounting heights for outlet boxes corresponds with contract document requirements.
8) All recessed outlet boxes in finished areas are mounted to the correct depth to accommodate and be flush to final surface finish.
9) Knockout closures provided for unused openings.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

E) FINALIZATION CHECKS

Date	Description of Work Performed	% Complete	Initials	Questions (See details below)									
				1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
				YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO
❑ CHECKLIST GROUP COMPLETE				INITIALS:	______________				DATE:	______________			

Question Details

1) All penetrations through fire rated wall assemblies have been sealed per specification requirements.
2) All penetrations through non-rated wall assemblies have been sealed per specification requirements for given space type.
3) Conduits that penetrate the building envelope are sealed to prevent intrusion of air and moisture and are accessible.
4) All conduit junction boxes are painted and tagged in accordance with specification requirements.
5) All splices and terminations are to be tagged within 2” to 4” of splice or termination and in accordance with specification requirements.
6) 1/8” nylon pull string provided in all empty conduits, except sleeves and nipples.
7) Grounding and bonding of conduits and raceways conform to specification requirements.

Negative Responses

Group/ Item	Date Found	Found By	Location	Reason for Negative Response	Resolved	Date Resolved	Resolution
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		
					YES / NO		

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CV-26 24 16 – Panelboards

Equipment Identification/Tag: _____
Location: _____

Group/Item	Group/Task Description	Submitted	Delivered
A	*MODEL VERIFICATION*		
1	Manufacturer		
2	Model		
3	Catalog Number		
4	Voltage / Phase / Frequency (V / - /Hz)	/ /	/ /
5	Main Amps (A)		
6	Circuit Count		
7	kAIC rating (kA)		
❑ **CHECKLIST GROUP COMPLETE**	**INITIALS:** _____	**DATE:**	_____

Group/Item	Group/Task Description	Response	
B	*PHYSICAL CHECKS*		
1	Unit is free from physical damage.	YES	NO
2	All components/accessories present.	YES	NO
3	Circuit breaker capacities documented.	YES	NO
4	Unit tags affixed.	YES	NO
5	Manufacturer's ratings readable/accurate.	YES	NO
❑ **CHECKLIST GROUP COMPLETE**	**INITIALS:** _____	**DATE:**	_____
C	*INSTALLATION*		
1	Unit secured as required by manufacture, specifications, and seismic zone requirements.	YES	NO
2	Adequate clearance around unit for service per table NEC-110.26.	YES	NO
3	Top of tub set at 6' from finished floor unless specified otherwise in contract documents.	YES	NO
4	Conduit feeds are aligned with openings and accommodate seismic motion.	YES	NO
5	Unit is level, plumb, and square.	YES	NO
6	Unit labeled and is easy to see.	YES	NO
❑ **CHECKLIST GROUP COMPLETE**	**INITIALS:** _____	**DATE:**	_____
D	*WIRING*		
1	Three spare ¾" empty conduits provided (recessed units ONLY).	YES	NO
2	Unit is adequately grounded to grounding lug for intended use.	YES	NO
3	Proper phasing has occurred in relationship to phase conductors.	YES	NO
4	All connections are terminated properly.	YES	NO
5	All electrical connections are tight.	YES	NO
6	All cables are permanently labeled relative to use.	YES	NO
❑ **CHECKLIST GROUP COMPLETE**	**INITIALS:** _____	**DATE:**	_____
E	*STARTUP*		
1	All protective coverings have been removed.	YES	NO
2	Unit has been cleaned of all debris and dirt on interior of unit.	YES	NO
3	Insulators and supports show no signs of damage or cracks.	YES	NO

Group/Item	Group/Task Description			Response	
4	Current transformers secured and wired per manufacturer instructions (metering applications ONLY).			YES	NO
5	All electronic circuit breaker settings have been adjusted to desired setting (if applicable).			YES	NO
6	Ground-fault-protection (GFP) trip and time delays have been adjusted to desired setting (if applicable).			YES	NO
7	All wiring connections verified for proper torques values and are acceptable.			YES	NO
8	Phase-to-phase, phase-to-ground, and neutral-to-ground, and dielectric tests have been accomplished and results are acceptable.			YES	NO
9	No hazards or adverse circumstances exist per continuity and high potential tests.			YES	NO
10	Insulation megger test accomplished and results acceptable.			YES	NO
11	Unit energized by authorized personnel.			YES	NO
12	All damage to unit finish is repaired.			YES	NO
❑ **CHECKLIST GROUP COMPLETE**		**INITIALS:**	_____	**DATE:**	_____
F	*TESTING & FINALIZATION*				
1	Overcurrent protective devices have been manually exercised.			YES	NO
2	Solid state circuit breaker self-diagnostics completed.			YES	NO
3	Electronic circuit breaker trip unit tests completed.			YES	NO
4	Ground-fault-protection (GFP) system tested and certified.			YES	NO
5	Filler plates provided for all unused spaces.			YES	NO
6	As-built circuit index provided and attached to interior of unit door.			YES	NO
❑ **CHECKLIST GROUP COMPLETE**		**INITIALS:**	_____	**DATE:**	_____

Negative Responses

Group/ Item	Date Found	Found By	Reason for Negative Response	Resolved	Date Resolved	Resolution
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		
				YES / NO		

SECTION 26 24 16
PANELBOARDS
BASED ON DFD MASTER ELECTRICAL SPEC DATED 09/03/24

PART 1 - GENERAL

SCOPE
The work under this section includes main, distribution and branch circuit panelboards. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- References
- Submittals
- Operation and Maintenance Data
- Spare Parts

PART 2 - PRODUCTS
- Branch Circuit Panelboards
- Coordination of Overcurrent Protective Devices

PART 3 - EXECUTION
- Installation
- Field Quality Control
- Construction Verification Items
- Agency Training

RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

Section 26 05 73 - Short Circuit/Coordination Study and Arc Flash Risk Assessment
Section 26 08 00 - Commissioning of Electrical
Section 01 91 01 or 01 91 02 – Commissioning Process

REFERENCES
ANSI C57.13 – Instrument Transformers
NEMA AB 1 - Molded Case Circuit Breakers
NEMA KS 1 - Enclosed Switches
UL-891 - Dead Front Switchboards

SUBMITTALS
Include outline and support point dimensions, voltage, main bus ampacity, circuit breaker arrangement and sizes, and interrupting ratings confirming a fully-rated system for all equipment and components.

Submit required short circuit coordination study per specification section 26 05 73 to the consulting engineer for review and approval. Submittal shall be on or before date of panelboard equipment submittal.

OPERATION AND MAINTENANCE DATA
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

SPARE PARTS
Keys: Furnish 2 keys for each panelboard to Owner.

Handle lock-off: Furnish (2) 20/1P circuit breaker handle lock-off devices for each panelboard to Owner.

One set of three spare fuses of each size and type utilized.

PART 2 - PRODUCTS

BRANCH CIRCUIT PANELBOARDS
Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.

The panelboard and overcurrent devices contained within shall be **fully-rated.**

Enclosure: Minimum cabinet size: 5-3/4 inches (144 mm) deep; 20 inches (508 mm) wide with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.

Cabinet front cover and cabinet shall be Type 4X, 304 stainless steel in wet and damp locations including kitchen, food service and therapeutic/pool applications.

Provide surface cabinet front with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.

Provide metal directory holders with clear plastic covers. Holder to be factory mounted.

Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Phase, neutral and ground bar terminations can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.

Incoming conductors shall terminate at lug landing pads rated for the panelboard.

Provide compression type lugs to accommodate the conductor shown on drawings.

Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings and as required by short circuit/ coordination study.

Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault interrupter circuit breakers as shown on Drawings. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

Do not use tandem circuit breakers.

Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.

Provide a minimum of 10% spare circuit breakers in branch panelboards.

All of the panelboards provided under this section shall be by the same manufacturer.

All panelboards installed side by side (double tub) shall utilize same enclosure height.

Double tub panelboard installations shall identify type of feed to adjacent panelboard- sub-feed or feed-thru. Identification shall be integral with panel label.

COORDINATION OF OVERCURRENT PROTECTIVE DEVICES

Provide a coordination study of the electrical system and recommend set points for all of the overcurrent and ground fault trip adjustments on the equipment provided. The coordination study and set point recommendations shall be submitted to the consulting engineer for approval. Submittal shall be on or before date of switchboard and panelboard equipment submittal. The study shall meet the requirements of specification section 26 05 73.

PART 3 - EXECUTION

INSTALLATION

See section 26 05 29 for support requirements.

Install panelboards plumb with wall finishes.

Height:

Branch panelboards: 6'-0" to top of panelboard.

Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a captive assembly rated for terminating stranded conductors.

Provide filler plates for unused spaces in panelboards.

See section 26 05 53 for identification requirements. Provide typed circuit directory for each panelboard per NEC 408.4(A). Revise directory to reflect circuiting changes required to balance phase loads.

Stub three (3) empty ¾" conduits to accessible location above ceiling or below floor out of each recessed panelboard. Cap these conduits to prevent material from entering them.

FIELD QUALITY CONTROL

If aluminum conductors sized #1/0 and larger (per Section 26 05 19) are to be used as panelboard feeders, it is the responsibility of the contractor to provide panelboards with adequate wire bending space to accommodate the aluminum conductors and terminators to meet allowable code requirements.

The Contractor shall circuit the panelboards as shown on the drawings. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in the panelboard to balance the phase loads within 10 percent.

Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.

CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION

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SECTION 26 27 02
EQUIPMENT WIRING SYSTEMS
BASED ON DFD MASTER ELECTRICAL SPEC DATED 03/01/23

PART 1 - GENERAL

SCOPE
The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:
-Misc. Equipment

Included are the following topics:

PART 1 - GENERAL
Scope
Related Work
Submittals
Coordination
PART 2 - PRODUCTS
Cords and Caps
Other Products
PART 3 - EXECUTION
Inspection
Preparation
Installation
Miscellaneous Connections

RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
Section 26 05 33 – Raceway and Boxes for Electrical Systems
Section 01 91 01 or 01 91 02 – Commissioning Process

SUBMITTALS
Product Data: Provide data for cord and wiring devices.

COORDINATION
Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

Coordinate the available fault current at equipment including control panels and internal components. Equipment shall be listed to interrupt the available fault current at point of connection.

PART 2 - PRODUCTS

CORDS AND CAPS
Straight-blade Attachment Plug: NEMA WD 1.

Locking-blade Attachment Plug: NEMA WD 5.

Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.

Cord Construction: Oil-resistant thermoset insulated multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.

Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

OTHER PRODUCTS
Refer to related sections for other product requirements.

PART 3 - EXECUTION

INSPECTION
Verify that equipment is ready for electrical connection, wiring, and energizing.

Working space for equipment shall be provided that is likely to require examination, adjustment, servicing or maintenance per NEC 110.26(A)(1) table.

PREPARATION
Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

INSTALLATION
Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

Provide a green equipment ground conductor for all installed equipment wiring.

Make conduit connections to equipment using flexible PVC-coated metal conduit.

Requirements of NEC Article 300.22 shall apply for boxes, conduit, conduit connections to equipment, devices and luminaire located in Mechanical Plenum spaces.

Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.

Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.

Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

All 120V single phase motor operated equipment such as fan coil units, unit heaters, door operators, shall be provided with a SSY, 2 gang combination plug fuse holder/ switch mounted adjacent to equipment.

MISCELLANEOUS CONNECTIONS
Hand Dryers: Provide handle lock on source circuit breaker to serve as required lock open disconnect.

Drinking Fountains and Bottle Fill Fountains: Provide GFCI source circuit breaker to serve receptacle at fountain.

EQUIPMENT CONNECTION SCHEDULE
As indicated on the drawings.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES
BASED ON DFD MASTER ELECTRICAL SPEC DATED 09/03/24

PART 1 - GENERAL

SCOPE
This section describes the products and execution requirements relating to furnishing and installing wiring devices and related systems for the project. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals
- Operation and Maintenance Data

PART 2 - PRODUCTS
- Device Colors
- Device Plates and Box Covers
- Modularly Connected (Modular) Devices
- Receptacles

PART 3 - EXECUTION
- Installation
- Field Quality Control
- Adjusting

RELATED WORK
Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process

SUBMITTALS
Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.

For motion sensor shop drawings, the manufacturer’s actual layout of motion sensors and the wiring diagrams shall be provided.

OPERATION AND MAINTENANCE DATA
All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

DEVICE COLORS:
Device colors shall be selected by project architect’s interior designer and coordinated with Agency representative during shop drawing review.

All switches and convenience outlets on emergency circuits shall have a red handle or red face with matching red cover plate.

DEVICE PLATES AND BOX COVERS
Decorative Cover Plate: 302/304 lined stainless steel. Note requirement for red plates on emergency outlets and switches.

Weatherproof Cover: All receptacles installed in wet locations shall have an enclosure that is weatherproof whether or not the attachment plug is inserted. Covers shall be gasketed metal with hinged “in-use” device covers, powder coat painted. Non-metallic covers are not allowed. Covers shall be latching type and shall be lockable. Covers shall be identified as “extra-duty” type per NEC 406.9(B)(1).

Damp Location Cover: All receptacles installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure that is weatherproof when the receptacle is covered (attachment plug not inserted and receptacle covers closed). Covers shall be gasketed metal with hinged device covers, powder coat painted. Non-metallic covers are not allowed.

Surface Cover Plate: Raised galvanized steel.

MODULARLY CONNECTED (MODULAR) DEVICES:
Modularly connected devices are allowed, but not required.

Modular Pigtailed Connector: Polarized connector with minimum six-inch stranded copper wire leads, polycarbonate right-angle housing, UL498 listed, with finger-safe connector housing which provides insulation from conductive surfaces. Contacts shall be brass. Connector shall be manufactured so that it provides a secure connection such that it will maintain contact with the device until the device is removed for replacement. Modular connectors shall be provided with covers which protect the contacts from paint, drywall mud, and construction dust and debris. Connectors shall be Hubbell SNAPConnect, Leviton Lev-Lok, Pass & Seymour PlugTail, or approved equal.

RECEPTACLES
General Requirements: NEMA Type 5-20R, Nylon or high impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596. All duplex receptacles shall be heavy duty Specification Grade, 20 amp rated.

Generally, all receptacles shall be duplex convenience type unless otherwise noted.

All receptacles installed in bathrooms, kitchens, and within 6 feet of the outside edge of sinks shall be GFCI type.

All receptacles installed in outdoor locations, garages, rooftops, and in other damp or wet locations shall be GFCI type with a weather-resistant (WR) rating.

Convenience and Straight-blade Receptacles: All receptacles shall be back- and side-wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be as follows:
Hubbell 5362*,
Leviton 5362-S*,
Pass & Seymour 5362*,
or approved equal. (* indicates color selection).

GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A, including self-test functionality and reverse line-load misfire function repeatability. GFCI receptacles shall be as follows:
Hubbell GFR5362SG*,
Leviton GFNT2-*,
Pass & Seymour 2097*,
or approved equal. (* indicates color selection).

GFCI Receptacles with a weather-resistant (WR) rating: Weather-Resistant duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class-A, including self-test functionality and reverse line-load misfire function repeatability. WR GFCI receptacles shall be as follows:
Hubbell GFR5362SG*,
Leviton GFWR2-*,
Pass & Seymour 2097TRWR*,
or approved equal. (* indicates color selection).

Locking-Blade Receptacles: As indicated on drawings.

Specific-use Receptacle Configuration: As indicated on drawings.

Modular Convenience and Straight-blade Receptacles: Receptacles shall be as follows:
Hubbell SNAP5362*A,
Leviton M5362-S*,
Pass & Seymour PT5362*,
or approved equal. (* indicates color selection).

Modular GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A, including self-test functionality and reverse line-load misfire function repeatability. GFCI receptacles shall be as follows:
Hubbell GFRST83SNAP*,
Leviton MGFN2-*,
Pass & Seymour PT2097*,
or approved equal. (* indicates color selection).

Modular GFCI Receptacles with a weather-resistant (WR) rating: Use back- and side-wired devices in lieu of modular weather-resistant rated GFCI receptacles.

or approved equal. (* indicates color selection).

PART 3 - EXECUTION

INSTALLATION

Device installations shall be per ADA requirements.

Install specific-use receptacles at heights shown on Contract Drawings.
Install decorative plates on switch, receptacle, and blank outlets in finished areas.

Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

Install devices and wall plates flush and level.

Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

FIELD QUALITY CONTROL

Inspect each wiring device for defects.

Operate each wall switch and sensor with circuit energized, and verify proper operation.

Verify that each receptacle device is energized.

Test each receptacle device for proper polarity.

Test each GFCI receptacle device for proper operation.

The user agency and DFD personnel reserve the right to be present at all tests.

END OF SECTION

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SECTION 26 56 29
SITE LIGHTING
BASED ON DFD MASTER ELECTRICAL SPEC DATED 09/03/24

PART 1 - GENERAL

SCOPE

The work under this section includes exterior luminaires and accessories, poles, and foundations. Also included are the following topics:

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Section 01 91 01 or 01 91 02 – Commissioning Process
Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
Section 26 08 00 – Commissioning of Electrical

REFERENCE STANDARDS

Wisconsin Administrative Code SPS 362.1807 Shallow Post Foundations.
International Building Code IBC 1807.3 Embedded Posts and Poles.
IEEE 1789 – Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.
RoHS – Restriction of Hazardous Substances. Council of the European Union (EC) Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
LM-79-08 (or latest) – IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
LM-80-08 (or latest) – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
TM-21-11 (or latest) – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
NEMA SSL 1-2010 (or latest) – Electronic Drivers for LED Devices, Arrays, or Systems.

DEFINITIONS

Driver: The power supply used to power LED luminaires, modules, or arrays.

L70, $L_{70,}$ or $L_{70\%}$: The reported life of an LED component or system to reach 70% lumen maintenance, or 70% of the LEDs original light output.

LEDs: Broadly defined as complete luminaire with light emitting diode (LED) packages, modules, light bars, or arrays, complete with driver.

LED luminaire failure: Negligible light output from more than 10 percent of the LEDs, or less than 70 percent of the listed lumen output constitutes luminaire failure.

SUBMITTALS

Shop Drawings: Indicate dimensions and components for each luminaire, pole, and base.

Product Data:

For each luminaire type, submit luminaire information including catalog cuts with highlighted catalog numbers, and required accessories:

- Luminaire:
  - Manufacturer and catalog number,
  - Type (identification) as indicated on the plans and schedule,
  - Delivered lumens,
  - Input watts,
  - Efficacy,
  - Color rendering index,
  - Performance data, and
  - Effective Projected Area (EPA).
- Driver:
  - Manufacturer and catalog number,
  - Type (Non-Dimming, Step-dimming, Continuous dimming, etc.),
  - Power Factor, Crest Factor, THD, etc.
- Pole (if applicable):
  - Diameter
  - Height
  - Pole thickness
  - Weight

Manufacturer's Instructions:

Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".

Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

Light Layout: Provide a computer-generated factory point-by-point foot-candle layout of the project for each area involved.

Post Installation Report: Provide to the Engineer and DFD the results of the measured foot-candle level for each area involved. Use a measuring device pre-approved by DFD.

PROJECT RECORD DOCUMENTS

Accurately record actual locations of each luminaire, pole, and underground circuit.

Provide record drawings of the final, as installed and measured, point-by-point foot-candle layout for each area involved.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

COORDINATION

Use bolt templates and pole mounting accessories to install anchor bolts in pole base.

EXTRA MATERIALS

Provide one (1) of each type of LED module, light bar, or array (if applicable). If the LEDs are integrated into the luminaire and are not separate components, then provide one (1) of each of these types of luminaires.

Provide one (1) LED driver of each type.

Provide five (5) percent of total fuses provided for each size, but not less than one (1) of each size.

PART 2 - PRODUCTS

LUMINAIRES

See the Luminaire Schedule on the drawings for type of luminaires and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Luminaires manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated luminaires and meet the intent of the design.

Luminaire shall be certified by a Nationally Recognized Testing Laboratory (UL, ETL, or IEC).

Provide luminaires with quick-connect disconnecting means, similar to Thomas & Betts Sta-Kon.

LED LUMINAIRES

- LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
    - Minimum Light Output.
    - Zonal Lumen Requirements.
    - Minimum Luminaire Efficacy.
    - Minimum CRI.
    - L70 Lumen Maintenance.
    - Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.

Additional requirements:

- Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
- Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 5-step MacAdam Ellipse binning process.
- Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
- Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
- LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -40°F to 104°F (-40°C to 40°C).
- Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- Luminaire shall have a maximum Total Harmonic Distortion (THD) of $\leq$20% at full input power and across specified voltage range.
- All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- All luminaires shall be provided with knockouts for conduit connections.

- The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).
- Provide all of the following data on submittals:
    - Delivered lumens
    - Input watts
    - Efficacy
    - Color rendering index.

LED Luminaires used for Emergency Egress Lighting:

- The failure of one LED shall not affect the operation of the remaining LEDs.

Emergency LED Luminaire Compatibility with Inverters:

- Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

LED DRIVERS

General:

- Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
- Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- Driver shall have a rated life of 50,000 hours, minimum.
- Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- Driver shall modulate current at high frequencies.
- Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- Driver shall have a maximum Total Harmonic Distortion (THD) of $\leq$20% at full input power and across specified voltage range.
- Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- Provide all of the following data on submittals:
    - Input watts
    - Power Factor (pf)
    - Crest Factor (cf) at full input power
    - Total Harmonic Distortion (THD).

Dimming Drivers:

- LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC), Constant Voltage, or a hybrid of Constant Current Reduction (CCR) with Pulse Width Modulation (PWM) operation. All dimmable drivers shall operate at high frequencies.

- Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.

Drivers for Bi-Level Switching:

- Provide two (2) drivers, or drivers compatible with bi-level switching control from two (2) separate contactors/switch-legs in each luminaire where indicated in the luminaire schedule on the drawings.

