



Freeway Landfill and Dump Closure - Dig and Line

Technical Specifications - *100% Draft Submittal*

Prepared for
Minnesota Pollution Control Agency

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**Minnesota Pollution Control Agency
Closed Landfill Program
Freeway Remediation: Dig and Line
Project Manual
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Drawings **Under Separate Cover**

Attachments

A *(attachments to be provided with final documents)*

Division 01

General Requirements

SECTION 01 11 00

SUMMARY OF WORK

PART 1: GENERAL

1.01 CONTRACT DOCUMENTS

- A. The Contract Documents are defined in the Agreement. The terms of the Contract Documents apply to these Specifications as though fully repeated herein.
- B. The format of these Specifications is based upon the CSI MASTERFORMAT; however differences in format and subject matter location do exist. It is Contractor's sole responsibility to thoroughly read and understand these Specifications and request written clarification of those portions that are unclear.
 - 1. The term "provide" or "provided" shall mean "furnish and install complete in-place".
- C. The division of the Work as described in these Contract Documents is for the purpose of specifying and describing work that is to be completed. There has been no attempt to make a classification according to trade or agreements that may exist between Contractor, Subcontractors, trade unions, or other organizations. Such division and classification of the Work shall be Contractor's sole responsibility.

1.02 DEFINITIONS

- A. Contract Documents – As defined in the Instructions to Bidders and the Agreement.
- B. Drawings – Contract Drawings.
- C. Specifications – All sections of the Technical Specification Sections listed on the Specification Index.
- D. Owner – Minnesota Pollution Control Agency (Project Owner)
- E. Property Owner – Property Owner as noted on the Drawings
- F. Engineer – Barr Engineering Company and engineer of record as stated on the Drawings and these Specifications.
- G. Owner's Representative - Owner's employee assigned authority to direct the Work, or employee of Engineer as designated by Owner.
- H. Landfill – Freeway Landfill
- I. Dump – Freeway Dump

- J. Waste – The waste materials contained in the Landfill and Dump

1.03 EXISTING SITE CONDITIONS

- A. The Site is located in Burnsville, Dakota County, Minnesota, on the south side of the Minnesota River near Interstate 35W (with the Landfill located west of Interstate 35W and the Dump located east of Interstate 35W). The construction limits shown on Drawings shall define the boundary of the Site.
- B. The Work generally consists of closure of the Freeway Landfill and Freeway Dump. This includes excavation of cover soils, excavation and temporary stockpiling of Waste, demolition of existing structures within the waste footprint, construction of liner system, replacement of Waste, placement of cover system, construction of landfill gas control system, and restoration of the area.
- C. Site Access:
 - 1. Landfill: Primary access to the landfill is from the northeast via W Black Dog Road. Secondary access is from the southeast via Embassy Road.
 - 2. Dump: Access to the dump is from the southwest via Clif Road.
- D. The Site has been developed as indicated on the Drawings. There are no potable water supplies, or sanitary facilities. Electrical service is not available for use at the Site.
- E. Groundwater monitoring wells are present at the Site and are sampled and maintained regularly. Some wells are designated for sealing as part of the Work as shown on the Drawings. Protect and maintain access to all other wells at all times. Contractor shall be responsible for damage to groundwater monitoring wells as a result of construction activity and shall repair or replace damaged wells to Owner's satisfaction at no expense to Owner.
- F. An active waste transfer facility, referred to as Freeway Transfer Station, is present on the eastern portion of the Freeway Landfill site. The Transfer Station will remain operational throughout the project, and uninterrupted access must be provided for employees and waste hauling trucks.
- G. A salt unloading and distribution facility, referred to as U.S. Salt or Port Marilyn LLC, is present to the north of the Landfill. Uninterrupted access must be provided for employees and commercial vehicles.

1.04 PROJECT DESCRIPTION

- A. The overall scope of the Work, which is more fully described in these Contract Documents, includes, but is not necessarily limited to, furnishing all labor, tools, equipment, and materials necessary for Contractor to:
 - 1. Obtain all permits necessary to complete the Work.

2. Mobilize and demobilize labor, equipment, and materials.
3. Performing and managing the work required to maintain requirements of the construction stormwater pollution plan (SWPPP).
4. Locating, identifying, and protecting existing utilities and site features.
5. Provide temporary controls:
 - a. Temporary utilities
 - b. Construction Facilities
 - c. Traffic Control
 - d. Flood Protection
 - e. Controlling erosion and sediment transport at the Site.
 - f. Controlling waste-contact runoff from leaving the existing waste limits.
 - g. Temporary Environmental Controls (noise, dust, odor, vector, etc.)
6. Site Preparation
 - a. Furnishing and installing construction rock entrance and silt fence.
 - b. Clearing and grubbing site vegetation as shown on Drawings
7. Demolish and dispose of existing structures as shown on Drawings.
8. Remove existing pavement as shown on Drawings.
9. Abandon-in-place or remove portions of existing utilities as shown on Drawings.
10. Seal monitoring wells as shown on Drawings.
11. Excavation and fill:
 - a. Stripping and stockpiling topsoil, cover soil and common fill for re-use.
 - b. Excavate, haul, and temporarily stockpile existing Waste
 - c. Backfill to liner subgrades with common fill
 - d. Construct composite liner system with compacted clay liner, geosynthetic clay liner, and geomembrane
 - e. Construct leachate collection system

- f. Backfill stockpiled Waste
 - g. Construct cover system using buffer layer, geomembrane, geocomposite drainage layer, cover soil, topsoil, and erosion control blanket
 - h. Construct stormwater pond
 - i. Backfill and grade disturbed areas of the Site to maintain drainage
 - j. Place topsoil.
12. Construct gas extraction system including installation of blower and flare system.
 13. Furnish and install potable, sanitary, and storm piping.
 14. Erosion Control and Site Restoration
 - a. Furnishing and installing erosion control blanket and sediment control logs.
 - b. Seeding, mulching, and fertilizing required to establish vegetation.
 - c. Furnishing and installing granular filter and riprap materials.
 - d. Furnishing and installing bituminous pavement.
 - e. Furnishing and installing gravel road surfacing materials.
 15. Install fencing and gates.
 16. Perform construction/certification surveying, soil/pipe testing, and other construction quality assurance (CQA) activities required by the Specifications.
 17. Cleanup and demobilization
 - a. Keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work, and at the completion of the Work, shall remove all waste materials, rubbish and debris from the premises as well as all tools, construction equipment and machinery, temporary facilities, and surplus materials. Contractor shall leave the Site clean and ready for occupancy by Owner.
 18. Perform other Work as shown on Drawings
- B. It is the intent of the Contract Documents to cover all aspects of the Project. Should there be some item or items not shown on the Drawings or not described in these Specifications which are required for the Work, providing those items shall be considered incidental to the Work at no additional cost to Owner.

- C. The Work includes the furnishing of all labor, equipment, tools, machinery, materials, and other items required for the construction of a complete project as specified, except as specified otherwise herein.
- D. Equipment furnished shall be in safe operating condition and of adequate size, capacity, and condition for the performance of the Work.
- E. Obtain all measurements necessary for the Work and be responsible for establishing all dimensions, levels, and layout of the Work. Where Work of one trade joins to or is part of other Work, there shall be no discrepancy or incompleteness in the finished Work.
- F. Supervise, inspect and direct the Work competently and efficiently, devoting such attention and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Means, methods, techniques, sequences, and procedures of construction are solely Contractor's responsibility. Contractor shall be responsible to see that the completed Work complies accurately with the Contract Documents.
- G. Provide time, access, and assistance for Owner's construction quality control program.
- H. All work shall be done in accordance with applicable Laws and Regulations.

1.05 PERMITS

- A. Perform Work in accordance with applicable Laws and Regulations.
- B. Secure all licenses and permits necessary for the execution of the Work.
- C. Contractor shall obtain and pay for all fees for the required permits, unless otherwise noted below. Work cannot begin until all permits are received. The regulatory requirements for construction of the work shall include, but are not limited to:
 - 1. Demolition Permit(s)
 - 2. Well Sealing Permit(s)
 - 3. MnDOT Right of Way Permit
 - 4. Minnesota DNR Water Appropriation Permit
 - 5. MPCA Contaminated Groundwater Pump-Out General Permit)
 - 6. Building Permit
 - 7. Electrical Permit
 - 8. Contractor shall contact Gopher State One Call and private parties to identify and mark all underground utilities prior to beginning any subsurface work.

9. Contractor will sign onto the site Construction Stormwater Permit and comply with all general permit requirements and the provisions of the site Construction Stormwater Pollution Prevention Plan.
10. Contractor shall obtain any necessary permits to haul materials or equipment on public streets and highways.
11. Contractor shall submit copies of all permits upon receipt.
12. Contractor shall notify Owner and submit any correspondence regarding any regulatory notice or correspondence.