BI-LEVEL SWITCHING

Provide bi-level switching operation where indicated on the drawings. Luminaires shall normally operate at 100% output during nighttime hours, but shall decrease to 50% output "after hours" as defined by 2015 IECC C405.2.5. Luminaires shall be compatible with bi-level switching operation.

FUSES

Furnish and install a fuse holder and fuse in each ungrounded leg of the electrical circuit supplying the outdoor luminaire. If the voltage is 208, 240, or 480 volts, then the fuse holder needs to be a 2-pole fuse holder which simultaneously disconnects both ungrounded conductors. Every luminaire (including bollards) shall be separately fused with a water-resistant fuse holder. Size the fuse for the amperage of the luminaire.

Tap the circuit conductors with a minimum #10 AWG conductor to serve the luminaire. The fuse and holder shall be accessible through the handhole. Provide sufficient wire to bring fuse holder outside of handhole.

WIRING CONNECTORS

Wiring Connectors shall meet the requirements of Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.

Twist-On Wire Connectors: Solderless twist-on spring connectors (wire-nuts) with insulating covers for copper wire splices and taps. All wire connectors used in site lighting applications shall be silicone gel-filled twist connectors or connectors designed for damp and wet locations. Gel-filled twist-on connectors may be used for copper conductor sizes 6 AWG and smaller for site lighting applications. The manufacturer's wire fill capacity must be followed.

POLES

Furnish products as specified in schedule on Drawings.
Handhole: With removable weatherproof cover.

Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

FOUNDATIONS

Provide foundations for poles, bollards, and ground-mounted flood and accent lighting. Construct from reinforced concrete in sizes as shown on drawings and to meet the minimum structural requirements of SPS 362.1807 Shallow Post Foundations, and IBC 1807.3 Embedded Posts and Poles.

Place the anchor bolts in pole bases so that the luminaire will be oriented perpendicular to the curb/street/sidewalk/parking lot or as indicated on the plan.

Provide a concrete-encased electrode (UFER) grounding system for grounding the foundation, luminaire, and pole:

1. Provide twenty-five (25) feet of #4 bare stranded copper grounding electrode conductor.
2. Extend three (3) feet of the grounding electrode conductor out the top of the foundation for connection to the luminaire/pole.
3. Clamp the grounding electrode conductor to the top of the rebar cage. Use a clamp rated for such use such as an Erico EK16 or similar.
4. Spiral a minimum of ten (10) feet of the grounding electrode conductor around the outside of the rebar cage.
5. Loop the remaining conductor around the rebar cage at the bottom of the foundation in direct contact with earth.

The exposed surface area of the foundation shall have the forms removed and the concrete rubbed out to a smooth finish.

Pole Base J-Boxes

For pole bases with multiple conduits to other poles/locations, the contractor may provide a non-metallic j-box with a curved cover mounted in the side of the exposed part of the base to accommodate the multiple conduits. Boxes shall be NEMA 3R Carlon Nonmetallic Curved Lid J-Boxes or equal. Mount j-box centered at 20" above grade. Use only in poles 18" in diameter and larger. Locate boxes 90-degrees or 180-degrees from traffic. Install boxes per manufacturer's recommendations.

PART 3 - EXECUTION

INSTALLATION

Install in accordance with manufacturers' instructions.

Minimum underground conduit size is 1 inch.

Underground and exterior wire shall be minimum #10 AWG conductors, type XHHW-2 or USE-2. Number 10 AWG conductors shall be utilized for vertical wire installed within pole and for overall circuit lengths of less than 100 LF.

Protect anchor bolts 2 inches (50 mm) minimum above base.

Install all anchor bolts and handhole fasteners with anti-seize compound.

Install poles plumb. Provide shims or double nuts to adjust plumb.

Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

Bond each luminaire, each metal accessory, the UFER ground conductor and the pole to the branch circuit equipment ground conductor with a separate ground wire sized per NEC or as shown on the drawings.

Dimmed luminaire circuits shall have separate neutrals.

Dimmed luminaires shall have a positive OFF, which requires turning off the circuit to the luminaire so that the luminaires don't "glow" at the lowest dimmed setting. This shall be accomplished using a switch, relay, or some other means acceptable to DFD.

FIELD QUALITY CONTROL
Operate each luminaire after installation and connection. Inspect for improper connections and operation.

ADJUSTING
Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.

All new luminaires shall be operational at the Substantial Completion of the project.

CLEANING
Clean photometric control surfaces.

Clean finishes and touch up damage.

CONSTRUCTION VERIFICATION
Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 26 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

AGENCY TRAINING
All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION

SECTION 30 05 00
COMMON WORK RESULTS FOR ALL EXTERIOR WORK
BASED ON DFD MASTER SPECIFICATION DATED 09/01/2015

PART 1 – GENERAL

SCOPE

This section provides information common to two or more technical site work specification sections or items that are of a general nature, and not included in other sections. This section applies to ALL work included as part of Division 31, Division 32, and Division 33. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Referenced Organizations
- Referenced Documents
- Quality Assurance
- Safety
- Permits
- Construction Limits
- Work by Others
- Submittals
- Off Site Storage
- Codes
- Certifications and Inspections
- As-Built Drawings

PART 2 - MATERIALS
- Barricades, Signs, and Warning Devices

PART 3 - EXECUTION
- Maintenance of Site and Building Access/Egress
- Continuity of Existing Traffic/Parking and Traffic Control
- Survey and Staking
- Utility Locates
- Protection and Continuity of Existing Utilities
- Protection of Existing Work and Facilities
- Stormwater/Excavation Water Management

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:
- Section 31 00 00 – Site Work for Premanufactured Concrete Vault Toilets
- Section 31 10 00 – Site Clearing
- Section 31 22 16.15 – Roadway Subgrade Preparation
- Section 31 23 16.13 – Trenching
- Section 31 23 16.26 – Rock Removal
- Section 31 23 19 – Dewatering
- Section 31 25 00 – Erosion Control
- Section 31 34 19.13 – Geogrid Reinforcement
- Section 32 11 23.33 – Dense Graded Base
- Section 32 11 26.17 – Pulverized and Re-Laid Pavement
- Section 32 12 16.13 – Hot Mix Asphalt Paving
- Section 32 17 23 – Pavement Markings & Permanent Signing
- Section 32 32 00 – Modular Concrete Block Retaining Wall
- Section 32 92 19 – Seeding

Section 33 40 00 – Storm Drainage Utilities

REFERENCED ORGANIZATIONS

Abbreviations of organizations referenced in these specifications are as follows:

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
OSHA	Occupational Safety and Health Administration
WDNR	State of Wisconsin Department of Natural Resources
WISDOT	State of Wisconsin Department of Transportation

REFERENCED DOCUMENTS

Where reference is made to WisDOT or SSHSC in this specification it shall mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental and interim specifications.

Where reference is made to the SSSWC, it shall mean pertinent sections of the Standard Specifications for Sewer and Water Construction (SSSWC) in Wisconsin, current edition.

Method of measurement and basis of payment sections in referenced documents shall not apply.

QUALITY ASSURANCE

Provide materials and products as required by individual specification sections. Refer to Section GC - General Conditions of the Contract regarding substitutions.

Provide quality assurance testing and reporting as required by individual specification sections.

SAFETY

Contractor is solely responsible for worksite safety.

Perform all work in accordance with applicable OSHA, state and local safety standards.

PERMITS

Unless otherwise noted in the Contract Documents, Contractor shall be responsible for obtaining and paying for all permits necessary to complete the work.

CONSTRUCTION LIMITS

Construction Limits are indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the DFD Project Representative. In no case shall construction activities extend beyond state property lines or construction easements.

The Contractor shall restore all disturbed areas in accordance with the drawings and specifications. If drawings and specifications do not address restoration of specific areas, these areas will be restored to pre-construction conditions as approved by the DFD Project Representative.

WORK BY OTHERS

Coordinate work under this project with work by Owner and other contractors on the site.

SUBMITTALS

Refer also to the General Conditions and Division 1.

Submit manufacturer's shop drawings, product data, samples, substitutions and operation and maintenance (O&M) data for approval as required by individual specification sections.

Unless otherwise noted, provide 6 copies of each submittal. Submit to project architect/engineer (A/E) unless otherwise directed by DFD Project Representative at the Pre-Construction Meeting.

OFF SITE STORAGE

Refer to Division 1.

In general, the payments for materials stored off site will only be considered in instances where there is limited space available for storage on the site. Prior approval by the DFD Project Representative, together with the execution of a Storage Agreement will be required.

CODES

Comply with the requirements of all applicable, local, state and federal codes.

CERTIFICATIONS AND INSPECTIONS

Refer to Section GC - General Conditions.

Obtain and pay for all required sampling, testing, inspections, and certifications except those expressly listed as provided by the A/E or other third party in the Contract Documents. Deliver originals of certificates and documents to the DFD Project Representative within 3 days; provide copies to the A/E. Include copies of the certifications and documents in the O&M Manual.

AS-BUILT DRAWINGS

DFD will provide the Contractor with a suitable set of Contract Documents on which daily records of changes and deviations from contract shall be recorded.

At completion of the project, the Contractor shall submit the marked-up as-built drawings to the A/E prior to final payment.

PART 2 – MATERIALS

BARRICADES, SIGNS, AND WARNING DEVICES

Traffic barricades, traffic signs, and warning devices shall meet the requirements of applicable OSHA standards and the FHA Manual of Uniform Traffic Control Devices (MUTCD).

PART 3 - EXECUTION

MAINTENANCE OF SITE AND BUILDING ACCESS/EGRESS

Unless otherwise shown or directed, maintain existing access and egress to the facility throughout construction. Maintain ANSI A117 compliant access for disabled persons, delivery access, emergency vehicle access, and emergency egress. Do not interrupt access and egress without prior written approval from the DFD Project Representative.

CONTINUITY OF EXISTING TRAFFIC/PARKING AND TRAFFIC CONTROL

Refer also to Section GR - General Requirements.

Do not interrupt or change existing traffic, delivery, or parking without prior written approval from the DFD Project Representative. When interruption is required, coordinate schedule with the Owner agency to minimize disruptions. When working in public right-of-way, obtain all necessary approvals and permits from applicable municipalities and WISDOT.

When Contractor's activities impede or obstruct traffic flow, Contractor shall provide traffic control devices, signs and flaggers in accordance with other Contract Documents and the current version of the MUTCD, or as shown on the Drawings.

SURVEY AND STAKING

A/E will provide benchmarks and control points for the project as requested by the Contractor if information is available and not already shown on the plans.

Contractor shall be responsible for transferring benchmarks, control points, lines and grades to the project site as necessary to complete work.

UTILITY LOCATES

Contact Diggers Hotline at 1-800-242-8511 in accordance with statutory requirements. Request that non-member utilities, institution owned utilities, and private utilities be located by the appropriate parties. Coordinate utility locates with the Department of Natural Resources staff. If required, the contractor shall pay all costs associated with private utility locates.

Contractor shall include the costs for ***ALL*** underground utility locates in their bid. Locates shall include excavation, backfill, survey and pictures of existing utilities within the construction limits. Survey information shall include size, elevation, horizontal location, materials and height and width of utility. Locates shall be authorized by DFD Project Representative.

PROTECTION AND CONTINUITY OF EXISTING UTILITIES

Verify the locations of any water, drainage, gas, storm sewer, sanitary sewer, electric, telephone/communication, fuel, steam lines, chilled water or other utilities and site features which may be encountered in any excavations or other sitework. All lines shall be properly underpinned and supported to avoid disruption of service.

Do not interrupt or change existing utilities without prior written approval from the DFD Project Representative, affected utilities and users. Notify all users impacted by outages a minimum of 48 hours in advance of outage. Notification shall be provided in writing and describe the nature and duration of outages and provide the name and number of Contractor's foreman or other contact.

Any service connections encountered that are to be removed shall be cut off at the limits of the excavation and capped in accordance with the requirements of applicable codes and any specifications governing such removals.

PROTECTION OF EXISTING WORK AND FACILITIES

Verify the locations of, and protect, any signs, paved surfaces, buildings, structures, landscaping, streetlights, utilities, and all other such facilities that may be encountered or interfered with during the progress of the work. Take measures necessary to safeguard all existing work and facilities that are outside the limits of the work or items that are within the construction limits but are intended to remain. Report any damage to existing facilities to the DFD Project Representative immediately. Correct all damages at no cost to Owner.

STORMWATER/EXCAVATION WATER MANAGEMENT

Control grading around structures, pitch ground to prevent runoff into excavated areas.

Pits, trenches within building lines and other excavations shall be maintained free of water.

Provide trenching, pumping, other facilities as needed to control stormwater runoff and excavation water.

Notify Architect/Engineer if springs or running water are encountered in excavation; provide discharge by trenches, drains, pumping to point outside of excavation. Provide information to Architect/Engineer of points and areas that water will be discharged.

Implement stormwater runoff and drainage control measures to prevent damage from flooding, erosion, and sedimentation to on-site and off-site areas during construction.

END OF SECTION

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SECTION 31 00 00
SITE WORK FOR PREMANUFACTURED CONCRETE VAULT TOILET

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all site work necessary for the installation a pre-manufactured concrete vault toilet, as required in these specifications, on the drawings, and as otherwise deemed necessary to successfully complete the work. Prepare the site to accept the Owner's pre-manufactured concrete vault toilet which will be owner furnished, and contractor installed (OFCI). Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- References
- General Requirements

PART 2 - MATERIALS
- Structural Fill
- Granular Backfill, Crushed Stone, or Sand Base Aggregate
- Path Stone Screenings

PART 3 - EXECUTION
- Topsoil Removal
- Site Preparation
- Access
- Finish Grading
- Clean Up

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 31 10 00 – Site Clearing
Section 31 25 00 – Erosion Control

REFERENCES

ANSI/ASCE-7-05 – Minimum Design Loads for Buildings and Other Structures

2021 International Building Code (IBC)

Concrete Reinforcing Institute, "Manual of Standard Practice".

Wisconsin Department of Safety and Professional Services (DSPS), SPS 384, 391.

Where reference is made to the "SSHSC", it shall mean the pertinent sections of the State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, current edition, and all supplemental and interim supplemental specifications.

GENERAL REQUIREMENTS

Contractor shall be responsible for coordinating delivery of the Owner's pre-manufactured precast concrete toilet with the Owner and the Owner's pre-manufactured precast concrete supplier (Huffcutt). The Contractor shall have the site ready for delivery and installation of the Owner's pre-manufactured, precast toilet building based on the project schedule, but atter a written notice to proceed and shall take into consideration the Owner manufacturer's production schedule.

It is the Contractor's responsibility to coordinating the exact delivery date and time directly with the Owner's pre-manufactured vault toilet supplier (Huffcutt) based on the pre-manufactured building supplier's production schedule, any road limits in effect, and other factors which may affect timing of unit delivery.

The Contractor shall be responsible for preparing the site in order to accept the Owner's pre-manufactured vault toilet. This work will include: preparing the site including the route of access for delivery trucks if required, excavation for building, and foundation preparation. The Contractor shall provide (72) hours advance written notice to the Owner informing them when excavation of the building foundation will take place and of the designated installation date and time.

If existing subsoil conditions are suspect or do not meet the assumed allowable bearing pressure, the Contractor shall stop excavation until the Owner's Engineer and/or Structural Consultant determine appropriate corrective measures.

The A/E or DFD Project Representative shall also be present at the time the pre-manufactured building arrives at the site in order to inspect the building. If the unit is rejected for any reason, the Contractor shall terminate work until deficiencies in the pre-manufactured unit are corrected. Delays created by non-acceptance of the unit shall not result in additional site work costs to the Owner.

The Contractor shall be responsible for any and all damages to the pre-manufactured vault toilet once it is set at the site as the result of the Contractor's activities.

The Owner's pre-manufactured vault toilet supplier shall be responsible for any/all permits or approvals required to transport the vault toilet unit from the production facility to the site.

PART 2 – MATERIALS

STRUCTURAL FILL

Clean material meeting the requirements of "Structure Backfill" as defined in SSHSC Section 210.2.

GRANULAR BACKFILL, CRUSHED STONE, OR SAND BASE AGGREGATE

Clean material meeting the requirements of "Grade 1" or "Grade 2" granular backfill as defined in SSHSC Section 209.2.

PART 3 - EXECUTION

TOPSOIL REMOVAL

Comply with erosion control requirements of Section 31 25 00 – Erosion Control relative to topsoil removal and storage.

Complete clearing and grubbing work as required by the Contract Documents and as specified in Section 31 10 00 – Site Clearing.

Coordinate topsoil stockpile locations with Owner.

Remove all topsoil from proposed locations of buildings, structures, roads, path, walks and other paved areas. Also, remove topsoil from proposed lawn or turf areas where the proposed elevation exceeds the existing elevation by 1’ or greater, or where fill will be placed.

Stockpile reusable topsoil for use in restoration. Salvaged topsoil shall not be removed from the site without prior approval of the DFD Project Representative.

Do not excavate, grade or work topsoil in frozen or muddy conditions.

Minimize compaction of topsoil to the greatest extent possible.

SITE PREPARATION

Contractor shall be responsible for all aspects of site work on this project including: preparing the site for vault toilet delivery and installation, preparing a route of travel/staging area for vault toilet delivery vehicles, removal of trees in order to accomplish vault toilet delivery and installation, excavation and placement of foundation base for the proposed building, backfilling, and finish work as described on the project plans once the pre manufactured concrete vault toilet supplier has set the building.

The Contractor shall excavate the foundation for the proposed building. Excavate the site so the finished floor height of the building will be located per the project drawings. Excavate a minimum of 1’ wider than the toilet building on all sides at the proposed base elevation. Site preparation shall include placing or installing granular backfill that is at least one foot larger than the length and width of the proposed building on each side.

The Contractor shall prepare the bedding foundation a minimum of 8" compacted thickness over undisturbed subgrade, unless otherwise noted on the plan. Place and compact the bedding base material only after verification of foundation soil conditions by A/E or DFD Project Representative. Screed the foundation bedding material level, to within 1/4" tolerance in all directions. Base material shall be placed within a perimeter form with flat and level top edges to facilitate screening of material. Thoroughly compact base material to avoid settling to 95% modified Proctor. Forms shall remain until after the building is set.

Keep granular backfill, crushed stone, sand foundation bedding within the confines of the soil or perimeter forms. Do not allow the bedding to become unconfined so that it washes, erodes, or otherwise becomes undermined. The Owners pre-manufactured building supplier will be responsible for setting the vault toilet building at the site prepared by the Contractor as described above.

Contractor shall be responsible for backfilling around the structure after the building has been placed. Backfill shall consist of structural backfill and shall be placed in uniform lifts not exceeding 6” thickness before compaction. Backfill evenly on each side of the vault walls. Backfill shall be free of any stones

larger than 3” in diameter or other debris. Thoroughly compact all backfill to avoid settling to 95% modified Proctor density.

Contractor shall create positive drainage away from building for all backfill, aprons, or slabs as required, or as shown on the plans.

ACCESS

Contractor shall coordinate with the Owner’s vault toilet manufacturer to ensure that access includes a level, unobstructed area large enough for the vault toilet manufacturer’s crane and tractor-trailer to park adjacent to the proposed building site. The toilet manufacturer’s crane must be able to place its outriggers within 3'-0" of the edge of the building pad and their truck and crane must be able to get side-by- side under their own power.

Contractor shall be responsible for making minor repairs to the lawn or turf areas as the result of trucks/cranes entering and leaving the site to set the proposed building(s).

FINISH GRADING

Contractor shall spread excess excavated material from the vault toilet excavation around the installed structure. Maintain 6” clearance between finished grade and floor on all sides of the building not having concrete aprons. Intended final grades are flush with the tops of any concrete sidewalks and building aprons. Top dress all disturbed areas with 4-inch thickness of topsoil to reach finish grades as indicated on the project plans. Finish grade all areas away from the proposed structure(s) at slopes of 4:1 to allow for drainage away from the structure, or as indicated on the project plans.

All disturbed areas shall be hand raked to remove exposed rocks over one inch in maximum dimension, sticks, roots, debris, etc. Debris removed from the surface shall be disposed of by the contractor off-site.

CLEAN UP

Clean up work site and all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

Contractor shall be responsible for removing any excess excavation from the site and for its disposal off site at the contractors expense.

Contractor is responsible for delay claims from Vault Supplier if the Vault Supplier provides written notice that they are ready to install and the site is not at an install ready condition when the Vault Supplier arrives on-site with the vault unit.

END OF SECTION

SECTION 31 10 00
SITE CLEARING
BASED ON DFD MASTER SPECIFICATION DATED 02/17/2016

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to clear and grub the site of existing vegetation as required in these specifications and on the drawings. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Clearing Limits

PART 2 - MATERIALS
- Not Used

PART 3 - EXECUTION
- General
- Cutting
- Removal Methods
- Grubbing

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 30 05 00 – Common Work Results for All Exterior Work
Section 31 25 00 – Erosion Control

CLEARING LIMITS

Confine clearing and grubbing operations to the limits as indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the Owner's Project Representative. Clearing and grubbing operations shall not extend past the property line or easement line without prior approval of the DFD Project Representative.

PART 2 - MATERIALS

Not Used

PART 3 - EXECUTION

GENERAL

Limits of clearing and grubbing shall be as shown on drawings. When selective pruning and removal is specified, limit work to only those plants or limbs shown on the drawings or detailed in the specifications.

Remove and dispose of trees, stumps, roots, brush, vegetation, debris, and other items that interfere with new construction as shown on the drawings.

To minimize erosion, limit heavy equipment travel only to areas that are necessary to complete clearing and grubbing operations.

Repair damaged erosion control features immediately.

CUTTING

Fell and prune trees in manner so as not to damage adjacent structures, site features or other plants not scheduled for removal.

If trees scheduled to remain are injured notify DFD Project Representative.

When pruning, limit removal only to those limbs shown on drawings or that which is necessary to complete other site work.