D. Owner will obtain and pay for all fees for the following permits:

1. Minnesota General Permit for Construction Stormwater under NPDES/SDS (SWPPP)
2. MCES Discharge Permit
3. MPCA Industrial Stormwater Permit
4. Lower Minnesota River Watershed District Individual Permit
5. Joint Permit Application for Activities Affecting Water Resources in Minnesota
6. Minnesota No Rise Certificate

1.06 WORK COVERED BY OTHERS

A. Owner, or Owner's On-site Representative, will perform the following task related to the Work:

1. Owner will provide benchmark and site coordinate information necessary for construction of the Work. Once provided, it is Contractor's responsibility to protect the information in accordance with Section 01 14 19, Use of Site. Contractor shall request such information from Owner a minimum of five days prior to the time when such information is needed.

B. Engineer will perform the following tasks related to the Work:

1. Screening excavations and collecting confirmation samples to determine final extent of excavation. Contractor is advised that removal area limits shown on the Drawings are approximate and field delineation is required.

C. Property Owners will perform the following tasks related to the Work:

1. Remove items from Site as shown on Drawings.
2. Continue to operate existing Freeway Transfer Station. Contractor shall maintain access, utilities, and security around Freeway Transfer Station during and after construction activities.

1.07 OWNER FURNISHED PRODUCTS (NONE)

1.08 CONTRACTOR'S USE OF PREMISES

- A. See Section 01 14 19, Use of Site for additional information.

1.09 SCHEDULE

- A. The Work performed under these Specifications shall begin and be completed in accordance with the schedule set forth in the Contract Documents.

1.10 PROJECT CONTACTS

- A. Owner – Project Manager

TBD

- B. Engineer – Principal/Certifying

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Barr Engineering Company
4300 MarketPointe Drive, Suite 200
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- C. Geologist – Project Manager/Design

TBD

- D. Engineer – Design

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- E. Owner's Representative – Construction Observer

TBD

F. Contractor

TBD

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 11 00

SECTION 01 14 19

USE OF SITE

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Contractor use of Site, including remote Sites
 - 2. Work hours
 - 3. Disruption of utilities
 - 4. Safety

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 CONTRACTOR USE OF SITE

- A. The Site is defined as the area within the construction limits as shown on the Drawings. Contractor shall limit operations, including material and equipment storage, to within those boundaries, and as otherwise agreed to with Owner.
- B. Coordinate with Owner and Engineer to limit operations, including materials and equipment storage, to the areas agreed upon prior to performance of the Work.
- C. Coordinate with Owner and Engineer to identify property limits at the Site prior to commencement of any construction activity.
- D. When unfavorable weather, soil, drainage, or other unsuitable construction conditions exist, confine operations to tasks that will not be adversely affected by such conditions. Construct no portion of the Work under conditions that would adversely affect the quality of the Work, unless special means or precautions are taken to perform the Work in a proper and satisfactory manner.
- E. Confine noise-generating hours of operation to between 7 AM and 9 PM local time Monday through Saturday. No Work shall be allowed outside of these hours or on legal holidays without written approval by Owner. This includes staging and operation of machinery; delivery of equipment, materials and machinery to the Site; construction activity; and any other activity that,

in the opinion of Owner, may be disrupting to the surrounding community or the operations of Owner.

1. For portions of the project that require utility service disruptions, coordinate timing of these tasks with Owner. These tasks may be required to be performed during off-peak or overnight hours.
- F. Coordinate with Owner and Engineer to identify project Site access, parking, and staging areas. If additional access is desired, submit plan to Owner and Engineer for review and approval. Any access shall not disturb traffic on city streets. Any damage to existing pavements or ground surfaces caused by access shall be restored to pre-construction conditions prior to demobilization.
- G. Contractor must perform all work so that access to the Site and adjacent facilities and installations are not restricted. At all times, Contractor shall conduct its operations so as to maintain the roads along work areas, including developing and maintaining by-passes or alternate routes if necessary, such that Contractor's operations do not impair the use or access to the Site or facilities and installations.
- H. Contractor shall be responsible for repair of streets, highways, and private roads including that are damaged by Contractor's operations. Contractor is responsible for any releases and their damages, environmental and otherwise, that are caused by Contractor's operations.
- I. Owner approval is required prior to storing any materials on Site.
- J. Perform operations carefully and in such a manner as to protect existing facilities and utilities, unless noted otherwise. Obstructions not shown on the Drawings may exist and shall be exposed by Contractor without damage. Contractor shall be responsible for damage to existing facilities and utilities resulting from Contractor's operations, and shall repair or replace damaged items to Owner's satisfaction. Groundwater monitoring wells shall be protected during construction, unless noted otherwise.
- K. Conduct operations so as to preserve benchmarks, survey reference points, and stakes existing or established by Owner for construction, unless noted otherwise. Contractor will be charged the expense of repairing or replacing survey markers and shall be responsible for mistakes or lost time that results from damage or destruction of survey markers due to Contractor's operations.
- L. Waste-contact water generated during construction must remain within the existing waste limits and may not be discharged except in accordance with permits. Under no circumstances shall waste-contact water be discharged into wetlands.
- M. Protect all wetlands from disturbance and sediment to the extent practicable, unless noted otherwise.
- N. Contractor to be liable for environmental impacts of Contractor's activities.