When pruning, make cuts near trunk, but beyond branch collar. If no branch collar is present, make a vertical cut near where the limb meets the trunk. Do not cut branch collar. Application of tree paint is not necessary for pruning trees as designated on the drawings unless otherwise noted.

Prevent the spread of oak wilt by treating all cut surfaces and abrasions sustained between April 1 and October 1 on healthy oak trees and saplings with a thorough application of tree paint immediately upon discovering a wound. Between these dates, also paint the cut surfaces of the stumps of all healthy oak trees and saplings immediately after cutting, whether remaining in place or grubbed.

Use sharp tools and make clean cuts.

REMOVAL METHODS

Unless the drawings specify otherwise, the Contractor owns all trees, brush and debris removed from the site. All cleared material shall be disposed of offsite unless otherwise specified on the drawings or agreed upon by the Owner and DFD Project Representative prior to any clearing and grubbing taking place.

Clearing and grubbing debris shall be disposed of at facilities designed to accept the material that is being disposed. Follow all local, state and federal regulations.

GRUBBING

Grubbing operations may be completed by removal of stump section or by grinding.

Remove stumps, logs, roots, other organic matter located within proposed building excavations completely.

Remove stumps, logs, roots, other organic matter located within proposed pavements and structures to the depth indicated:

Walks: 24 inches below subgrade
Roads and drives and parking areas: 36 inches below subgrade
Concrete slabs: 24 inches below subgrade
Lawn areas: 12 inches
Footings and foundations for signs, lights, etc.: 18 inches below footing base

Depressions resulting from grubbing operations shall be backfilled with suitable material similar in properties to the adjacent materials.

END OF SECTION

SECTION 31 22 16.15
ROADWAY SUBGRADE PREPARATION
BASED ON DFD MASTER SPECIFICATION DATED 12/30/2022

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete pavement subgrade preparation and provide a surface ready for constructing and supporting the Dense Graded Base aggregate, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 30 05 00 – Common Work Results for All Exterior Work
- Section 02 32 00 – Geo Technical Investigation
- Section 03 30 10 – Cast-In-Place Concrete for Site Work
- Section 31 23 16.13 – Trenching
- Section 31 25 00 – Erosion Control
- Section 31 34 19.13 – Geogrid Reinforcement
- Section 32 11 23.33 – Dense Graded Base

REFERENCE DOCUMENTS

Where reference is made to WisDOT or SSHSC in this specification it shall mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental and interim specifications.

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing consultant shall meet the requirements of ASTM E329.

The A/E and Contactor's construction materials testing personnel shall observe all proof-rolling operations. The DFD Project Representative shall also be informed of all proof-rolling operations. Provide minimum of 48 hours confirmed notice for all parties.

SUBMITTALS

Provide aggregate quality and source verification testing reports for breaker run material used on the project. All aggregates shall meet the requirements outlined in WisDOT SSHSC Section 311. All breaker run material will be approved based on visual inspection of in place condition by A/E or DFD Project Representative.

PERMITS/FEES

Contractor shall be solely responsible for obtaining all construction permits necessary to complete the work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-of-way, land disturbance permits and building permits.

PART 2 - MATERIALS

BREAKER RUN AGGREGATE

Crushed stone, rock or gravel meeting the requirements of either Breaker Run or Select Crushed material as defined in WisDOT Section 311.2 or WisDOT Section 312.2, respectively.

RECYCLED AGGREGATE AND PAVEMENT

Recycled or salvaged aggregate and pavement products shall be free of organics, clay, rocks greater than 3-inches in least dimension and all other deleterious materials. The successful Bidder may submit specifications for these materials for consideration by the A/E for use on the project as part of the submittal process following contract award.

GEOGRID

Geogrid shall conform to the requirements of Section 31 34 19.13.

GEOTEXTILE FABRIC

Fabric shall be insect, rodent, mildew, and rot resistant woven or nonwoven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. All fabric shall have the minimum strength values in the weakest primary direction. Fabric shall conform to WisDOT Section 645.2.8.

PART 3 - EXECUTION

PREPARATION

Review drawings and prepare work plan and schedule. Coordinate any necessary interruptions in site access with DFD Project Representative, in accordance with other specification sections.

Remove topsoil from work area. Sawcut and remove pavement from work area as indicated on the drawings. Sawcuts shall be made for the full depth of pavement.

Grade roadways and parking areas to drain water away from buildings.

EXCAVATION

Excavate to elevations and dimensions as shown on the drawings and as necessary to complete construction. Excavations shall be sufficiently deep to provide for depth of base course and pavement.

Stones over 6-inches in size shall be removed from the loosened portion of the subgrade.

Notify DFD Project Representative if correction of unauthorized excavation or over-excavation is necessary. Said excavations will be corrected by placement of Breaker Run Aggregate. Contractor will be responsible for all costs associated with correcting these excavations.

Segregate the various materials excavated. Excavated material that does not meet the requirements of backfill and excess excavated material, shall be removed from the site and disposed by the Contractor, unless directed otherwise by other specification sections or the DFD Project Representative.

Locate spoil piles so they do not interfere with public travel, adjacent landowners or other construction activities.

PREPARING THE FOUNDATION

The subgrade shall be constructed to have a uniform stability throughout. Use of recycled and salvaged aggregate and pavements shall be fully incorporated into subgrade soil. Construct the foundation to the required elevation with equipment and methods adapted for the purpose. Shape and compact to provide a smooth foundation, at required density, and at the proper elevation to receive the Dense Grade Base (See Section 32 11 23.33).

Compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand-place and compact material as necessary.

It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain a subgrade that satisfies the conditions of a satisfactory subgrade as defined below. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

The prepared foundation shall be tested for compaction as defined in the paragraph entitled ‘Subgrade Approval / Proof Rolling’.

SUBGRADE APPROVAL / PROOF ROLLING

Prior to undercutting or excavating below subgrade (EBS) or placing any Dense Grade Base (See Section 32 11 23.33), contact the DFD Project Representative to schedule inspection of the subgrade and proof rolling of the subgrade for all surfaces that will be supporting vehicular traffic (roadways, parking lots, ramps, walkways, etc…). All proof rolling shall be completed in accordance with the requirements of the paragraph entitled ‘Quality Assurance’ and shall meet the criteria as defined below.

To complete proof rolling, the entire pavement subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof rolling.

Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof – rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with "tag" or "pusher" axles retracted from the ground.

Proof rolling shall be accomplished in a series of traverses parallel to the centerline of the driveway, street, or parking area. The truck shall traverse the length of the street or parking area once for each 12' of width at speeds less than 5 mph. Additional passes along the traverse shall be completed as directed by the DFD Project Representative to further define unsatisfactory subgrade.

Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.

Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)

Undercutting/EBS shall be completed only when directed by the DFD Project Representative or if unsatisfactory subgrade, as defined above, is observed. The Contractor shall not be compensated for any unauthorized undercutting/EBS. Measure and document undercut areas and depths in consultation with DFD Project Representative.

Excavate undercut areas to the depth specified by A/E or DFD Project Representative using equipment with smooth cutting edge. Excavated undercut material that does not meet the specifications for fill needed elsewhere on site shall be removed from the site and legally disposed.

Undercut areas shall be backfilled with Breaker Run (or with a combination of Breaker Run and Geogrid) in maximum of 9 inch thick lifts (compacted). Breaker Run shall be compacted to 90% Modified Proctor dry density. If geogrid is used, install per the requirements of Section 31 34 19.13.

Following installation and compaction of place Breaker Run material, the area shall be subject to the work defined in the paragraph entitled 'Subgrade Approval / Proof – Rolling'.

Undercutting/Excavation Below Subgrade (EBS) work shall include all materials, labor, equipment and supervision necessary to remove the soils from the Project Site considered to be poor from the proof roll and backfill and compact with Breaker Run material brought to the Project Site. EBS shall be measured in its original position. The cost of the compacted Breaker Run material is incidental to the unit price item for Undercutting/Excavation Below Subgrade (EBS). If Geogrid is required and is used in combination with the Breaker Run, the unit price for the Geogrid Reinforcement shall include all materials, labor and equipment for installation.

RESTORATION

Roll all pavement subgrade surfaces using a smooth drum roller to promote an impervious surface and minimize percolation of water into the subgrade.

END OF SECTION

SECTION 31 23 16.13
TRENCHING
BASED ON DFD MASTER SPECIFICATION DATED 5/19/2025

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete trenching for utilities and other work, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference Standards
- Quality Assurance
- Submittals
- Permits/Fees

PART 2 - MATERIALS
- Geotextile Fabric
- Crushed Stone Chips
- Crushed Stone Screenings
- Bedding Sand
- Crushed Stone
- Earth Backfill

PART 3 - EXECUTION
- Preparation
- Underground Locates
- Connections to Existing Utilities
- Dewatering
- Drainage Protection
- Excavation
- Unstable Trench Bottom
- Support of Existing Utilities
- Insulation for Existing Utilities
- Bedding & Utility Cover Material
- Backfill and Compaction
- Grading
- Grading Around Trees
- Clean Up

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 02 32 00 – Geo Technical Investigation
- Section 30 05 00 – Common Work Results for All Exterior Work
- Section 31 25 00 – Erosion Control
- Section 31 23 19 – Dewatering
- Section 31 25 00 – Erosion Control
- Section 33 40 00 – Storm Drainage Utilities

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

D422	Standard Test Method for Particle Size Analysis of Soils
D4318	Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
D698	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
D1557	Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
D3017	Standard Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods
E329	Standard Specifications for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing personnel shall meet the requirements of ASTM E329.

The Contractor's construction materials testing personnel shall complete material testing as outlined in Table 31 23 16.13-1:

Table 31 23 16.13-1

Material	Test Required	Test/Sample Frequency
Utility Bedding and Cover	ASTM D1557-12 Test Method for Laboratory Compaction Characteristics Using Modified Effort	1 test/25 cy placed
Earth Backfill	ASTM D1557-12 Test Method for Laboratory Compaction Characteristics Using Modified Effort	1 test/25 cy placed
Earth Backfill	D422-63(2007) Standard Test Method for Particle Size Analysis of Soils	1 test/5000 cy placed

SUBMITTALS

Provide grainsize analysis for bedding and backfill materials.

Provide manufacturers product information for geotextile fabric.

Provide written plan(s) for Support of Existing Utilities for excavations that will expose multiple large utilities at the same time or expose utility or building structures including tunnels, box conduits, manholes and pits. Show anticipated loads and verification that proposed supports are adequate.

Provide copies of all material field testing reports completed for the project to the DFD Project Representative and the AE within 48 hours of completing the individual tests. Along with each individual test result, provide a running spreadsheet of all individual test results.

PERMITS/FEES

Contractor shall be responsible for obtaining all permits necessary to complete trenching work. Contractor shall pay all fees associated with obtaining permits. These include, but are not limited to permits to work within right-of-way.

PART 2 – MATERIALS

GEOTEXTILE FABRIC

Woven or non-woven fabric shall meet the requirements of the WisDOT SSSHC Section 645.2.1 and 645.2.2, Geotextile Fabric Type SAS.

CRUSHED STONE CHIPS

Pipe 18" Diameter or Less:

Clean material meeting the requirements of "3/8" Crushed Stone Chips" as defined in Section 8.43.2(a)1 of the SSSWC, except that the gradation shall be as shown herein. If used for pipe bedding, Crushed Stone Chips shall also be used for cover material.

Sieve Sizes	Percent Passing by Weight
1/2 inch	100%
3/8 inch	85 – 100%
No. 4	10 – 30%
No. 8	0 – 10%
No. 16	0 – 5%

Pipe Over 18" Diameter:

Clean material meeting the requirements of "3/4" Crushed Stone Chips" as defined in Section 8.43.2(a)2 of the SSSWC, except that the gradation shall be as shown herein. If used for pipe bedding, Crushed Stone Chips shall also be used for cover material.

Sieve Sizes	Percent Passing by Weight
1 inch	100%
3/4 inch	90 – 100%
3/8 inch	20 – 55%
No. 4	0 – 10%
No. 8	0 – 5%

CRUSHED STONE SCREENINGS

Crushed stone shall be free of organic material, concrete, asphalt and other debris. Material shall meet the requirements of "Crushed Stone Screenings" as defined in Section 8.43.2(b) of the SSSWC. If used for pipe bedding, Crushed Stone Screenings shall also be used for cover material.

Sieve Sizes	Percent Passing by Weight
1/2 inch	100%
No. 4	75 – 100%
No. 100	10 – 25%

BEDDING SAND

Sand shall meet the requirements of "Bedding Sand" as defined in Section 8.43.2(c) of the SSSWC. If used for pipe bedding, Bedding Sand shall also be used for cover material.

Sieve Sizes	Percent Passing by Weight
1 inch	100%
No. 16	45 – 80%
Material finer Than No. 200	2 – 10%

CRUSHED STONE

When crushed stone is required to affect soil stability or drainage it shall meet the gradation requirement below.

Sieve Sizes	Percent Passing by Weight
2-1/2 inch	100%
2-inch	90-100%
1-1/2 inch	35-70%
1-inch	0 – 15%
½ inch	0 – 5%

UTILITY COVER MATERIAL

Material that is to be used around and over the pipe and above the pipe bedding shall be termed utility cover material. The utility cover material for pipe shall be the same as the bedding material.

EARTH BACKFILL

Sand/gravel non-cohesive non-expansive, free of vegetable matter, clay , rubbish, rock larger than 2 inches, boulders, concrete, paving, masonry debris, waste, frozen materials, other inorganic and deleterious materials. Existing material meeting these requirements can be reused.

PART 3 - EXECUTION

PREPARATION

General Contractor shall excavate and backfill the following utilities in accordance with this section:

-Storm sewer piping.

Review drawings and prepare work plan and schedule. Coordinate any necessary interruptions in utility service with DFD Project Representative, in accordance with other specification sections.

Test pits, potholes or other means used to verify the location of existing underground facilities that are shown on the plans are considered incidental to utility installation.

Remove topsoil from work area. Saw cut and remove pavement from the work area. Remove excavated materials throughout the day. Deliver imported materials as needed throughout the day.

The same trench may not obstruct more than one street at one time without an approved traffic control plan and posted detour in accordance with Section 30 05 00 Common Work Results for All Exterior Work.

UNDERGROUND LOCATES

Contractor shall include ALL underground utility locates as item of work. Locates shall include excavation, backfill, survey and pictures of existing utilities within the construction limits. Survey information shall include size, elevation, horizontal location, materials and height and width of utility. Locates areas shall identified and authorized by DFD Project Representative.

CONNECTIONS TO EXISTING UTILITIES

Connect to existing utilities in accordance with the requirements of other pertinent specification sections.

DEWATERING

Dewatering shall be completed in accordance with Section 31 23-19 – Dewatering.

Provide erosion control in accordance with Section 31 25 00 – Erosion Control.

DRAINAGE PROTECTION

Prevent surface drainage from entering utility excavations and trenches. Shape area to direct water away from excavation or trench with diversions such as berms, or ditches. If drainage must cross the excavation or trench, use culverts or other structure to minimize water entering the excavation or trench.

EXCAVATION

Excavate to elevations and dimensions necessary to complete construction. Excavations shall be sufficiently deep to provide for bedding beneath pipes and structures and as otherwise required to complete the work as shown. Excavations shall be sufficiently wide to provide for compaction equipment along the side of the pipe and the sidewall of trench or inside wall of trench box, shield or shoring.

The Contractor shall provide all trench soil retention, trench boxes, sheeting and/or bracing needed to protect the work, existing property, utilities, pavement, and existing improvements, and to provide safe working conditions in the trench. Removal of any trench soil retention, sheeting and/or bracing from the trench shall not disturb pipe bedding and cover on new or existing utilities. Sheeting and bracing shall be removed unless specific permission to leave it in place is given by the DFD Project Representative.

The Contractor shall not excavate soil or impact the area of influence for structure foundations or footings. Notify DFD Project Representative and A/E immediately if foundations or footings are undermined, cracked, damaged or appear unstable.

Unless noted on the drawings, the Contractor shall remove all vegetation along the full width of the trench before beginning excavation. Vegetation and soil containing organic material, rock or boulders larger than 6 inches in diameter shall not be used for trench backfill. Unless otherwise specified, surplus material shall be the property of the Contractor and shall be disposed of at Contractor's cost.

Trench excavation shall be backfilled when the Contractor is not working in the trench. If trench cannot be backfilled due to progression of work, fence shall be installed and extend the full length of open trench on all sides. Temporary fence shall be as noted in No. 18 of the General Requirements.

UNSTABLE TRENCH BOTTOM

Notify DFD Project Representative if trench bottom consists of unstable soil, organic material, debris or other undesirable material. When this condition arises, the excavation shall be carried to such depth as directed by the A/E. Undercut backfill shall be installed and mechanically compacted to replace the excavated materials to trench bottom subgrade.

SUPPORT OF EXISTING UTILITIES

Contractor shall support all tunnels, conduits, sewers, structures, piping, wiring and cables that are exposed due to trenching and excavations. Support systems shall maintain current horizontal alignment, prevent vertical deflection and stabilize exposed piping, tunnel, duct package or conduit crossing the trench or running lengthwise in or along the trench.

INSULATION FOR EXISTING UTILITIES

Contractor shall provide temporary insulation over exposed utilities to prevent damage/corrosion, wasted energy and or freezing.

BEDDING AND UTILITY COVER MATERIAL

Excavate trench to depth and alignment of proposed utility lines and grades, allowing for required amount of bedding material. Excavation shall be reasonably free of water prior to placement of bedding material. Bedding material shall be shaped to conform to bell of pipe, fittings and structures.

If unstable soils are adjacent to bedding and cover material in trench wrap bedding and utility cover material in geotextile fabric. Where sheet piling/shoring is abandoned between unstable soil and trench wall geotextile fabric may be omitted.

Bed pipes and place utility cover material for the utility and pipe type being installed in accordance with detail drawings and the depth and compaction requirements specified in table 31 23 16.13-2 . After placing pipe, support during placement and compaction of initial utility cover material.

Compaction of utility cover material for pipe and fittings shall be accomplished using hand tools and vibratory plate or tamping type walk behind compactors.

BACKFILL AND COMPACTION

Backfilling shall not begin until excavation is cleaned of trash and debris.

After initial cover material is placed and compacted, backfill and compact trenches using the material specified in Table 31 23 16.13 – 2. Take care to minimize settlement and avoid damage to new and existing structures, pipes, utility lines and other features during backfill placement and compaction. Place backfill simultaneously on all sides of structures. Moisture condition backfill material as necessary to achieve density required for given use. Do not place material on frozen surfaces or use frozen material.

Backfill trenches from the top of utility cover material to subgrade below pavements, base course, and topsoil as required by the drawings. Where final restoration will be delayed backfill trench to match existing grade and maintain surface drainage patterns. Wedge around structures that extend above existing grade with compacted soil or pavement to match the existing surface.

It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain the specified density. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

Flooding or jetting of backfill material for compaction purposes is not allowed.

Table 31 23 16.13-2

Location	Required Material	Maximum Compacted Lift Thickness	Minimum Proctor Compaction	Minimum Relative Density [(a)]
Bedding Material Beneath Utility Structures	Crushed Stone Chips or Crushed Stone	12”	95% Modified	70%
Bedding Materials Beneath Utilities	Crushed Stone Chips, Crushed Stone Screenings, or Bedding Sand (as required in Division 33)	6”	95% Modified	70%
Utility Cover – Areas Over Bedding Materials to 12” Over Utilities	Crushed Stone Chips, Crushed Stone Screenings, or Bedding Sand (as required in Division 33)	6”	95% Modified	70%
Areas Between Topsoil and Utility Cover	Earth Backfill	12”	90% Modified	50%
Areas Between Utility Cover and Crushed Aggregate Base Course Beneath Existing or Proposed Pavement (Roads, Drives, Walks)	Controlled Backfill	12”	95% Modified	60%
Areas with 10’ of an Existing or Proposed Building or Structure Footing or Slab	Controlled Backfill	12”	95% Modified	60%
Turf Areas	Earth Backfill	12”	88 % Modified	50%

(a) Minimum relative density as determined by ASTM D-4253-00 for coarse-grained soils with less than 15% by mass passing the No. 200 sieve. Applicable only when minimum proctor compaction cannot be achieved.

GRADING

Grade areas disturbed during trench excavation and backfilling and adjacent areas as necessary to establish new grades shown on plans as soon as practicable after backfilling. If new grades are not shown on plans, grade areas to tie into the surrounding area without abrupt changes in elevations or slopes and provide drainage away from structures.

New grades are designed to produce desired configuration of site and do not represent a balance between cut and fill.

Grades for earthwork shall not deviate more than 1 inch from plan elevations unless otherwise directed by DFD Project Representative.

GRADING AROUND TREES

Limit excavation, fill or grading near trees or other vegetation to the extent possible. No excavation, trenching or backfilling shall occur within the fenced tree protection zone of existing trees without authorization from DFD Project Representative. If tree roots are encountered during trenching cut roots cleanly and squarely.

CLEAN UP

Remove excess bedding, backfill and spoil material from the site as soon as possible after backfilling is complete, but no later than 1 calendar day after backfilling is complete.

Thoroughly clean all drainage ways, roads, parking lots sidewalks and paved surfaces and remove and dispose of all debris and mud.

END OF SECTION

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SECTION 31 23 16.26
ROCK REMOVAL
BASED ON DFD MASTER SPECIFICATION DATED 09/01/2015

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete removal of rock, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Definitions
- Measurement and Payment

PART 2 - MATERIALS
- Not Applicable

PART 3 - EXECUTION
- General
- Overburden Soil
- Rock Breaking
- Rock Excavation

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 02 32 00 – Geo Technical Investigation
- Section 30 05 00 – Common Work Results For all Exterior Work
- Section 31 23 16.13 – Trenching
- Section 31 25 00 – Erosion Control

DEFINITIONS

Rock Removal is classified as all rock excavation of hard, solid rock in ledges, bedded deposits, and unstratified masses, and all conglomerate deposits or any other material so firmly cemented they present all the characteristics of solid rock, and the A/E or DFD Project Representative determines it is impracticable to excavate this material without blasting or using rippers. Rock Removal also includes removing all rock boulders having a volume of one cubic yard or more. The classification of rock removal does not apply to crushed aggregate or asphaltic base or surface courses, or to concrete base or surface courses.

MEASUREMENT AND PAYMENT

Rock removal work shall include all materials, labor, equipment and supervision necessary to remove material classified as rock from the Project Site. Rock removal shall be measured in its original position and the material removed is incidental to the unit price item for Rock Removal.

PART 2 - MATERIALS

Not Applicable

PART 3 - EXECUTION

GENERAL

Review drawings and prepare work plan and schedule for rock removal. Coordinate activities with institution, agency, DFD, A/E and other contractors working onsite.

OVERBURDEN SOIL

Remove all topsoil from the site prior to rock removal to avoid contamination of topsoil. Stockpile topsoil in location that will not interfere with other construction.

Remove and stockpile overburden soil. Remove potentially dangerous boulders or other material located beyond the excavation limits.

ROCK BREAKING

Break rock using trenchers, hydraulic breakers, rippers or other specialized equipment.

Break rock to lines and grades shown on the drawings, or as required to complete the work. Finished rock surface should be relatively uniform.

ROCK EXCAVATION

Excavate to elevations and dimensions as shown on the drawings and as necessary to complete construction. Excavations shall be sufficiently deep to provide for all proposed bedding, base course or other subgrade materials.

Slope and shore excavations as necessary to complete the work and comply with all applicable OSHA regulations.

Notify DFD Project Representative if correction of excessive rock breaking and/or over-excavation is necessary. Said excavations will be corrected based on recommendations of DFD Project Representative or DFD's geotechnical consultant. Contractor will be responsible for all costs associated with correcting these excavations, including fees charged by DFD's geotechnical consultant.

Segregate the various materials excavated. Reserve material meeting the requirements of backfill for the project location. Excavated material that does not meet the requirements of backfill, and excess excavated material, shall be removed from the site and disposed by the contractor, unless directed otherwise by other specification sections or the DFD Project Representative.

Locate backfill and spoil piles in accordance with OSHA requirements, and so that it does not interfere with public travel, adjacent landowners or other construction activities.

END OF SECTION

SECTION 31 23 19
DEWATERING
BASED ON DFD MASTER SPECIFICATION DATED 09/01/2015

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for dewatering as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. All dewatering required for construction shall be included in the Contractor's Bid. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals
- Permits/Fees
- Environmental Contaminants
- Noise Pollution

PART 2 - MATERIALS
- Not Used

PART 3 - EXECUTION
- General
- Sump Dewatering
- Operation
- Removal/Abandonment

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.
Related work specified elsewhere:

- Section 02 05 00 – Common Work Results for Existing Conditions
- Section 02 32 00 – Geo Technical Investigation
- Section 30 05 00 – Common Work Results for All Exterior Work
- Section 31 23 16.13 – Trenching
- Section 31 25 00 – Erosion Control

SUBMITTALS

When permits are required for dewatering, provide copies of all permits.

Provide copies of the layout of all dewatering system components.

PERMITS/FEES

Pay for and obtain all permits/approval required by local, state and federal regulations.

When installing by jetting methods, the Contractor shall provide their own water source. Do not use hydrants as water source without permission from DFD Project Representative and/or local utility, as applicable. If permission to use hydrants has been allowed, the Contractor shall obtain and pay for any required hydrant use permits.

ENVIRONMENTAL CONTAMINANTS

Monitor dewatering system discharge regularly for signs of chemicals or other environmental contaminants.

If chemicals or environmental contaminants are observed, terminate dewatering system operation immediately and contact the DFD Project Representative.

Prevent dewatering system from introducing contaminants into the soil or groundwater.

NOISE POLLUTION

Provide mufflers, housing, berms and fencing as necessary to minimize noise pollution resulting from dewatering system operation.

PART 2 - MATERIALS

Not Used

PART 3- EXECUTION

GENERAL

Comply with all local, state, and federal regulations.

Design system to dewater site as necessary to complete construction, but minimize impact on local water table. Do not adversely impact neighboring private wells.

Coordinate installation of dewatering system with other contractors. Locate dewatering system components in locations that do not interfere with site operations or other construction activities.

Pump groundwater at lowest rate necessary to dewater site as required to accommodate other sitework.

SUMP DEWATERING

Install collection sump in the low point of the excavation(s).

Provide filter material, trash screens and other devices around pump or intake to avoid pumping of sediment.

OPERATION

Provide personnel, equipment and power necessary to maintain and operate the dewatering system as required to complete construction at the site. Do not discharge water into the sanitary sewer system.

REMOVAL/ABANDONMENT

Remove all dewatering system components immediately following use.

Clean receiving storm sewer system, ground surface and surface waters of any sediment or debris deposits resulting from dewatering system operation.

END OF SECTION

SECTION 31 25 00
EROSION CONTROL
BASED ON DFD MASTER SPECIFICATION DATED 02/17/2016

PART 1 - GENERAL

SCOPE

The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and construct erosion control measures necessary to protect property and the environment. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference Documents
- Submittals
- Erosion Control Plan

PART 2 - MATERIALS
- General
- Geotextile Fabric
- Temporary Ditch Barriers
- Silt Fence
- Sediment Logs
- Erosion Mat
- Staples
- Riprap
- Select Crushed Material

PART 3 - EXECUTION
- General
- Grading and Earthwork
- Drainage
- Tracking Control
- Maintenance

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 02 41 13 – Demolition
Section 30 05 00 – Common Work Results for All Exterior Work
Section 31 22 16.15 – Roadway Subgrade Preparation
Section 31 23 16.13 – Trenching
Section 31 23 19 – Dewatering
Section 32 92 19 - Seeding

Provide erosion control in accordance with the following references:

- Erosion Control Product Acceptability List (“PAL”), current version as published by the WisDOT.
- Construction Site Erosion & Sediment Control Technical Standards, current version as published by the Wisconsin Department of Natural Resources WDNR.
- Storm Water Post-Construction Technical Standards, current version as published by the WDNR.

Method of measurement and basis of payment sections in any referenced erosion control documents shall not apply to this contract.

REFERENCE DOCUMENTS

Wherever PAL appears in this specification, it shall mean the Wisconsin Department of Transportation, Erosion Control Product Acceptability List (PAL), current edition.

Where reference is made to WisDOT or SSHSC in this specification it shall mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental and interim specifications.

SUBMITTALS

Submit shop drawings for the following erosion control features:

- Silt Fence
- Sediment Logs
- Erosion Mat & Stakes
- Geotextile Fabrics (all applications)

EROSION CONTROL PLAN

The A/E has prepared an erosion control plan for the project. The A/E will complete, apply for, and pay for a Water Resources Application for Project Permits (WRAPP) to obtain acceptance for land disturbing activities in excess of 1 acre from the WDNR. The Contractor will provide the A/E with submittals for materials used to implement the erosion control plan, as well as any modifications to the erosion control plan that are necessary due to the Contractor's means and methods of construction.

Contractor shall comply with all the requirements of the erosion control plan, and if applicable, the Construction Site Storm Water Runoff General Permit requirements as obtained from the WRAPP. Contractor shall be responsible for completing all construction site inspection reports for the duration of the project and the Notice of Termination form required by the WDNR.

PART 2 – MATERIALS

GENERAL

When the design or contract includes permanent erosion control or stormwater control features, the contractor may employ these items in his control of erosion and stormwater during his construction activities. However, these items shall be fully cleaned, restored, and in every way fully functioning for its intended permanent use prior to acceptance of the work.

GEOTEXTILE FABRIC

Type FF geotextile fabric meeting the requirement of the PAL shall be used for inlet protection. Type HR geotextile fabric shall be used under riprap and Select Crushed Material at culvert ends and within ditches. Type SAS geotextile fabric shall be used in conjunction with retaining walls as detailed in the drawings.

TEMPORARY DITCH BARRIERS

Rectangular bales of hay or straw, tightly bound with twine, not wire. Anchor stakes shall be "T" or "U" steel posts, or hardwood, 2-inches by 2-inches nominal. Rebar shall not be used for anchor bales.

Temporary ditch checks meeting the requirements of the PAL and installed per the manufacturer's instructions may be used in lieu of bales. Temporary ditch checks may also be classified as silt logs, silt logs, or wattles. Temporary ditch checks shall be American Excelsior, Erosion Tech, Western Excelsior, or approved equal.

SILT FENCE

Fence fabric shall comply with the requirements of Standard Specifications for Highway and Structure Construction 628.2.6, in 3 foot tall rolls, with 4' tall 2" x 2" nominal cross section hardwood posts spaced a maximum of 10' o.c. Silt fence shall be Mirafi, Trevira, Amoco, CFM, or approved equal.

SEDIMENT LOGS

Sediment logs shall conform to Wisconsin DNR Conservation Practice Standard #1071,"Interim Manufactured Perimeter Control and Slope Interruption Products". Sediment logs shall be American Excelsior, Ero-Guard, Erosion Tech, Western Excelsior, or approved equal.

EROSION MAT

For environmentally sensitive areas that have a high probability of trapping animals or for establishing natural areas with taller vegetation it is recommended that an urban mat is used. Erosion mat shall comply with the requirements of Class I; Urban Type B erosion mat as defined by Standard Specifications for Highway and Structure Construction and the PAL. Erosion mat shall be American Excelsior-Curlex Net-Free, Erosion Control Blanket-S32BD, Western Excelsior-Excel SS-2 All Natural, Ero-Guard EG-25 (NN), Erosion Tech ETRS2BN or approved equal.

For steeper slope and ditch areas as shown on the drawings, provide an erosion mat that complies with the requirements of Class II; Type B erosion mat as defined by Standard Specifications for Highway and Structure Construction and the PAL. Erosion mat shall be American Excelsior AEC Premier Coconut, Erosion Control Blanket C32BD, Western Green Excel CC-4 All Natural, or approved equal.

STAPLES

Use biodegradable staples in accordance with manufacturer's recommendations for anchoring urban erosion mats. Acceptable anchoring devices are listed in the PAL. Wood and metal staples are not allowed for use with urban erosion mats.

RIPRAP

Riprap shall be the class specified in the plan and shall conform to Standard Specifications for Highway and Structure Construction 606.2. If a class is not specified in the plan, medium riprap shall be used.

SELECT CRUSHED MATERIAL

Select Crushed Material shall be the class specified in the plan and shall conform to Standard Specifications for Highway and Structure Construction 312.2.

PART 3 - EXECUTION

GENERAL

Install erosion control measures as required by the erosion control plan and contract documents. Provide additional erosion control measures as dictated by Contractor's means and methods, or by differing site conditions. Notify DFD Project Representative of additional erosion control features that are provided, but not shown on the plan.

Contractor shall provide all erosion control measures necessary to protect property and the environment. Perform all work in accordance with manufacturer's instruction where these specifications do not specify a higher requirement. Erosion control measures shall be installed at the end of each stage of work that is completed. If work is completed beyond the regular seeding season as noted in Section 32 92 19, area shall be temporarily restored with seeding and soil stabilizer until the following spring when the disturbed areas can be restored with seeding and the appropriate erosion control devices.

GRADING AND EARTHWORK

Install all temporary or permanent erosion control measures prior to any onsite grading or land disturbances.

Clear only those areas designated for the placement of improvements or earthwork before placement of the final cover. Perform stripping of vegetation, grading, excavation, or other land disturbing activities in a logical sequence and manner which will minimize erosion. If possible, schedule construction for times of the year when erosion hazards are minimal.

Do not clear the site of topsoil, trees, and other natural ground covers before the commencement of construction. Retain natural vegetation and protect until the final ground cover is placed.

Do not stockpile soil within 25 feet of any roadway, parking lot, paved area, or drainage structure or channel. Provide temporary stabilization and control measures (seeding, mulching, covering, erosion matting, barrier fencing) for the protection of disturbed areas and soil piles which will remain unfinished for a period of more than 14 consecutive calendar days.

Remove surplus excavation materials from the site immediately after rough grading. The disposal site for the surplus excavation materials shall also be subject to these erosion control requirements.

DRAINAGE

Minimize water runoff and retain or detain on-site whenever possible so as to promote settling of solids and groundwater recharge.

Convey drainage to the nearest adequate public facility. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving facility.

Protect storm sewer inlets and catch basins in accordance with the erosion control plan, if provided. If not specified, protect inlets with straw bale barriers, silt fencing, filter basket, gabion stone weepers, or other equivalent methods approved by the A/E which provide the necessary erosion protection.

Divert roof drainage and runoff from all areas upslope of the site around areas to be disturbed or channel them through the site in a manner that will not cause erosion.

Minimize the pumping of sediments when dewatering. Discharge to a sedimentation basin or sedimentation vessel to reduce the discharge of sediments. Do not discharge water in a manner that will cause erosion or sedimentation of the site or receiving facility.

TRACKING CONTROL

Provide each entrance to the site with a stone tracking pad. Tracking pad shall be constructed of Select Crushed Materials as defined in SSHSC Section 312.

If necessary, provide a crushed aggregate paved parking area.

If applicable, wash water shall be discharged to sedimentation basins, sedimentation vessels, or other such control areas. Untreated wash water shall not be discharged to storm sewers or surface water bodies.

MAINTENANCE

Inspect all erosion control measures within 24 hours of the end of each rainfall event that exceeds 0.50" or daily during period of prolonged rainfall, or weekly during periods without rainfall. Immediately repair and/or replace any and all damaged, failed, or inadequate erosion control measures.

Maintain records of all inspections and any remedial actions taken.

Maintain stockpile stabilization measures as necessary after rainfall events and heavy winds. Replace tarps, re-seed, and reapply mulch, tackifiers and stabilizers as necessary.

Remove sediment from stormwater and erosion control structures, basins and vessels as necessary.

Repair or replace damaged inlet protection.

Replace or supplement stone tracking pads with additional stone when they become ineffective.

Remove any sediment reaching a public or private roadway, parking lot, sidewalk, or other paved. Do not remove tracked sediments by flushing. Completely remove any accumulations not requiring immediate attention at least once daily at the end of the workday.

Frequently dispose of all waste and unused construction materials in licensed solid waste or wastewater facilities. Do not bury, dump, or discharge, any garbage, debris, cleaning wastes, toxic materials, or hazardous materials on the site, on the land surface or in detention basins, or otherwise allow materials to be carried off the site by runoff onto adjacent lands or into receiving waters or storm sewer systems.

END OF SECTION

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SECTION 31 34 19.13
GEOGRID REINFORCEMENT

PART 1 - GENERAL

SCOPE

The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and install geogrid fabric for reinforcement of the base or subbase layers of a flexible pavement structure as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference
- Submittals

PART 2 - MATERIALS
- Properties

PART 3 - EXECUTION
- Preparation
- Installation
- Cleaning

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

Section 31 22 16.15 – Roadway Subgrade Preparation

REFERENCES

American Society for Testing and Materials (ASTM)

- D1388 Standard Test Method for Stiffness of Fabrics
- D4439 Standard Terminology for Geosynthetics
- D4354 Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing
- D4595 Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
- D4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

SUBMITTALS

The submittal for geogrid shall include the following at a minimum:

- Manufacturer's certification indicating the product name and that the material meets the requirements of the specification based on the intend use of the geotextile.
- Sample piece of material (18" x 18" minimum)
- Batch Number
- Date Manufactured (Material more than one year old will not be accepted)
- Manufacturer Name and Address.

PART 2 – MATERIALS

PROPERTIES

Geogrid will be extruded polypropylene, bi-axial, single layer with opening configuration either square or rectangular in shape.

Provide geogrid that consists of either single or joined multiple layers of a uniform rectangular grid of bonded, formed, or fused polymer tensile strands crossing with a nominal right angle orientation. The polymer shall consist of polyester, polypropylene, polyamide, or polyethylene. The grid shall maintain dimensional stability during handling, placing, and installation. The geogrid shall be insect, rodent, mildew, and rot resistant. Minimum geogrid width shall be 6.0 feet.

The geogrid shall conform to the following physical properties:

Test	Test Procedure	Test Results (1)
Tensile Strength @ 5% Strain (Both Principal Directions – lb/ft)	ASTM D 4595 (2)	450 minimum
Flexural Rigidity (Both Principal Directions – mg-cm)	ASTM D 1388 (3)	150,000 minimum
Aperture Area (in^2)	Inside Measurement (4)	5.0 maximum
Aperture Dimension (in)	Inside Measurement (4)	0.5 minimum

(1) All numerical values represent minimum/maximum average roll values, i.e. the average minimum test results on any roll in a lot shall meet or exceed the minimum specified value.

(2) The tensile strength (T) of a joined multi-layered geogrid shall be computed using the following equation:

$$T = n(f)t$$

where

n = the number of individual layers in the joined multi-layered geogrid
t = the tensile strength of a single layer of geogrid as determined using testing method ASTM D4595
f = reduction factor based on the number of layers comprising the multi-layered system and determined by the equation f=1.00 - [0.04(n - 1)]

(3) Values shall be determined by Option "A" (Cantilever Test) of testing method ASTM D1388 using test specimens that are 36 inches ±0.04 inch long. Test specimen widths for differing geogrids shall be variable and equal to 1 element plus ½ the aperture width on both sides of that element. An element is defined as the minimum number of parallel strands that form distinguishable repeating pattern.

(4) Aperture Area and Aperture Dimension for joined multi-layer geogrids shall be determined based on measurement of a single layer of the geogrid. Protect the geogrid from ultraviolet radiation and from damage due to shipping and handling. Keep the geogrid dry until it is installed. The geogrid rolls shall be clearly marked to identify the material contained.

PART 3 - EXECUTION

PREPARATION

Inspect subgrade for acceptability. Surface shall be cleared of sharp objects, roots and other debris that may cause damage to the geogrid during placement or covering. Area shall be smoothed, shaped and compacted to the required grade, section and density for proper surface drainage and cross slope shaping.

INSTALLATION

Place the geogrid on the prepared surface at the locations and to the limits as shown on the plans, or as directed in the field by the A/E or DFD Project Representative. After placement, pull the geogrid taut and secure it using pins, clips, staples, or other devices to prevent movement or displacement. Place parallel strips of geogrid with a minimum overlap of 30 inches. Lap butt joints between roll ends a minimum of 24 inches. Fasten all lapped sections together by using ties, straps, clips, or other devices to develop a secure joint that meets the approval of the A/E or DFD Project Representative. After the fabric has been placed, no construction equipment will be permitted to travel directly on the fabric. Expose fabric no longer than 48 hours prior to covering. See also Section 31 22 16.15.

Cover small rips, tears, or defects in the geogrid with an additional section of geogrid; secure the additional geogrid in place so that it overlaps the damaged area by at least 36 inches in all directions. Remove and replace geogrid sections with large rips, tears, defects, or other damage at the direction of the engineer. All costs to repair or replace damaged or defective geogrid shall be the responsibility of the contractor.

After placement, cover the geogrid with the type of material required on the plans or in the specifications. Placing, spreading, and compacting of this material shall comply with the applicable sections of the specifications except that the initial lift of material placed on the geogrid must be at least 4 inches. Place, spread, and compact the required backfill material so that the geogrid is not displaced or damaged. The A/E may require changes in equipment and/or operations to prevent such damage or displacement.

CLEANING

Remove tools, materials and equipment, debris and rubbish from site upon completion of geogrid installation.

END OF SECTION

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SECTION 32 11 23.33
DENSE GRADED BASE
BASED ON DFD MASTER SPECIFICATION DATED 12/30/2022

PART 1 - GENERAL

SCOPE

The work under this section consists of constructing a dense graded base using crushed stone or crushed gravel. The Contractor may also use crushed concrete, reclaimed asphaltic pavement, reprocessed material, or blended material. The work under this section shall provide a surface ready for constructing and supporting the Concrete or Asphalt Pavement.

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related work specified elsewhere:

- Section 03 30 10 – Cast In Place Concrete for Site Work
- Section 30 05 00 – Common Work Results for All Exterior Work
- Section 31 22 16.15 – Roadway Subgrade Preparation
- Section 32 12 16.13 – Hot Mix Asphalt Paving

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods
E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

QUALITY ASSURANCE

The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing

consultant or with internal certified testers. The materials testing personnel shall meet the requirements of ASTM E329.

The Contractor's construction materials testing personnel shall complete material testing as outlined in Table 32 11 23.33-1.

Table 32 11 23.33 -1

Material	Test Required	Test/Sample Frequency
¾-inch & 1¼-inch Base Aggregate Dense and Crushed Aggregate for Surface Course	ASTM D1557: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort	1 test/500 CY placed
¾-inch & 1¼-inch Base Aggregate Dense and Crushed Aggregate for Surface Course	ASTM D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods	1 test/500 CY placed

SUBMITTALS

Provide aggregate quality and source verification testing reports for all aggregate materials used on the project. All aggregates shall meet the requirements outlined in WisDOT Section 301.2 of the SSHSC. Provide completed test results for the project within 48 hours of completing the individual tests. Along with each individual test result, provide a running spreadsheet of all individual test results.

PART 2 – MATERIALS

DENSE GRADED BASE

Use dense graded base ¾-Inch and 1¼-Inch as shown on the plan. Provide aggregate conforming to WisDOT Section 301.2 of the SSHSC for crushed stone, crushed gravel, crushed concrete, reclaimed asphaltic pavement, reprocessed material or blended material. Material gradations shall conform to WisDOT Section 305.2.2 of the SSHSC unless specified elsewhere in the contract documents.

CRUSHED AGGREGATE FOR SURFACE COURSE

Use crushed aggregate meeting the graduation requirements in below Table 32 11 23.33 -2. At least 50 percent, by weight, of the aggregate retained on the No.4 sieve is to have one fractured face. Naturally fractured faces may be included in the 50-percent requirement. A/E or DFD Project Representative may approve other gradations for trail surfaces if they are similar to the specified grade aggregate from coarse to fine within the gradation band.

Table 32 11 23.33 -2

Sieve	% Passing by Weight ¾-Inch Trail Blend
1"	-----
¾"	100
½"	70-100
3/8"	-----
No.4	45-75
No.8	30-60
No.30	15-40
No.200	6-20

PART 3 - EXECUTION

CONSTRUCTION

Preparing the Foundation

Refer to Section 31 22 16.15 – Roadway Subgrade Preparation.

Placing Dense Graded Base and Crushed Aggregate

Construct Dense Graded Base and Crushed Aggregate as specified in WisDOT Section 305.3 of the SSHSC. Compact each base layer, including shoulder foreslopes and trails, with equipment specified in WisDOT Section 301.3.1 of the SSHSC.

Use standard compaction conforming to WisDOT Section 301.3.4.2 of the SSHSC, unless otherwise specified herein. Final shaping of shoulder foreslopes does not require compaction.

Construct the base to the width and section the drawings show. Shape and compact the base surface to within 0.04 feet of the drawing elevation.

Ensure there is adequate moisture in the aggregate during placing, shaping, and compacting to prevent segregation and achieve adequate compaction. Moisture condition dense graded base as necessary to achieve required density as determined by ASTM D1557.

Excavation shall be reasonably free of water prior to placement of dense graded base. Do not place dense graded base on frozen surfaces or use frozen material.

Maintain the base until paving over it, or until the DFD Project Representative accepts the work, if paving is not part of the contract.

Placing Dense Graded Base Shoulders

If the roadway is closed to through traffic during construction, construct the aggregate shoulders before opening the road to traffic.

If the roadway remains open to through traffic during construction and a 2-inch or more drop-off at the pavement edge exists; eliminate the drop-off within 48 hours after completing the asphalt or concrete work. Unless the special provisions specify otherwise, provide aggregate shoulder material compacted to a 4:1 or flatter cross slope from the surface of the pavement edge.

Provide and maintain signing and other traffic protection and control devices, as specified in WisDOT Section 643 of the SSHSC, until completing shoulder construction to the required cross-section and flush with the asphaltic pavement or surfacing.

Construct aggregate shoulders to the elevations and typical sections the drawings show, except for minor modifications needed to conform to other work. Use equipment that does not damage or mar the pavement surface, curbs, or appurtenances.

Place aggregate directly on the shoulder area between the pavement edge and the outer shoulder limits. Recover uncontaminated material deposited outside the limits and place within the limits.

Do not deposit aggregate on the pavement during placement, unless the A/E specifically allows. Do not leave aggregate on the pavement overnight. After placing the shoulder aggregate, keep the pavement surface free of lose aggregate.

COMPACTION

Compacting Dense Graded Base and Crushed Aggregate

If using a pneumatic roller, do not exceed a compacted thickness of 6 inches per layer. For the first layer placed over a loose sandy subgrade, the Contractor may, with A/E approval, increase the compacted layer thickness to 8 inches. If using a vibratory roller, do not exceed a compacted thickness of 8 inches per layer.

The material shall be compacted to meet the following:

Test Method to determine maximum density and moisture	ASTM D1557
Relative compaction relative to the optimum	95%
Moisture content relative to the optimum	-2% to +2%

The compacted material shall be tested for in-place field density in accordance with this Section, Part I, Quality Assurance.

Compacting Dense Graded Base Shoulders

Spread and compact the aggregate in compacted layers of 6 inches or less to 95% of the modified maximum density prior to placing each subsequent layer.

After final compaction shape the shoulders to remove all longitudinal ridges to ensure proper drainage.

CLEANUP

After the project is completed, thoroughly clean up all debris which may have accumulated during the placement of dense graded base and breaker run, if placed. All storm sewer manholes, inlets, and trench drains within the project area shall be inspected in the presence of the DFD Project Representation, the Owner Agency, and the A/E to confirm there is no accumulated debris. The Contractor shall ensure the manholes, inlets, and trench drains are free of water and debris prior to inspection by the parties noted above. Any accumulated debris in the manholes, inlets, and trench drains shall be removed and properly disposed of by the Contractor.

Replace or repair as required, all surfaces and/or landscape features damaged or disturbed under this item of work.

END OF SECTION

SECTION 32 11 26.17
PULVERIZED AND RE-LAID PAVEMENT
BASED ON DFD MASTER SPECIFICATION DATED 12/30/2022

PART 1 - GENERAL

SCOPE

The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to perform full depth in-place pulverizing of existing asphalt as provided for in these specifications and on the drawings.

This section describes full depth in-place pulverizing of the existing asphaltic pavement along with a portion of the underlying base and relaying and grading the pulverized material to construct a new base.

Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference Documents

PART 2 - MATERIALS
- Not Used

PART 3 - EXECUTION
- Pulverized and Re-laid Pavement
- Cleanup

RELATED WORK

Applicable provisions of Division 01 govern work under this Section.

Related Work Specified Elsewhere:

- Section 30 05 00 – Common Work Results for All Exterior Work
- Section 31 22 16.15 – Roadway Subgrade Preparation
- Section 32 11 23.33 – Dense Graded Base
- Section 32 12 16.13 – Hot Mix Asphalt Paving

REFERENCE DOCUMENTS

Where reference is made to WisDOT or SSHSC in this specification it shall mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental and interim specifications.

PART 2 - MATERIALS

Not Used.

PART 3 - EXECUTION

PULVERIZED AND RE-LAID PAVEMENT

Work is to generally be performed as described in WisDOT SSHSC Section 325. Pulverize the full depth of the existing asphaltic pavement until 97 percent or more will pass the 2-inch sieve. Also pulverize the existing base to the depth the plans show and mix with the pulverized asphaltic pavement. Windrow material as construction operations dictate.

Immediately after pulverizing, relay the material with a paver, grader, or both a paver and grader.

If sufficient material is available at a given location, match the lines, grades, and cross slopes the plans show. If there is insufficient material at a given location, shape the available material to create a smooth profile and cross slope for a good ride. Eliminate localized bumps, depressions, and ruts. The contractor may be required to haul material from one location on the project to another.

Immediately after relaying, compact the re-laid material first with either a rubber tired roller or vibratory padfoot roller and second with a vibratory steel roller. Add water, as required, both before and during compaction. Compact each layer to the extent required for standard compaction under WisDOT SSHSC Subsection 301.3. Use compaction equipment as follows:

1. For a compacted lift of 6 inches or less, use equipment as specified in SSHSC subsection 301.3.1.
2. 2. For a compacted lift from 6 to 8 inches, use a 12.5-ton or heavier vibratory padfoot roller and an 8-ton or heavier vibratory steel roller.
3. 3. For a compacted lift greater than 8 inches, split into lifts less than 8 inches and use the equipment specified for those lift thicknesses.

Perform each day's pulverize and relay operations to avoid leaving abrupt longitudinal differences between adjacent lanes. Grade shoulders adjacent to pulverized areas by the end of each work day to provide positive drainage of the pavement. Repair surface damage caused by intervening construction or public traffic immediately before paving as necessary to provide a good riding pavement.

CLEANUP

After the project is completed, thoroughly clean up all debris that accumulated during the pulverizing and relaying of material. Utilize excess pulverized material to the extent possible for balancing grades and satisfying plan elevations. All other excess pulverized material shall be the property of the contractor unless otherwise noted elsewhere in the contract documents. Replace or repair as required, all surfaces and/or landscape features damaged or disturbed under this item of work.

END OF SECTION

SECTION 32 12 16.13
HOT MIX ASPHALT PAVING
BASED ON DFD MASTER SPECIFICATION DATED 12/30/2022

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide and construct the paving and surfacing as provided for in these specifications and on the drawings. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference Documents
- Quality Assurance
- Submittals

PART 2 - MATERIALS
- Recycled Products and Materials
- Hot Mix Asphalt (HMA) Pavement
- Tack Coat

PART 3 - EXECUTION
- Hot Mix Asphalt (HMA) Pavement
- Pavement Repairs

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related Work Specified Elsewhere:

Section 30 05 00 – Common Work Results for all Exterior Work
Section 31 22 16.15 – Roadway Subgrade Preparation
Section 32 11 23.33 – Dense Graded Base
Section 32 11 26.17 – Pulverized and Re-Laid Pavement

REFERENCE DOCUMENTS

Where reference is made to WisDOT or SSHSC in this specification it shall mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental and interim specifications.

QUALITY ASSURANCE

The Contractor is to conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents by retaining the services of an independent construction materials testing firm acceptable to DFD. Contractor must maintain a quality control program in accordance with WisDOT SSHSC Section 701 General QMP Requirements and Section 460.2.8 Quality Management Program to ensure that the asphalt produced meets the specified mix design and plan requirements.

The Contractor’s construction materials testing personnel must complete non-destructive nuclear density testing as outlined in Table 32 12 16.13-1. Test results shall be provided to A/E and DFD Construction

Representative within 24 hours of being completed. All densities shall meet the requirements outlined in WisDOT SSHSC Subsection 460.3.3

Table 32 12 16.13 - 1

Layer	Test/Sample Frequency	Approximate Number of Tests / Layer
Lower	3 random tests/5000 SF placed	265,800 SF / 3 test/5000 SF = ~156 tests
Upper	1 random test/5000 SF placed	265,800 SF / 1 test/5000 SF = ~52 tests

If density is below specified amount, submit proposed corrective action to DFD Project Representative. Corrective action may consist of removal and replacement of deficient pavement or reduced payment, as agreed to by the DFD Project Representative.

SUBMITTALS

Provide HMA pavement mix design reports for all mix designs to be used on the project. All mix designs shall meet the requirements outlined in WisDOT SSHSC Sections 450 and 460, and shall be listed on the current WisDOT Approved Mix Design List.

PART 2 - MATERIALS

RECYCLED PRODUCTS AND MATERIALS

The Wisconsin Department of Administration, Division of Facilities Development (DFD) strongly encourages the use of recycled materials and products containing recycled materials. Bidders and Contractors may submit specifications for recycled materials and products containing recycled materials for consideration by the DFD for use on the project as part of the submittal process following the contract award.

HOT MIX ASPHALTIC (HMA) PAVEMENT

Provide HMA pavement thickness and type as indicated on the plan and conforming to the requirements of WisDOT SSHSC Section 450 and Section 460. Utilize the same material type throughout the paving operation unless noted elsewhere on the drawings. Ensure all asphaltic materials provided under this section conform to the requirements of WisDOT SSHSC Section 455 and as revised in any current Supplemental Specifications.

TACK COAT

Apply tack coat at a minimum rate of 0.05 gallons per square yard to the lower layer(s) of HMA pavement surface prior to placing upper layer(s) of HMA pavement, unless otherwise noted. Apply at rate of 0.07 gallons per square yard where tack coat is being applied to a milled surface or other hard rigid surface. The surface shall be clean and dry prior to tack coat application. Tack coat shall require a minimum asphalt content of 50% and meet all other requirements of the WisDOT SSHSC Section 455.

PART 3 - EXECUTION

HOT MIX ASPHALT (HMA) PAVEMENT

Complete all work under this section to WisDOT SSHSC Section 450 and Section 460. Provide HMA layer thicknesses as shown on the drawings. If the drawings do not indicate HMA layer thicknesses, the minimum thickness of the HMA lower layer shall not be less than 1-3/4 inches (12.5 mm nominal aggregate size) and the minimum thickness of the HMA upper layer shall not be less than 1-1/2 inches (9.5 mm nominal aggregate size).

PAVEMENT REPAIRS

Sawcut all pavement surfaces to neat and straight lines at the limits of removal by a two-step method. Limit the initial pavement removal to the immediate area of the proposed work. Full depth sawcutting is not required for this phase of removal. After the work is completed, make a full depth sawcut to neat and straight lines outside the widest point of pavement disruption. Sawcut the lines of the repair parallel to existing joints, or parallel to or perpendicular to pavement edges, to form a neat patch. Carefully remove all remaining pavement within the sawcut area to the lines of the sawcut. Do not disturb the existing base materials between the area disturbed by the work and the sawcut line by the sawcutting, pavement removal, or pavement replacement processes.

Remove all walks, curbs, and other jointed paving by sawcutting at the nearest joint beyond the limits of removal.

Adjust all inlets, manholes, catch basins, valve boxes, and other such castings to match new finished grade as incidental work.

Clean and fill all major structural cracks (not alligatored areas) with crack filler conforming to ASTM D-3405 prior to placing new HMA pavement overlay. Place tack coat on all surfaces in accordance with WisDOT SSHSC Section 455. Apply emulsified asphalt tack coat at the rate of 0.05 gallons per square yard to the existing asphalt surface.

Place HMA lower layer in all areas undergoing removal and replacement. Remove existing gravel as necessary to allow placement of lower layer in lift thicknesses as shown on the drawings.

Place HMA upper layer on all roadway, parking lots, service drives, and loading dock areas as designated on the drawings.

END OF SECTION

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SECTION 32 17 23
PAVEMENT MARKINGS & PERMANENT SIGNING
BASED ON DFD MASTER SPECIFICATION DATED 09/01/2015

PART 1 - GENERAL

SCOPE

The work under this section consists of providing all work, materials, labor, equipment, and supervision necessary to provide and install pavement markings as provided for in these specifications and on the drawings. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Submittals

PART 2 - MATERIALS
- Pavement Markings
- Permanent Signing

PART 3 - EXECUTION
- Pavement Markings
- Permanent Signing & Posts

RELATED WORK

Applicable provisions of Division 01 govern work under this Section.

Related work specified elsewhere:

Section 03 30 10 – Cast In Place Concrete for Site Work
Section 30 05 00 – Common Work Results for All Exterior Work
Section 32 12 16.13 – Hot Mix Asphalt Paving

SUBMITTALS

Submit the manufacturer specifications for each pavement marking. The submittal for each material shall include the following at a minimum:

<u>Pavement Marking</u>
- Pavement Marking Material and Manufacturer
- Color and Batch Number
- Date Manufactured (Material more than one year old will not be accepted)
- Manufacturer Name and Address.
- Pavement Marking Reflectivity Elements – Glass Beads (with epoxy only)

<u>Permanent Signing</u>
- Base Material: Manufacturers certification of compliance for sheet aluminum
- Reflective Sheeting: Manufacturers certification of compliance.
- Sign Message: Manufacturers certification of compliance.
- Post: Manufacturers certification of compliance for type, material and size

PART 2 - MATERIALS

PAVEMENT MARKINGS

Furnish white pavement markings, or as specified in the drawings. Pavement marking material shall be either epoxy conforming to WisDOT Section 646.2, Methyl-Methacrylate (MMA) 1:1 Two Component Traffic Marking resin or approved equal.

PERMANENT SIGNING

Permanent signing shall meet the requirements of the WisDOT SSHSC Section 637.2.

Sign Base Material
The sign material shall be sheet aluminum as outlined in 637.2.1.3

Sign Face Material
The sign face material shall be Type H reflective sheeting as outlined in 637.2.2.2, unless the DFD Construction Representative allows an alternate material.

Sign Message Material
The sign message material shall be Type H as outlined in 637.2.3

Sign Post Material
Sign post material shall be as shown in the plan that meets the requirements of the WisDOT SSHSC Section 634.2. All wood posts shall be cedar tone premium pressure treated.

PART 3 - EXECUTION

PAVEMENT MARKINGS

Prepare surface to receive markings and install markings and glass beads in accordance with WisDOT Section 646.3 or per manufacturers recommendations. If MMA is used as the preferred pavement marking, reflectivity beads are not required.

Apply pavement markings at the locations and to the dimensions and colors as shown on the drawings. If not otherwise specified, marking lines shall be yellow and have a minimum width of 4 inches.

Apply pavement markings at a rate per the manufacturers recommended application rate based on the temperature and surface material.

PERMANENT SIGNING AND POSTS

Install permanent signs and posts at the locations shown on the drawings. Install signs as outlined in the WisDOT SSHSC Section 637.3, as noted in the drawings and according to the any drawings bound herein.

END OF SECTION

SECTION 32 32 00
MODULAR CONCRETE BLOCK RETAINING WALL

PART 1 - GENERAL

SCOPE

Work under this section includes salvaging existing beach sand, furnishing and installing modular concrete block wall and cap units, concrete step units, leveling pad, free draining backfill, perforated wrapped underdrain pipe, grout, and furnishing and installing beach sand to the lines and grades as shown on the construction drawings and as specified herein. Included are the following topics:

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related Work Specified Elsewhere:

Section 02 05 00 – Common Work Results for Existing Conditions
Section 03 30 10 – Cast-in-Place Concrete for Site Work
Section 30 05 00 – Common Work Results for all Exterior Work
Section 32 11 23.33 – Dense Graded Base

REFERENCE DOCUMENTS

ASTM C33 – Concrete Aggregates
ASTM C94 – Ready-Mixed Concrete
ASTM C140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C1372 – Segmental Retaining Wall Units

Where reference is made to WisDOT or SSHSC in this specification it shall mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental and interim specifications.

Section 210 - Structure Backfill
Section 612 - Underdrains
Section 645 - Geosynthetics

QUALITY ASSURANCE

Obtain concrete block units, caps, and steps from a single, local source with resources to provide materials of consistent quality in appearance and physical properties.

Installer Qualifications: A qualified installer who employs on Project personnel who has successfully completed modular concrete retaining wall installations similar in material, design, and extent to that indicated for this project.

SUBMITTALS

Provide manufacturer's product data verifying adherence to performance specifications, including product finishes and color range. Color samples and photographs of textured finish may be required to verify acceptance of equivalent products.

Provide a material sample and photograph of beach sand for acceptance.

Retaining wall stamped design computations prepared by a licensed Wisconsin Professional Engineer (only for conditionally accepted equivalent retaining wall product or system).

Retaining wall stamped shop drawings prepared by a licensed Wisconsin Professional Engineer (only for conditionally accepted equivalent retaining wall product or system).

DELIVERY, STORAGE AND HANDLING

Check materials upon delivery to assure proper material has been received. Protect materials from damage during storage and handling. Damaged materials shall not be incorporated into the project and will be removed from the site.

Handle modular block units to prevent chipping, breakage, soiling or other damage. Do not use pinch or use wrecking bars without protecting edges of block units with wood or other rigid materials. Lift with wide-belt type slings wherever possible; do not use wire ropes or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.

PROJECT CONDITIONS

Do not install modular concrete block units or leveling pad when ground is frozen or during freezing conditions, or if surface water or groundwater are freestanding at the structure excavation.

Mirror Lake water surface elevation is natural and is not controlled by a dam.

Equipment shall not be operated within 2-feet of the water's edge. Equipment and materials shall not be stored along the beach.

PART 2 - MATERIALS

MODULAR BLOCK WALL UNITS

Wall Units and Cap Units for the Modular Block System shall be fabricated by the same manufacturer and designed to fit compatibly when installed. Wall Unit and Cap Unit dimensions shown on the plan documents are based on Redi-Rock retaining wall units, freestanding wall units, cap units, and step units.

The design is based on the dimensions, appearance, and performance of these products; proposed equivalent modular block systems or cast-in-place concrete wall must adhere as closely as possible to these standards and require approval by the A/E.

Equivalent retaining wall system or product, if conditionally accepted by the A/E, shall require the contractor to provide stamped design computations prepared by a Wisconsin licensed Professional Engineer and shop drawings for acceptance by the A/E.

Modular wall, cap, and step units shall be made with Ready-Mixed concrete in accordance with ASTM C94, latest revision, and per the following for use in the severe climate zone:

- Air Content: 4-1/2% to 7-1/2%
- 28 Day Compressive Strength: 4,000 psi
- Slump: 5-inch +/- 1-1/2-inch (Note: Higher slumps are allowed if achieved by use of appropriate admixtures)

Exterior block dimensions shall be uniform and consistent. Maximum dimensional deviations shall be 1% excluding the architectural surface. Maximum width (face to back) deviation including the architectural finish surface shall be 1.0-inch. Exterior face dimension of a full size block shall be approximately 18-inches high x 46-1/8-inches long.

This project as designed includes multiple course sections of block with cap.

Retaining wall units for bottom, middle and top shall be as shown in the plan and plan details.

Modular block wall unit architectural surface finish shall be rectangular “Cobblestone” texture in standard gray concrete. Dime-sized bug holes on the block face may be patched.

GEOTEXTILE FILTER FABRIC

Rot resistant polypropylene filter fabric, water permeable, and unaffected by freezing and thawing, conforming to WisDOT SSHSC, Section 645.2.2.2. Geotextile Fabric, Type SAS (soil separation).

LEVELING PAD AND FREE DRAINING BACKFILL STONE

Leveling pad material shall consist of structural backfill, type A, consistent with WisDOT SSHSC, Section 210.2.2 gradation as follows:

For the entire sample, conform to the following gradation limits:

	PERCENT PASSING BY WEIGHT	
SIEVE	TYPE A	TYPE B
3-inch	100	100
No. 4	25 - 100	25 - 100
For the portion of the sample passing the No. 4 sieve, conform to the following gradation limits:		
	PERCENT PASSING BY WEIGHT	
SIEVE	TYPE A	TYPE B
No. 4	100	100

Free draining backfill stone shall be ¾-inch to 1-inch diameter washed crushed stone. Crushed Stone should meet ASTM No. 57 gradation:

SIEVE	PERCENT PASSING BY WEIGHT
1 ½-inch	100
1-inch	95-100
½-inch	25 - 60
No. 4	0 - 10
No. 8	0 – 5.0
No. 200	0

UNDERDRAIN

Furnish 4-inch wrapped perforated underdrain conforming to WisDOT SSHSC, Section 612.2

BEACH SAND

Contractor furnished beach sand shall be uniform in size and color, and clean of foreign materials.

PART 3 - EXECUTION

INSPECTION

Examine all earth grades and pavement surfaces before starting work. Do not start beach wall work until unsatisfactory conditions are corrected.

PREPARATION

Clean surfaces that have become dirty or stained prior to setting by thoroughly scrubbing with fiber brushes followed by a thorough drenching with clear water. Use only mild, biodegradable and non-toxic cleaning compounds without abrasives or harsh fillers.

Salvage beach sand within the limits shown in the plans and stockpile within the project limits. Prevent cross contamination from other salvaged materials. Place salvaged sand on tarps to prevent material contamination.

Locate and layout walls. Obtain acceptance of layout from the Architect prior to installation. Remove existing soil material to the bottom of the leveling pad elevation for the beach wall and over-excavation elevation for 18-inches of contractor furnished sand between walls. The base and back of excavation should expose undisturbed soil. Remove all soil material which sloughs into the excavated area.

Compact the base of the leveling pad to 95% maximum density.

INSTALLATION

<u>Geotextile Fabric and Leveling Pad:</u>

Place soil separator fabric and install base material for setting bed. Ensure sufficient soil separator fabric to fold over top of free draining backfill. Place geotextile fabric along the bottom of the leveling pad, up the back of excavation, and leave approximately 3-feet extending from the finished face side so that it can be wrapped over the completed leveling pad. Lap the geotextile fabric over the leveling pad so that it is tight and securely enclosed the front face of the leveling pad.

Place leveling pad material and compact to a uniform, level pad on which to place the modular block units. Consolidate stone with a minimum of three passes with a 24-inch wide, walk-behind vibrating plate compactor capable of delivering 2,000 pounds of centrifugal force. Do not place sand between the leveling pad and bottom block.

Modular Block Wall Bottom and Middle Course:

Specified modular block units can weigh up to 2,500 pounds. Make sure properly sized equipment is used to move and place blocks. Provide OSHA compliant lifting chains, rigging or slings; safety rated for working loads.

Properly mark the location of the beach wall using a string line or offset stakes to establish horizontal and vertical alignment.

Begin installation at the lowest elevation of the wall, starting at the North Shore Chateau building.

Place a row of retaining wall or freestanding blocks on the prepared leveling pad as shown in the plans. Block face edges shall be placed tightly together. Check all blocks for level and alignment as they are placed. Small adjustments to the block location can be made with a large pry bar.

Retaining wall blocks on radius curve alignment will be placed with a measurement gap between units as shown in the plans and per the manufacturer's recommendations. Install 18-inch high geotextile fabric between retaining wall blocks to prevent aggregate material from leaching through butt joints.

Place and compact sand backfill in front of the beach wall up to the grades shown in the plans to hold wall units in place. Install salvaged beach sand and contractor furnished beach sand to the depths and grades shown in the plans.

Place washed free draining backfill behind the wall in loose, uniform lifts of 6-inches up to the 4-inch perforated wrapped underdrain level. Consolidate stone with a minimum of three passes with a 24-inch wide, walk-behind vibrating plate compactor capable of delivering 2,000 pounds of centrifugal force. Set the 4-inch perforated wrapped underdrain in the center of the backfill trench, connect to existing underdrain as shown in the plans, install tees and end caps as needed, extend out to the face of the block units and place grout to fill voids between the pipe and block. Continue placing free draining backfill and compacting as indicated.

Backfill behind the washed free-draining backfill stone in lifts not to exceed 9-inches. Use proper equipment to ensure complete compaction of backfill material.

Sweep the top of installed wall units before placing the second course or cap units.

Place modular block wall second course units on top of the bottom course blocks with staggered vertical joins as shown in the plans and with a vertical face (0-inch batter).

Modular Block Wall Top Course:

Install Freestanding top block units as shown in the plans.

Freestanding wall blocks on radius curve alignment will be vertically sawcut on the back recess stub for proper alignment per the manufacturer's recommendations. Install 18-inch high geotextile fabric between retaining wall blocks to prevent aggregate material from leaching through butt joints. Fill all recesses between blocks with compacted free draining material.

Freestanding stepdown corner units on radius curve alignment will be sawcut on the ends for proper alignment.

Modular Caps:

Before setting cap blocks, place a minimum of two beads of construction adhesive on top of the wall unit. Use an adhesive that meets the requirements of ASTM D3498 and C557. Examples include Titebond Heavy Duty Construction Adhesive by Franklin International or PL Premium Construction Adhesive. Mortar Cement can also be used.

Three-sided caps shall be used on the ends of walls and where top of wall elevations transition. Caps can be cut as needed for proper alignment.

Complete free-draining stone backfill and fold soil separator over top of free-draining stone. Place topsoil level at the back top edge of capstones.

Modular Steps:

Place steps at the grades and locations as shown in the plans. Steps shall be pitched 1% to drain over the riser. Stagger butt joints to alternate sides and keeping joints lined up with previous steps.

Grout:

Apply grout to open butt joints where the retaining wall meets existing features and at weep hole openings where underdrain pipe is installed. Trowel or by other means work grout to at least 4-inch uniform depth across the entire joint surface. Clean off excess grout with water and a clean rag and finish the grout line to a neat and clean finish.

Sweep and clean wall units after installation

END OF SECTION

SECTION 32 92 19
SEEDING
BASED ON DFD MASTER SPECIFICATION DATED 01/06/2023

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete lawn seeding, mulching, and lawn maintenance operations. Included are the following topics:

RELATED WORK

Applicable provisions of Division 1 govern work under this Section.

Related Work Specified Elsewhere:

Section 31 25 00 – Erosion Control

REFERENCE STANDARDS

Association of Official Seed Analysts (AOSA)

SUBMITTALS

Provide copies of all quality assurance testing reports:

Soil-testing: For native topsoil, stockpiled/stored topsoil, and imported topsoil

Topsoil Description: Contractor to provide a written description and quantity of topsoil required; as native or imported, or a breakdown of each, prior to performing landscape work on the site.

Provide product data, including applicable analytical data, for required topsoil amendments including:

Fertilizer

Proposed Fertilizer to be submitted prior to purchase

Fertilizer Label: Contractor to provide tag from product packaging

Proposed Seed Mix to be submitted prior to purchase

Seed Mix Label: Contractor to provide seed analysis tag from product packaging

Request for Inspection

Seeding Maintenance Log

DELIVERY, STORAGE, AND HANDLING

Seed shall be delivered to the site in its original, unopened container, labeled as to weight, analysis and manufacturer. Store any seed delivered in a manner safe from damage from heat, moisture, rodents, or other causes. Any seed damaged after acceptance shall be replaced by the Contractor at his / her expense.

INSTALLATION SCHEDULE

Seed during one of the following periods:

Spring Installation:	May 1 to Mid-July
Fall Installation:	September 1 to Mid-October
Dormant Seeding:	Only permitted upon written approval by DFD Construction Representative and Architect/Engineer

Coordinate installation periods with on-going maintenance requirements throughout sodding operations.

Weather Limitations: Proceed with seed installation only when existing and forecasted weather conditions permit. No seeding shall occur on frozen ground or at air temperatures lower than 32° F. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

JOB CONDITIONS

During construction, protect all structures, utilities, sidewalks, pavements, and other facilities and existing and newly installed vegetated areas from damage at all times. All vegetation damaged during construction shall be treated, repaired or replaced with new material as necessary, to restore to the original condition.

Work areas shall be kept clean and orderly during the installation period. Under no condition shall debris from planting activities result in a safety hazard on-site or to adjacent off-site property.

WARRANTY

Contractor shall warranty the establishment of a satisfactory seeded lawn for a minimum of one growing season after date of seeding acceptance. This assumes the Owner performs required maintenance (i.e. regular watering) after the Contractor's maintenance period is completed. Contractor shall inform Owner when required maintenance has concluded.

Satisfactory seeded lawn: At end of the warranty period, a healthy, uniform, and dense stand of grass has been established per Lawn Seeding Acceptance below.

Contractor shall re-seed and maintain lawn areas that do not comply with requirements until lawns are satisfactory at the Contractor's expense.

Contractor shall provide an additional period of lawn maintenance following any actions needed to re-seed per the warranty requirements at the Contractor's expense.

Damage to vegetated and lawn areas incurred as a result of warranty replacement operations shall be repaired by Contractor at no cost to Owner.

During the Warranty Period, damage to lawn areas not caused by Contractor shall be excluded from Warranty. Such damage shall include ruts caused by driving vehicles over lawns, excavation and backfill work in lawn areas, damage from animals, or acts of vandalism or extreme weather conditions. Where evidence of such damage exists, advise Owner in writing, stating location, cause and extent of damage. Owner, upon receipt of such notice may order Contractor to correct damage at Owner's expense to exclude damaged area from Warranty provisions and correct damage by any arrangement deemed by Owner in his/her best interest.

PART 2 - PRODUCTS

LAWN SEED

Fresh, clean, dry, new seed that meets or exceeds the minimum requirements of purity and germination stated on an independent certificate of seed analysis document according to the Association of Official Seed Analysts (AOSA) rules.

Do not use wet seed or seed that is moldy or otherwise damaged. All seed packaging shall include a seed tag that contains: the name of the seller, the lot number, seed varieties with purity and germination percentages, as well as percentage of other crop seed, weed seed, noxious weeds and inert material. Variety Not Stated (VNS) seed is not permitted.

Seed shall have been test within the last 9 months and contain the following properties:

Purity	>90%
Germination	>85%
Other Crop	<0.5%
Weed Seed	<0.5%
Noxious Weeds	None
Inert Matter	<8%

Annual ryegrass shall not be permitted in lawn seed mixtures, except as a temporary cover for erosion control.

Select a high-quality lawn seed mixture that is adapted to the local site conditions and intended use of the turf, that is contains seed types fitting within one of the following percentages:

For Sun and Partial Shade areas, proportioned by weight as follows:

Kentucky Bluegrass / Fine Fescue / Perennial Ryegrass Blend

- 40 percent Kentucky bluegrass (at least two varieties)
- 40 percent fine fescue including Chewings fescue, creeping red fescue, or hard fescue
- No more than 20 percent perennial ryegrass

For Shaded areas (best for dry shade), proportioned by weight as follows:

Fine Fescue / Kentucky Blue Grass Blend

25 percent Creeping red fescue
25 percent Hard fescue
25 percent Chewings fescue
25 percent Kentucky bluegrass

WATER

Water to be free of wastewater effluent or other hazardous chemicals.

TOPSOIL

Naturally fertile, agricultural soil, classified as sandy loam to silty loam, capable of supporting turf and plant growth; of uniform composition throughout, without admixtures of subsoil, free of clay lumps, stones larger than 1" diameter, roots, trash and debris of any kind.

FERTILIZER

Fertilizer: Granular product composed of not less than fifty (50) percent slow-acting, guaranteed analysis fertilizer. All fertilizers shall be delivered fully labeled according to applicable regulations, bearing name and trade name or trademark of producer.

Starter Fertilizer: shall be composed of nitrogen, phosphorus and potassium with higher phosphorus ratio than found in maintenance fertilizers.

Maintenance Fertilizer: shall have nutrient ratios of nitrogen, phosphorus, and potassium to support any deficiencies indicated by soil-testing analysis.

All fertilizers shall be delivered fully labeled according to applicable regulations, bearing name, trade name or trademark of producer, along with producer's warranty.

MULCH

Straw Mulch: Provide air-dry, clean, mildew and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
Hydro Mulch: wood fiber mulch with tackifier.

PART 3 - EXECUTION

SITE PREPARATION

During construction, protect all structures, utilities, sidewalks, pavements, and other facilities and existing and newly installed vegetated areas from damage at all times.

Delay grading and spreading topsoil if unfavorable weather conditions may result in washouts or loss of material.

SOIL PREPARATION

Newly graded subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 0.5 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

Existing vegetated areas: If seeding occurs in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare surface soil as follows:

Remove existing vegetation. Do not mix vegetation into surface soil. Loosen existing topsoil to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

Rough grade areas to within 1 inch of subgrade elevations. Areas shall be graded to a smooth uniform surface plane with loose, uniformly fine texture. Areas shall be restored if eroded or otherwise disturbed after rough grading is complete.

PLACING TOPSOIL

Areas to be seeded shall have a minimum of 4 to 6 inches of topsoil of existing, amended or imported topsoil, but not less than required to meet finish grades after light rolling and natural settlement. Do not spread topsoil if subgrade is frozen, muddy, or excessively wet.

Limit fine grading to areas that can be seeded in the immediate future. After finish grading, restore any eroded or otherwise disturbed areas before sodding.

Do not place topsoil on top of saturated or frozen subgrade soil.

SEEDING

Methods of seed installation may vary at the discretion of the Contractor in order to establish and guarantee a smooth, uniform quality lawn. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

Install seed mixes at manufacturer’s recommended rates.

Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray.

MULCHING

Protect seeded areas not already receiving erosion mat as shown on plans by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.

CLEANING AND REPAIR

Waste and excess material from the seeding operation shall be promptly removed. Adjacent paved areas are to be cleaned, and any damage to existing adjacent landscape areas shall be repaired.

MAINTENANCE

Contractor to provide regular watering, weeding, pest management, and trash removal services for all newly seeded areas for a period of 60 (sixty) days after the date of seeding acceptance, at which time maintenance duties will be taken over by the Owner.

Contractor shall provide a temporary irrigation system or import water via watering truck as often as necessary to maintain moist soil to a depth of at least 2 inches. Seed installation shall be watered unless natural rainfall precludes the need for specific visits. During periods of hot weather (higher than 80º-85ºF), the seed installation may need additional irrigation.

Contractor to replace any mulch and/or seed that has been blown or washed away.

Fertilizing: Apply maintenance fertilizer with a mechanical rotary or drop-type distributor approximately thirty (30) days after seed installation, at manufacturer's recommended rate, and thoroughly water into the soil.

Contractor shall remove all weeds by the roots on a bi-weekly basis. Use of herbicide for weed-control shall be requested by Contractor, and allowed only with approval by Owner in writing.
Chemical applications of fertilizer or herbicides are to be performed in accordance with current federal, state, and local laws, through EPA-registered materials and application techniques, and performed under the supervision of a licensed certified applicator.

Mowing: The first mowing shall not be performed until the lawn has grown to a height of approximately 3 to 4 inches. Lawn shall be mown as often as necessary to maintain a height of 2-1/2 to 4 inches. No more than one third of the height of grass leaf shall be removed during any single mowing operation. The mowing operation is to include trimming around obstacles and the removal of excess grass clippings.

Line trimmers shall not be used around tree trunks.

Seeding Maintenance Log: Contractor shall submit a written record to the DFD Construction Representative that documents regular maintenance visits and actions performed. Failure of Contractor to provide documentation of regular required landscape maintenance duties, and resultant unsuccessful lawn establishment, will result in lawn re-seeding at full cost to Contractor per the seeding Warranty.

Contractor shall inform Owner when required maintenance period has concluded.

SEEDING ACCEPTANCE

The DFD Construction Representative and the Architect/Engineer shall perform inspections with the Contractor at the conclusion of the installation operations to verify that seeded lawn areas have been satisfactorily established.

A satisfactory installation shall meet the following requirements:

- An established root system (leaf blades break before seedlings can be pulled from the soil by hand)
- Uniform coverage throughout all turf areas with no bare spots larger than 5 inches by 5 inches
- No bare areas comprising more than 1% of any given 1,000 square foot area
- No deformation of the turf areas caused by mowing or other Contractor equipment
- Shall be free of weeds, disease and harmful pests

Request for Inspection: Contractor shall submit a request for inspection to the DFD Construction Representative and Architect/Engineer. The request shall be received at least 7 (seven) days before the anticipated date of inspection.

Contractor shall re-seed lawn areas that do not comply with requirements, and continue required maintenance until lawns are satisfactory.

Any defects or imperfections appearing in whole or any part of the work caused by or due to any fault or negligence on the part of the Contractor shall be corrected before the work is accepted.

Seeding work may be accepted in stages when the Contractor and Owner deem that practice to be in their mutual interest. Approval must be given in writing by Owner to the Contractor verifying that work may be completed in stages.

Acceptance of seeding work shall not waive any provisions of the Warranty.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE UTILITIES
BASED ON DFD MASTER SPECIFICATION DATED 11/23/2021

PART 1 - GENERAL

SCOPE

The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to provide for the storm drainage work required in these specifications and on the drawings. The limits of the work, including the responsible party for testing purposes, shall be clearly defined on the Drawings. Included are the following topics:

PART 1 - GENERAL
- Scope
- Related Work
- Reference Documents
- Reference Standards
- Submittals
- As-Built Drawings

PART 2 - MATERIALS
- Reinforced Concrete Pipe
- Corrugated Metal Pipe
- Connections for Dissimilar Pipe Materials
- Manholes
- Inlets
- Castings
- Apron Endwalls
- Locator Tape

PART 3 - EXECUTION
- General
- Laying Pipe
- Bedding/Utility Cover
- Structures (Manholes and Inlets)
- Apron Endwalls
- Casting Installation
- Connections to Existing Structures
- Drainage Laterals
- Locator Tape

RELATED WORK

Applicable provisions of Division 1 govern work under this section.

Related work specified elsewhere:

- Section 02 32 00 – Geo Technical Investigation
- Section 30 05 00 – Common Work Results for All Exterior Work
- Section 31 23 16.13 – Trenching
- Section 31 25 00 – Erosion Control

REFERENCE DOCUMENTS

Wherever WisDOT or SSHSC appears in this specification it shall be construed to mean the pertinent sections of the Wisconsin Department of Transportation, Standard Specifications for Highway and

Structure Construction (SSHSC), current edition, and all supplemental and interim supplemental specifications, as they may pertain, except this contract shall be a lump sum contract and measurement and basis of payment methods shall not apply.

Where these specifications do not cover portions of the work to be undertaken, the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition, shall govern the work.

REFERENCE STANDARDS

American Society for Testing and Materials (ASTM):

C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
C877	Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

SUBMITTALS

Provide manufacturer's product information (cut sheets), shop drawings and O&M information for storm drainage materials including:

- Pipe
- Fittings
- Pre-Cast and Cast-in-Place Structures
- Outfalls
- Castings

Provide reports documenting all required testing and televising.

AS-BUILT DRAWINGS

Show the actual locations of storm drainage facilities and service lines and structures on drawings. Show changes to proposed storm drainage facilities, alignment, or grades. Show the actual locations, sizes and types of underground utilities and other features encountered during construction.

PART 2 - MATERIALS

REINFORCED CONCRETE PIPE

Pipe and fittings shall conform to ASTM C-76 for circular pipe and ASTM C-507 for elliptical pipe. Unless otherwise specified, provide Class III for circular pipe and Class HE-III for elliptical pipe.

Joints for reinforced concrete pipe shall be bell and spigot or tongue and groove. Joints shall be provided with rubber gaskets conforming to ASTM C433. Joints for elliptical pipe shall be provided with trowelable

impervious bituminous joint sealer that is manufactured for sealing reinforced concrete storm drainage pipe joints.

When required, external sealing bands shall meet the requirements of ASTM C877 (Type II), and shall be Mar Mac Mac Wrap, Cretex Wrap, Sealing Systems, Infi-Shield, or approved equal.

CORRUGATED METAL PIPE

Galvanized pipe meeting the requirements of AASHTO M36. Minimum wall thickness shall be 16 Ga. for 12"-24" diameter pipe, 14 Ga. for 30" and 36" pipe, and 12 Ga. for 42"-54" diameter pipe.

Provide galvanized corrugated coupling bands with angle connectors having a minimum of 2 bolts. Coupling bands shall provide a joint that is soil tight.

CONNECTIONS FOR DISSIMILAR PIPE MATERIALS

Where new storm drainage pipe connects to and existing dissimilar pipe, the connection shall be made with either a no hub type couplings meeting the requirements of CISPI 310, or a rubberized mastic laminated to a strong reinforcing mesh, tightened with sheathed and protected steel straps.

Hub type couplings shall have neoprene gaskets with stainless steel shield, and multiple stainless steel clamps with worm gear tightening device. The rubberized mastic coupler shall be double wide, and clamped with four ratcheted steel straps protected by sheathing and a heavy cross-laminated polyethylene backing. The couplers shall be made specifically for the type and size of pipe materials being connected.

Couplings shall be Fernco, Husky, Charlotte, Mar Mac or approved equal.

MANHOLES

General

Provide precast concrete manholes unless otherwise shown or required. Cast-in-place manholes may only be used after receiving written approval by the DFD Project Representative and the A/E for customized manhole sizes and shapes.

Submit manufacturer's preproduction (shop) drawings for approval prior to the start of manufacturing.

Contractor shall carefully locate all pipe locations, sizes, orientation and elevation prior to ordering new manholes.

Precast Manhole Sections

Precast concrete manhole sections, including bottom and top shall meet the requirements of ASTM C478.

If conditions require a larger structure than shown on drawings, contact the DFD Project Representative and the A/E.

Provide eccentric cone top sections with a minimum clear opening of 24". Flat top slabs may be used on manholes greater than 6-foot inside diameter.

Manhole wall thickness shall be a minimum of 5" for 4-foot inside diameter manholes, 6" for 5-foot inside diameter manholes, and 7" for 6-foot and 7-foot inside diameter manholes or as shown in drawing details.

Provide pre-cast manhole base. Manhole bottom section may be pre-cast with integral base.

Joints

Provide manhole riser and barrel sections, cones, and flat tops, with standard pipe section tongue and groove joints.

Seal joints watertight with prefabricated rubber or plastic gaskets or formed in place butyl rubber seal.

Joint sealers: Hamilton Kent, ConSeal, MultiSeal Butyl-Tite, or approved equal.

Connections

Openings for connections in pre-cast structures shall be knock-outs or cut-outs. Cut-outs shall not extend into the joint of the bottom manhole section. Provide a minimum of 12" of separation between the edge of adjacent cut-outs or knock-outs.

Manhole Steps

Provide steps at 16" O.C. and project approximately 6" from wall.

Manhole steps shall be located in a straight, vertical line from the top of the manhole to the bottom. If the orientation of pipe openings prohibits this, locate manhole steps over the downstream pipe opening.

Manhole steps shall be steel reinforced polypropylene with ½-inch diameter deformed reinforcing bar. Steps shall be permanently secured in the manhole wall.

Manhole steps shall be American Step Company, M.A. Industries, or approved equal.

Bench and Flowline

Provide precast or cast-in-place bench and flowline.

Unless otherwise indicated on the drawings, bench height shall be ¾ the diameter of the downstream pipe. Slope bench towards flowlines at a minimum ½" per foot. Provide light broom finish on bench.

Flowlines shall be formed with gradual, uniform sweeps directed towards the downstream pipe. Provide smooth, troweled finish for flowlines.

When cast-in-place benches and flowline are used, lay the storm sewer pipe through the manhole.

Adjusting Rings

Fiber-reinforced pre-cast concrete adjusting rings meeting the requirements of ASTM C-478. Provide rings of 2" or 4" thickness.

Precompressed butyl gasket, 3/8" x 3½" shall be used between the top of the manhole and first adjustment ring, and between all subsequent rings. Butyl material shall be E-Z Stick, or equal.

INLETS

General

Inlets shall be round or rectangular precast concrete unless otherwise shown or required. Cast-in-place inlets may only be used after receiving written approval by the DFD Project Representative and the A/E for customized sizes and shapes.

Submit manufacturer's preproduction (shop) drawings for approval prior to the start of manufacturing.

Contractor shall verify pipe locations, sizes, orientation and elevation prior to ordering new inlets.

Precast Inlets

Precast inlets, shall meet the requirements of ASTM C478.

If field conditions require a larger structure than shown on drawings contact the DFD Project Representative and the A/E.

Joints

Inlets requiring separate base and riser sections must be provided with standard pipe tongue and groove joints.

Seal joints watertight with prefabricated rubber or plastic gaskets or formed in place butyl rubber seal. Joint sealers: Kent Seal, ConSeal, MultiSeal Butyl-Tite or approved equal.

Pipe Connections

Provide custom knock-outs/cut-outs based on project and location specific conditions.

A minimum of 2" of the precast structure is required between the top of a knock-out/cut-out and the top of the structure. A minimum of 2" of precast structure is required between the side of a knock-out/cut-out and the inside face of an adjacent sidewall.

Inlet Flowline

Provide either pre-cast or cast-in-place flowline that provides positive flow through the structure. Provide bench that directs water towards the flowline.

Flowlines and benches shall be formed with gradual, uniform sweeps directed towards the downstream pipe. Provide smooth, troweled finish for flowlines.

Adjusting Rings

Fiber-reinforced pre-cast concrete adjusting rings meeting the requirements of ASTM C-478. Provide rings of 2" or 4" thickness.

Precompressed butyl gasket, 3/8" x 3½" shall be used between the top of the inlet and first adjustment ring, and between all subsequent rings. Butyl material shall be E-Z Stick, or equal.

CASTINGS

General

All castings shall be heavy duty iron conforming to ASTM A48, Class 20 and rated for AASHTO H-20 loading. Provide non-rocking or machined castings with concealed pickhole.

Standard Curb Inlet Casting

Neenah Foundry Company R-3067, with Type L grate; or approved equal.

Beehive Casting and Grate

Neenah Foundry Company R-2560-E, with beehive cover R-1550-A; or approved equal.

Flat Inlet Casting

Neenah Foundry Company R-3067-C, with Type L grate; or approved equal.

APRON ENDWALLS

General

Provide apron endwalls where shown on the drawings and at the following locations:

- Where storm sewers outfall into ditches, swales or other surface water body
- On both ends of a culvert pipe (pipe that crosses under a road, sidewalk, trail or other surface feature)

Unless otherwise indicated, apron endwalls shall be constructed of the same material, same sidewall thickness and to the same design standards as the pipe they are connected to. Apron endwalls shall be the same diameter as the pipe that they are connected to.

Pipe ties shall be constructed using galvanized ¾" diameter steel rod and hardware, or other approved materials.

Pipe Gates

Apron endwalls for pipe greater than 18" in diameter shall be provide with pipe gates. Pipe gates shall be constructed of 1" diameter standard steel pipe members with welded connections and spaced no greater than 12" O.C.E.W. Pipe gate shall be attached to endwall at a minimum of 4 locations using 4"x4"x3/16" thick steel angles and 3/8" galvanized machine bolts. Pipe gates shall be provided with a galvanized finish, unless noted.

LOCATOR TAPE

Detectable metallic locator tape, specifically manufactured for marking utilities.

Tape shall be a minimum of 6" wide and shall be marked "STORM".

PART 3 - EXECUTION

GENERAL

Complete exploratory excavations at utility crossings as shown on the drawings and as necessary to complete the work.

Maintain clearances between existing or proposed storm drainage lines and watermains as follows:

- 8' horizontal separation (measured center to center) between existing or proposed sanitary or storm drainage lines and watermains.
- 12" vertical separation (measured from outsides of pipes) where watermains cross over sanitary or storm drainage lines.
- 18" vertical separation (measured from outsides of pipes) where watermains cross under sanitary or storm drainage lines.

Notify the A/E and DFD Project Representative of utility conflicts as soon as they are encountered.

Store and handle pipe in accordance with manufacturers' recommendations. Keep pipes clean of soil, debris and animals.

LAYING PIPE

Install pipe in accordance with the SSSWC and ASTM specifications that pertain to the specified type of pipe material and the installation situation.

Do not use any pipe or fittings cracked in cutting or handling or otherwise not free from defects.

Clean all pipe of any dirt and/or debris both inside and outside prior to placing in the trench.

Make joints in accordance with manufacturer's directions with due care to avoid damaging pipe and/or disturbing previously laid pipe.

Cut pipe only according to manufacturer's directions.

Lay all drainage pipes to horizontal alignment and grade shown on the drawings with bell ends up hill. Establish and maintain horizontal alignment using total station, transit or theodolite. Discrepancies from the required horizontal alignment or grade at any location shall not be greater than 0.10' or 0.05', respectively.

BEDDING/UTILITY COVER

Provide bedding and utility cover in accordance with the applicable requirements of Section 31 23 16.13 – Trenching.

Where excavation extends below the bottom of the structure's base or the trench, bring the excavation to the required elevation by the use of compacted Crush Stone Bedding.

A minimum of 12" of compacted Crush Stone Bedding shall be placed below the structure base.

A minimum of 8" of compacted Crush Stone Bedding shall be placed below the bottom of the apron endwall.

A minimum of 6" of compacted Crush Stone Bedding shall be placed below the storm drainage pipe and 12" of cover material shall be placed over the storm drainage pipe (both measured at the bell of the pipe).

STRUCTURES (MANHOLES AND INLETS)

Structures having improper location and/or orientation of the pipe connections will be rejected. Field repairs or adjustments of connection points are not permitted.

Do not connect abandoned pipes to new structures.

Limit the excavation for structures so as to provide only the necessary amount of space to sufficiently prepare the subgrade, set the base, set the structure, and lay pipe. Provide adequate clearance for compaction equipment and operator between structure and trench soil retention for adequate backfilling and compaction.

Set structure base in accordance with elevation and location as indicated on the drawings. Install base plumb and level. Install subsequent pre-cast sections in accordance with shop drawing layout. Provide watertight gaskets between each section.

<u>Inlets</u>
Pour inverts with smooth surface draining to downstream pipe. Where two or more lines meet at an angle, provide curved channel. Slope bench or floor at 2 inches/ft towards flow channel.

Structures shall be provided with between 4" and 8" of adjusting rings, with the top adjusting ring being 2" thick. Provide butyl sealant material between rings. Once rings are in place, tuck point the exterior joint and provide the entire exterior surface of the adjusting ring riser with a coating of mortar.

APRON ENDWALLS

Limit the excavation for apron endwalls so as to provide only the necessary amount of space to sufficiently prepare the subgrade, set the apron endwall, and lay pipe. Provide adequate clearance for compaction equipment and operator between apron endwall and trench soil retention for adequate backfilling and compaction.

Where excavation occurs below the bottom elevation of the apron endwall bottom, bring the excavation to the required elevation by the use of compacted crushed stone bedding.

Set apron endwall in accordance with elevation and location as indicated on the drawings. Install base plumb and level.

Apron endwalls for pipe greater than 18" in diameter shall be restrained using a minimum of two pipe ties per section. Pipe ties shall also be used to restrain the first two pipes located immediately upstream of the apron endwall. Pipe ties shall be bolted through the sidewall of the pipe.

Provide riprap downstream of apron endwalls at all storm drainage outfalls and at other locations as indicated on the drawings.

CASTING INSTALLATION

Install casting type as indicated on the drawings or in the specifications.

Provide butyl sealant material between last adjusting ring and casting base. Adjust casting elevation and slope to match adjacent proposed grades.

CONNECTIONS TO EXISTING STRUCTURES

Make all necessary openings into existing structures or drainage pipes including the reconstruction of existing inverts or benches, as necessary. Patch all openings permanently watertight with concrete brick and mortar, hydraulic cement, or flexible watertight boots.

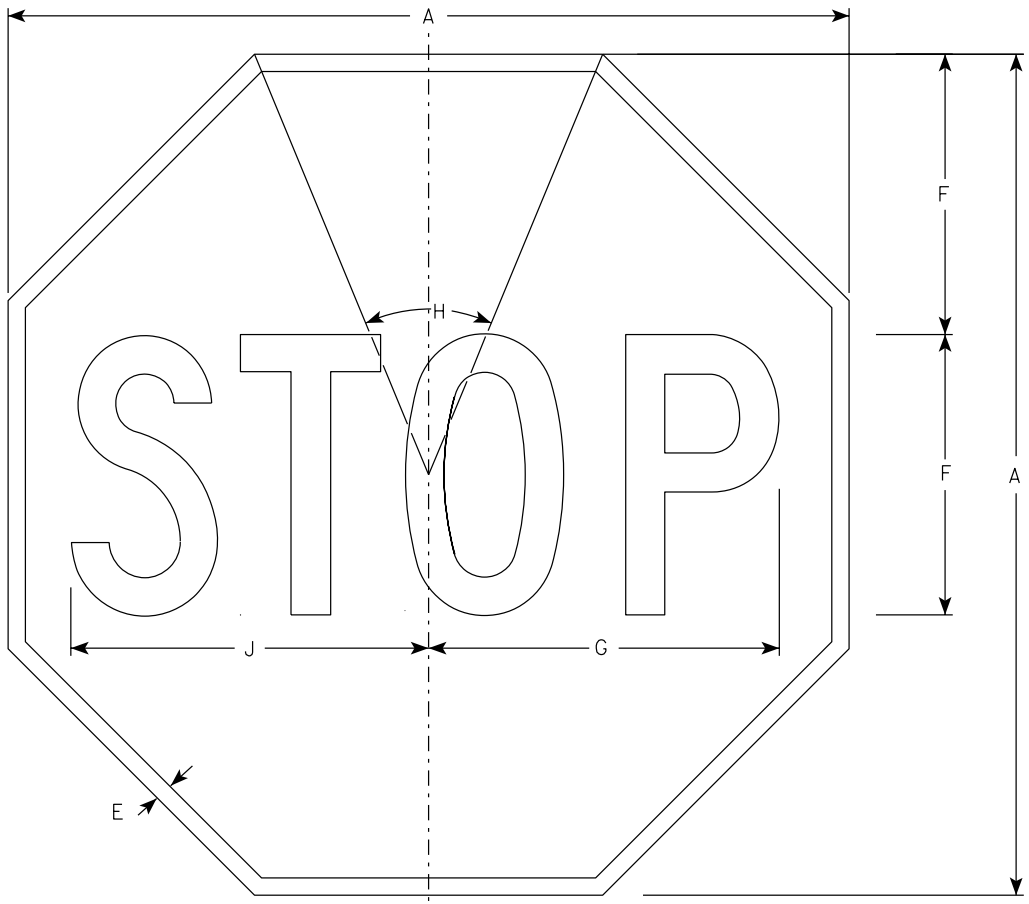
DRAINAGE LATERALS

Connect existing storm drainage laterals in accordance with all of the requirements of the storm drainage mains, including bedding, backfill, compaction, and jointing of the pipe. Connect drainage laterals to the storm drainage main by means of an approved "wye" fitting. Connect the new pipe to the existing lateral material using a no-hub coupling or approved transition fitting. Coupling/fitting shall be selected for the specific pipe material being connected.

LOCATOR TAPE

Install locator tape directly above new non-metallic storm sewer pipe approximately 15 inches below finished grade. Bring tape to surface and terminate in a drainage structure.

END OF SECTION



R1-1

NOTES

1. Sign is Type II - Type H Reflective - reference WIS DOT Standard Specification for HIGHWAY and STRUCTURE CONSTRUCTION latest edition.
2. Color:
   Background - Red
   Message - White
3. Message Series - C

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1	30				5/8	10	12 1/2	45°		12 3/4																	5.18
2S	30				5/8	10	12 1/2	45°		12 3/4																	5.18
2M	36				3/4	12	15	45°		15 3/8																	7.46
3	36				3/4	12	15	45°		15 3/8																	7.46
4	48				1	16	20	45°		20 1/2																	13.25
5	48				1	16	20	45°		20 1/2																	13.25
6	18				3/8	6	7 3/4	45°		7 3/4																	1.86
7	12				1/4	4	5	45°		5 1/8																	0.78

STANDARD SIGN
R1-1

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/12/15 PLATE NO. R1-1.13

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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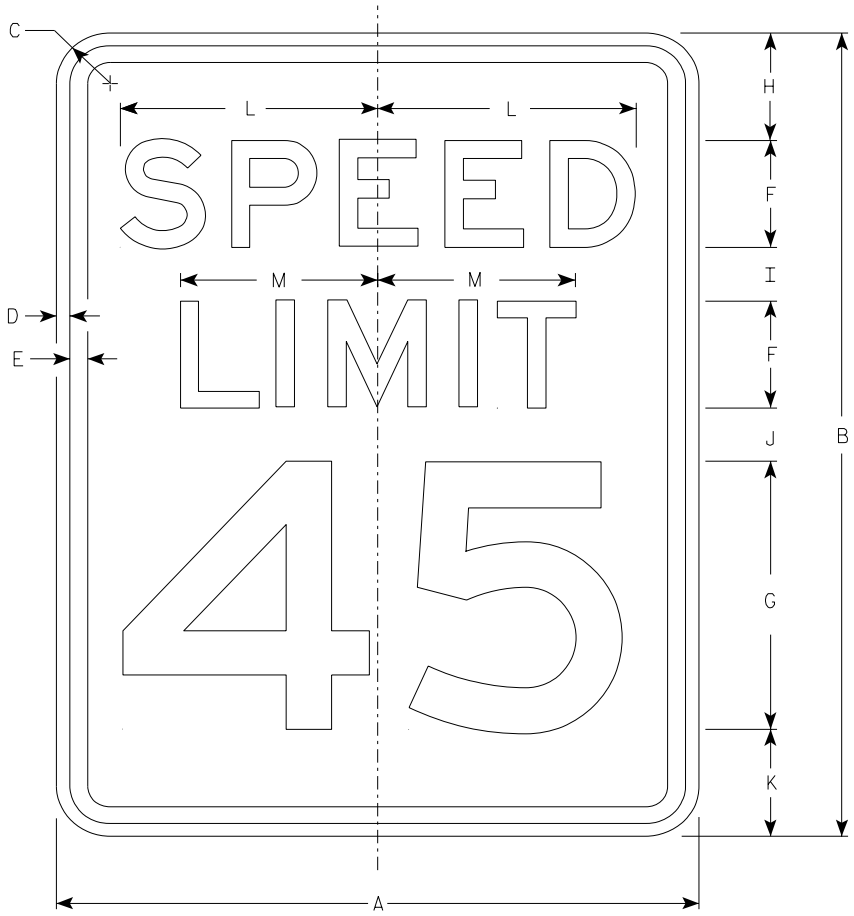

R2-1

NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - White
   Message - Black
3. Message Series - E
4. Substitute appropriate numerals and optically adjust spacing to achieve proper balance.

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1	18	24	1 1/2	3/8	1/2	3	8	3	2	2	3	7 1/4	5 1/2														3.0
2S	24	30	1 1/2	3/8	1/2	4	10	3	2 1/4	3 3/8	3 3/8	9 5/8	7 3/8														5.0
2M	30	36	1 7/8	1/2	5/8	5	12	5	2 1/2	2 1/2	4	12	9 1/4														7.5
3	36	48	1 7/8	1/2	5/8	6	14	6	5	5	6	14 3/8	11														12.0
4	36	48	1 7/8	1/2	5/8	6	14	6	5	5	6	14 3/8	11														12.0
5	48	60	3	3/4	1	8	20	6	4 1/2	6 3/4	6 3/4	19 1/4	14 5/8														20.0

STANDARD SIGN
R2-1

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 2/1/23 PLATE NO. R2-1.14

PROJECT NO:	HWY:	COUNTY:	SHEET NO:	E

FILE NAME : C:\CAEfiles\Projects\tr_stdplate\R21.dgn PLOT DATE : 9-JULY 2024 1:47 PLOT BY : msc_9h PLOT NAME : PLOT SCALE : $$.....plotscale.....$$ WISDOT/CADDS SHEET 42

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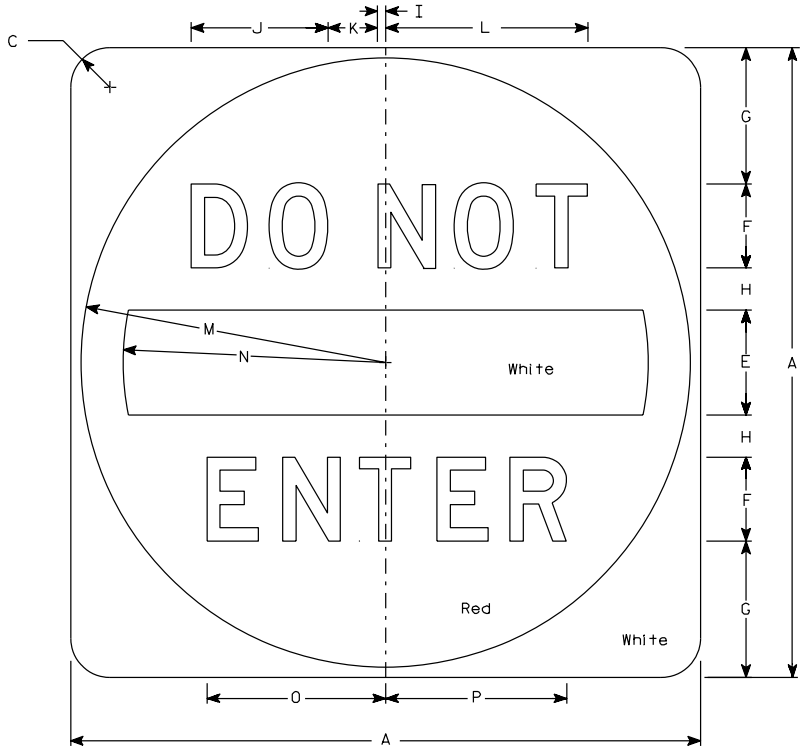
NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - See detail
   Message - White
3. Message Series - D



R5-1

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1																											
2S	30		1 7/8		5	4	6 1/2	2	3/8	6 1/2	2 3/8	9 5/8	14 1/2	12 1/2	8 1/2	8 5/8											6.25
2M	36		2 1/4		6	5	7 1/2	2 1/2	1/2	8 1/8	3	12 1/8	17 1/2	15	10 5/8	10 3/4											9.0
3	36		2 1/4		6	5	7 1/2	2 1/2	1/2	8 1/8	3	12 1/8	17 1/2	15	10 5/8	10 3/4											9.0
4	36		2 1/4		6	5	7 1/2	2 1/2	1/2	8 1/8	3	12 1/8	17 1/2	15	10 5/8	10 3/4											9.0
5	48		3		8	6	11	3	5/8	9 3/4	3 5/8	14 1/2	23 1/2	20	12 3/4	12 7/8											16.0

STANDARD SIGN
R5-1

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 3/15/18 PLATE NO. R5-1.16

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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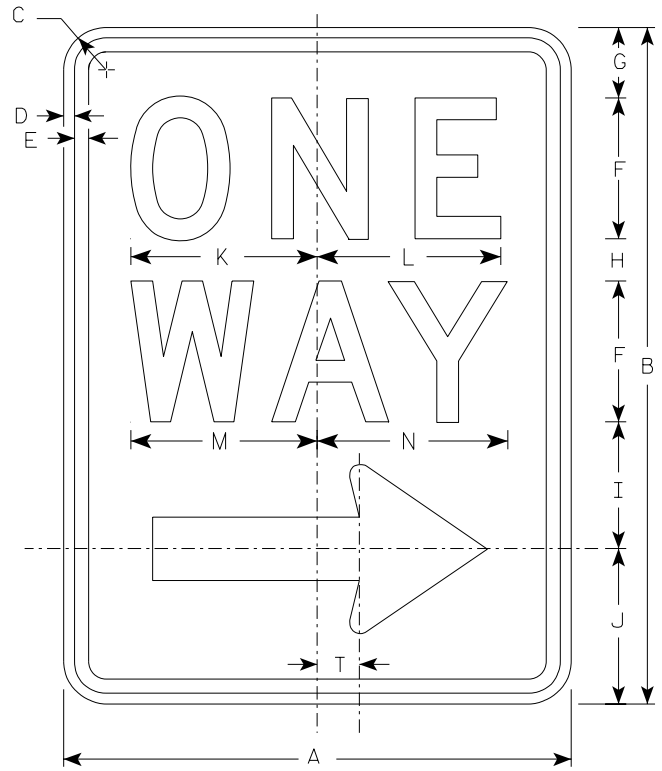
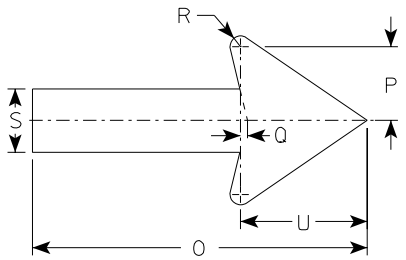
NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - White
   Message - Black
3. Message Series - D
4. R6-2L same as R6-2R except arrow points to the left.



R6-2R

Arrow Detail



SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	18	24	1 1/2	3/8	1/2	5	2 1/2	1 1/2	4 1/2	5 1/2	6 5/8	6 1/2	6 5/8	6 3/4	11 7/8	2 5/8	1/4	3/8	2 1/4	1 1/2	4 1/2					
2S	24	1 1/2	1 1/2	3/8	1/2	6	3	2 1/2	5 1/2	7	8 1/8	8 1/8	8 1/2	8 5/8	16	3 1/2	3/8	1/2	3	2	6					
2M	30	36	1 7/8	1/2	5/8	8	2 1/2	2 5/8	6 7/8	8	10 1/2	10 1/2	11 1/4	11 1/4	20	4 3/8	1/2	5/8	3 3/4	2 1/2	7 1/2					
3	36	48	1 7/8	1/2	5/8	10	5 1/4	3 1/4	9	10 1/2	12 3/4	12 3/4	13 1/4	13 1/2	24	5 5/8	1/2	3/4	4 3/4	3	9					
4	36	48	1 7/8	1/2	5/8	10	5 1/4	3 1/4	9	10 1/2	12 3/4	12 3/4	13 1/4	13 1/2	24	5 5/8	1/2	3/4	4 3/4	3	9					
5																										

STANDARD SIGN
R6-2 R&L

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/2/10 PLATE NO. R6-2.8

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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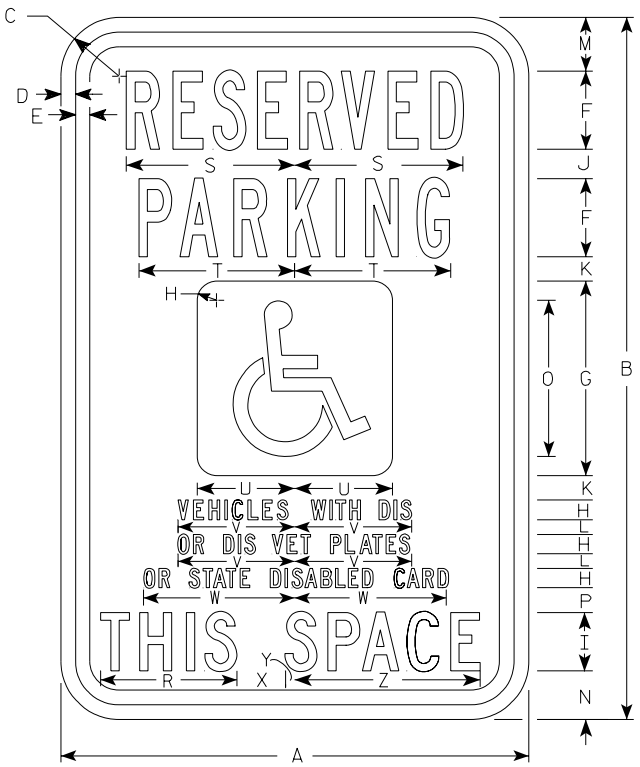

R7-8A

NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - Sign is white Type H Reflective; paraplegic background is blue.
   Message - Legend and border are green; paraplegic symbol is white
3. Message Series - Lines 1 & 2 are Series B
   Lines 3, 4, 5 & 6 are Series C

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1																											
2S	12	18	1 1/2	3/8	3/8	2	5	1/2	1 1/2	3/4	5/8	3/8	1 3/8	1 1/4	4	5/8		3 1/2	4 3/8	4	2 1/2	3	3 7/8	1 1/4	1/4	4 3/4	1.5
2M	18	24	1 1/2	3/8	1/2	3	6	3/4	2	7/8	5/8	1/2	1 7/8	2	5	3/4		4 5/8	6 1/2	5 3/8	3	4 1/2	5 7/8	1 1/2	1/4	6 3/8	3.0
3	18	24	1 1/2	3/8	1/2	3	6	3/4	2	7/8	5/8	1/2	1 7/8	2	5	3/4		4 5/8	6 1/2	5 3/8	3	4 1/2	5 7/8	1 1/2	1/4	6 3/8	3.0
4																											
5																											

STANDARD SIGN
R7-8A

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/9/23 PLATE NO. R7-8A.7

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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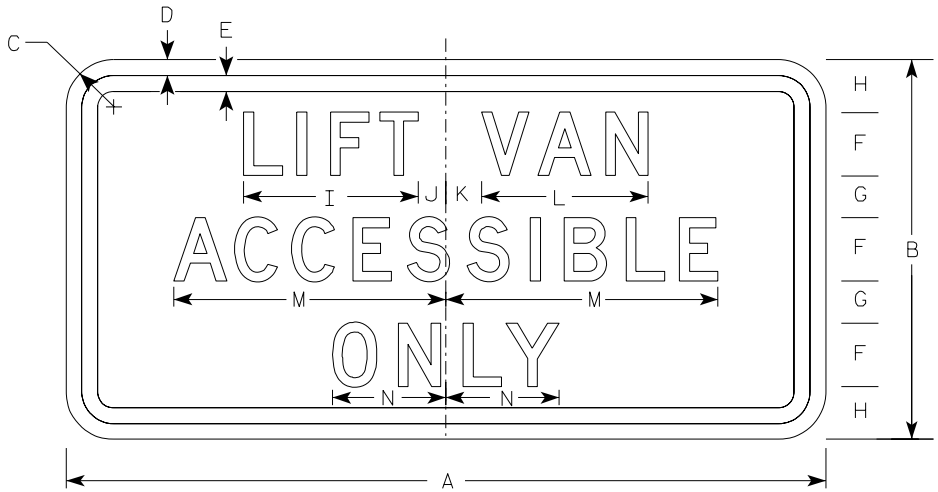
NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - White
   Message - Green
3. Message Series - D



R7-8V

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1																											
2S	12	6	1 ½	⅜	⅜	1	½	1	2 ¾	½	½	2 ⅝	4 ¼	1 ¾													0.50
2M	18	9	1 ½	⅜	⅜	1 ½	1	1 ¼	4 ⅛	⅝	⅞	4	6 ½	2 ⅝													1.125
3	18	9	1 ½	⅜	⅜	1 ½	1	1 ¼	4 ⅛	⅝	⅞	4	6 ½	2 ⅝													1.125
4																											
5																											

STANDARD SIGN
R7-8V

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/9/23 PLATE NO. R7-8V.8

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

FILE NAME : C:\CAEfiles\Projects\tr_stdplate\R78V.dgn PLOT DATE : 9-NOV 2023 2:52 PLOT BY : mscj9h PLOT NAME : PLOT SCALE : $$.....plotscale.....$$ WISDOT/CADDS SHEET 42

7

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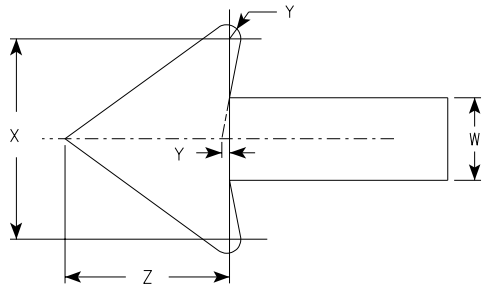
R7-51

NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - White
   Message - Red
3. Message Series - Lines 1, 3 and 4 are Series C.
   Line 2 is Series B.
4. R7-51D (double arrow)
   R7-51R (right arrow)
   R7-51L (left arrow)



ARROW DETAIL

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1	12	18	1 1/2	3/8	3/8	3	1 7/8	2	7/8	5/8	1 1/2	2 1/2	2	2	4 7/8	4 7/8	4 7/8	5/8	1 3/4	2 1/2	4 3/8	3 7/8	3/4	1 3/4	1/8	1 1/2	1.5
2S	18	24	1 1/2	3/8	1/2	4	2 1/2	2 1/2	1 1/4	1	2	3 1/4	2 3/4	2 5/8	7 1/8	7	5 3/4	1 1/8	1 1/2	3 1/8	5 1/2	5 7/8	1 1/8	2 5/8	1/4	2 1/4	3.0
2M	24	30	1 1/2	3/8	1/2	5	3	3	2	1 1/4	2 1/2	4	3 1/4	3 3/8	9 1/4	9 1/4	7 1/8	1 1/4	2	3 3/4	6 1/2	7 3/4	1 1/2	3 1/2	1/4	3	5.0
3	24	30	1 1/2	3/8	1/2	5	3	3	2	1 1/4	2 1/2	4	3 1/4	3 3/8	9 1/4	9 1/4	7 1/8	1 1/4	2	3 3/4	6 1/2	7 3/4	1 1/2	3 1/2	1/4	3	5.0
4																											
5																											

STANDARD SIGN
R7-51

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/9/23 PLATE NO. R7-51.7

PROJECT NO:	HWY:	COUNTY:			SHEET NO:	E

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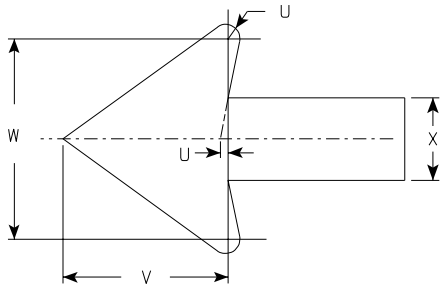
R7-52

NOTES

1. Sign is Type II - Type H Reflective
2. Color:
   Background - White
   Message - Red
3. Message Series - See Note 4
4. Lines 1, 3 and 4 are series C, line 2 is series B.
5. R7-52D (double arrow)
   R7-52L (left arrow)
   R7-52R (right arrow)



ARROW DETAIL

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1	12	18	1 1/2	3/8	3/8	3	1 7/8	1 1/2	7/8	7/8	2	2 1/2	2	2	4 7/8	4 7/8	3 7/8	3 3/4	2 3/8	3 7/8	1/8	1 1/2	1 3/4	3/4			1.5
2S	18	24	1 1/2	3/8	1/2	4	2 1/2	2 1/2	1 1/4	1	2	3 1/4	2 3/4	2 5/8	7 1/8	7	6 3/8	6 1/4	3 7/8	5 7/8	1/4	2 1/4	2 5/8	1 1/8			3.0
2M	24	30	1 1/2	3/8	1/2	5	3	3	2	1 1/4	2 1/2	4	3 1/4	3 3/8	9 1/4	9 1/4	7 5/8	7 5/8	4 3/4	7 3/4	1/4	3	3 1/2	1 1/2			5.0
3	24	30	1 1/2	3/8	1/2	5	3	3	2	1 1/4	2 1/2	4	3 1/4	3 3/8	9 1/4	9 1/4	7 5/8	7 5/8	4 3/4	7 3/4	1/4	3	3 1/2	1 1/2			5.0
4																											
5																											

STANDARD SIGN
R7-52

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/9/23 PLATE NO. R7-52.7

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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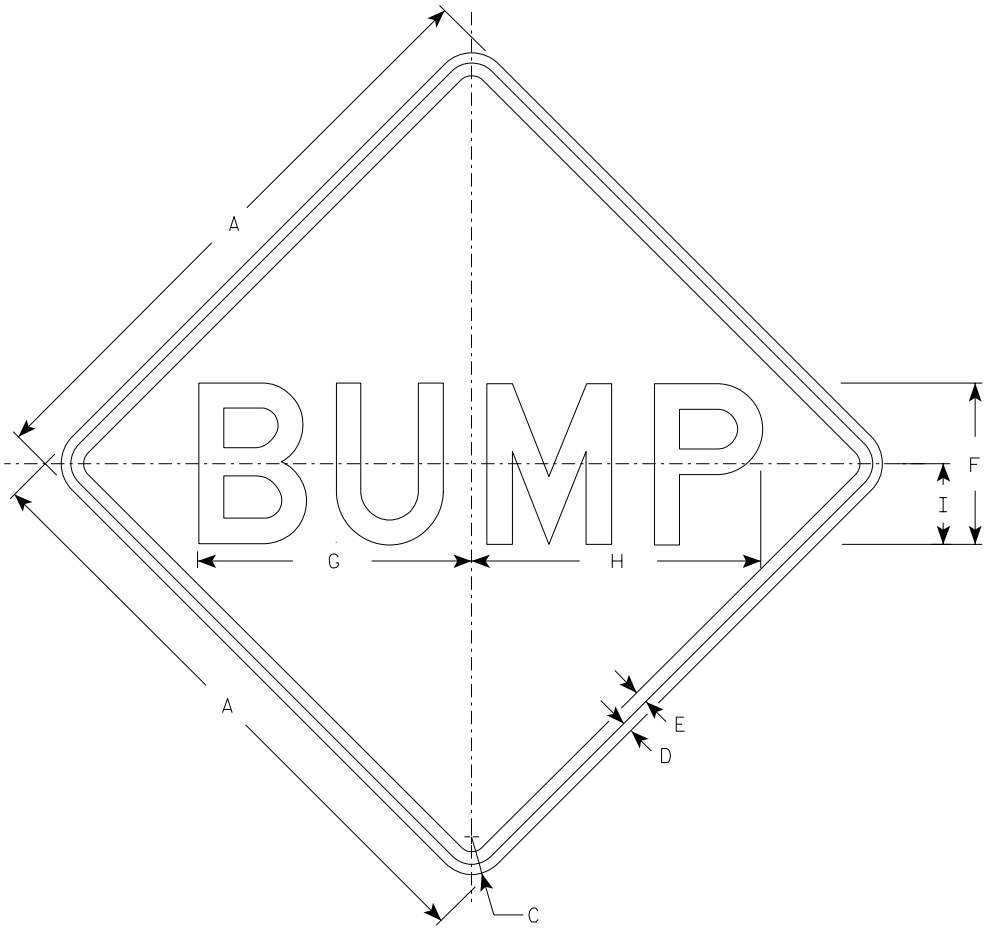

W8-1

NOTES

1. Sign is Type II - Type F Reflective
2. Color:
   Background - Yellow
   Message - Black
3. Message Series - D

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1	24		1 1/2	3/8	1/2	6	10 1/8	10 3/4	3																		4.0
2S	30		1 7/8	1/2	5/8	8	13 5/8	14 3/8	4																		6.25
2M	36		2 1/4	5/8	3/4	10	16 7/8	17 7/8	5																		9.0
3	36		2 1/4	5/8	3/4	10	16 7/8	17 7/8	5																		9.0
4	36		2 1/4	5/8	3/4	10	16 7/8	17 7/8	5																		9.0
5	48		3	3/4	1	12	20 3/8	21 5/8	6																		16.0

STANDARD SIGN
W8-1

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
For State Traffic Engineer

DATE 10/24/2023 PLATE NO. W8-1.8

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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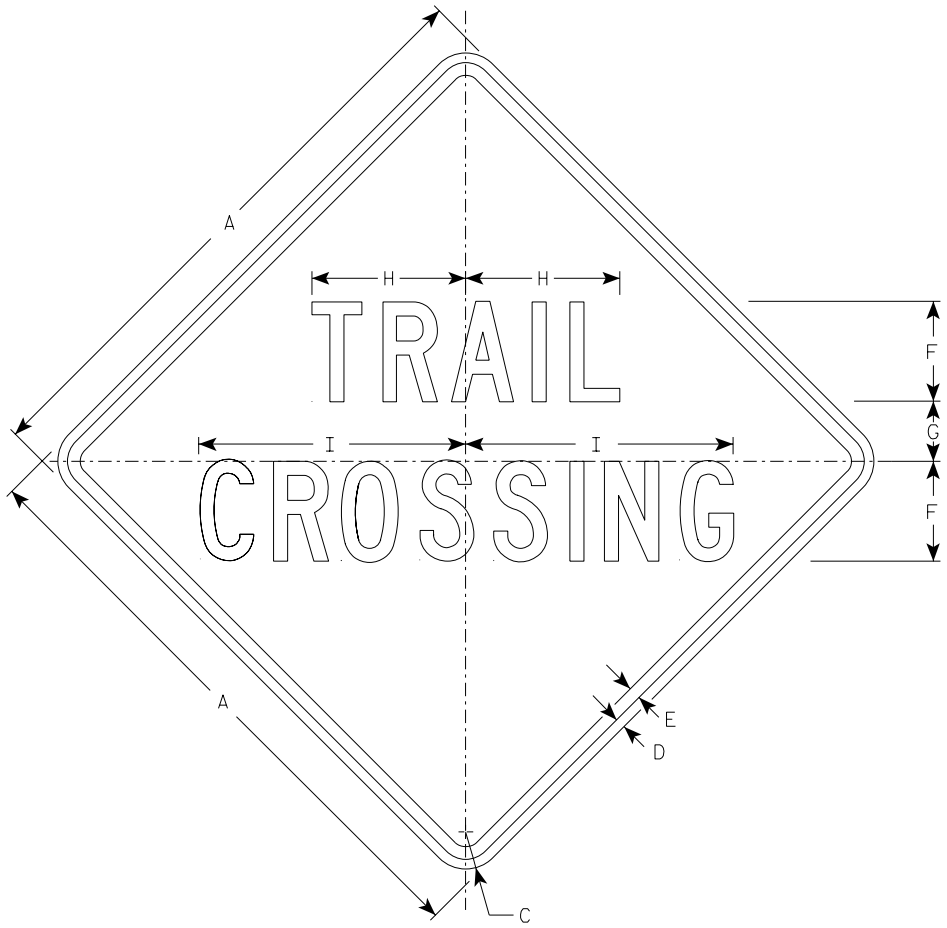

W11-15A

NOTES

1. Sign is Type II - Type F Reflective
2. Color:
   Background - Yellow
   Message - Black
3. Message Series - C

SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
1	24		1 1/2	3/8	1/2	4	2 3/8	6 1/8	10 3/4																		4.0
2S	30		1 7/8	1/2	5/8	5	3	7 3/4	13 3/8																		6.25
2M	36		2 1/4	5/8	3/4	6	3 1/2	9 1/4	16																		9.0
3	36		2 1/4	5/8	3/4	6	3 1/2	9 1/4	16																		9.0
4	48		3	3/4	1	8	5	12 7/8	21 1/4																		16.0
5																											

STANDARD SIGN
W11-15A

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 11/21/2023 PLATE NO. W11-15A.2

PROJECT NO:	HWY:	COUNTY:		SHEET NO:	E

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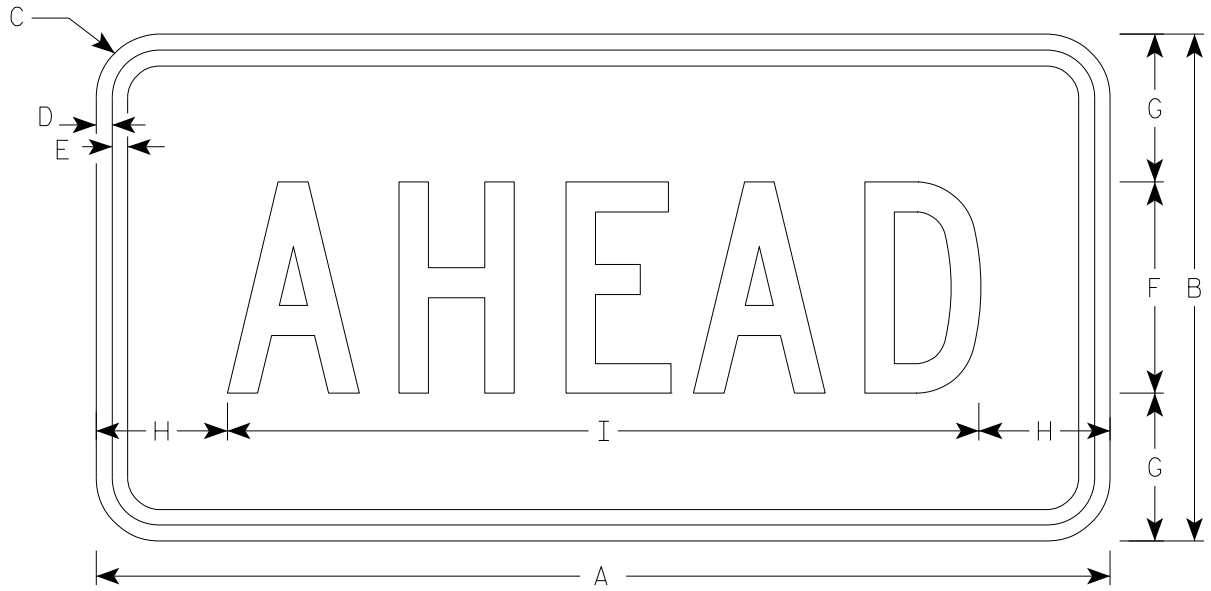
NOTES

1. Sign is Type II - Type F Reflective
2. Color:
   Background - Yellow
   Message - Black
3. Message Series - C



W16-9P

* For 36" x 36" Warning Signs, use 30" x 18" W16-9P signs.
* For 48" x 48" Warning Signs, use 48" x 24" W16-9P signs.

	SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Area sq. ft.
	1																											
	2S	24	12	1 1/2	3/8	3/8	5	3 1/2	3 1/8	17 3/4																		2.0
*	2M	30	18	1 1/2	3/8	1/2	7	5 1/2	2 3/4	24 1/2																		3.75
*	3	30	18	1 1/2	3/8	1/2	7	3 1/2	2 3/4	24 1/2																		3.75
*	4	48	24	1 7/8	1/2	5/8	10	7	6 1/8	35 3/4																		8.0
	5																											

STANDARD SIGN
W16-9P

WISCONSIN DEPT OF TRANSPORTATION

APPROVED Matthew R Rauch
for State Traffic Engineer

DATE 1/9/2024 PLATE NO. W16-9P.9

PROJECT NO: | HWY: | COUNTY: | SHEET NO: E

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