1.04 UTILITIES

- A. Immediately resolve any disruptions caused by Contractor activity or inactivity that result in shut down of any utility service, other than those service disruptions scheduled and approved by Owner.
- B. Contractor shall be responsible for any costs associated with the unscheduled facility or utility service shutdown and its resolution to bring the services back to normal operation, including, but not limited to, cost for storage; piping; pumping; trucking; cleanup; or labor costs, fees, fines, or penalties incurred by Owner related to the service disruption.

1.05 SAFETY

- A. See Section 01 35 00, Construction Safety and Security.

1.06 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 14 19

SECTION 01 29 00

MEASUREMENT AND PAYMENT

PART 1: GENERAL

1.01 SUMMARY

- A. This Section of the Specifications describes the measurement and payment for the Work to be completed for each of the lump sum or unit price items which make up the entire Total Contract Price.
- B. Each lump sum or unit price (each a "Contract Unit Price") shall constitute full compensation as specified herein for each item of Work completed in accordance with the Specifications and Contract Drawings and other Contract Documents, including all clean up and restoration.
- C. All costs in connection with the Work, including furnishing all materials, machinery, supplies and appurtenances; providing all construction equipment and tools; and performing all necessary labor, coordination, supervision, and management to fully complete the Work shall be included in the unit or lump sum prices quoted on the Bid Form. All Work not specifically set forth as a separate item shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the amounts and prices submitted in the Total Contract Price.

1.02 RELATED SECTIONS

- A. Section 01 33 00 Submittals
- B. Section 01 77 00 Closeout Procedures

1.03 ESTIMATED QUANTITIES

- A. All estimated quantities for unit price items in the Bid Form are approximate and are to be used only as a basis for estimating the Total Contract Price. The actual amount of work completed or materials furnished under the unit price items may differ from the estimated quantities. The basis of payment for work or materials furnished or placed will be the actual amount of Work completed or material furnished and placed. Contractor agrees to make no claim for damages, anticipated profits, or otherwise due to any difference between the amounts of work actually performed or materials furnished and placed and the estimated amounts included in the Bid Form. The unit prices in the Bid Form shall not be adjusted if actual quantities of Work vary from estimated quantities in the Bid Form. Owner reserves the right to adjust estimated quantities (including removing the item completely) based on testing and field conditions.

1.04 INTENT OF BID FORM ORGANIZATION

- A. Payment for all Work shall be in accordance with the terms and conditions set forth in the Agreement in the Contract Documents and Contractor's Contract Unit Prices set forth in Contractor's conformed Bid Form incorporated in the Agreement. The bid items set forth in the Bid Form subdivide the Work for purposes of measurement and payment only, and are intended to represent the entirety of the Work as set forth in the Contract Documents.
- B. The following paragraphs provide additional descriptions of the Work included in each of the Bid items subject to the provisions of paragraphs 1.01, 1.02, and 1.03 of this Section.
 - 1. Some of the Bid items are based on unit lump sum prices. Partial progress payment for those unit lump sum items shall be made in accordance with percent completed for each item based on the breakdown of the lump sum price in Contractor's conformed Bid Form or as agreed to in the Schedule of Values.
 - 2. Other Bid items are based on Unit Prices. For those items, progress payments shall be based on the actual quantities of each item of Work completed in accordance with the Contract Documents.
- C. The procedures for submitting and processing progress payments are set forth elsewhere in the Contract Documents.
- D. The paragraphs below describe the materials, equipment, labor, and supplies that are included in each of the Bid items.

1.05 BID ITEMS

- A. General Items (GE)

GE.1. Mobilization and Demobilization

- a. Method of measurement: Mobilization and Demobilization shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Mobilization and Demobilization and all project support, including but not limited to, costs of all supervision, labor, coordination, management, materials, equipment, overhead and profit unless specifically included in other Bid Items, and performing all operations as are necessary for mobilization and demobilization, all complete as specified.
- c. This item shall include Contractor's premium for any special insurance obtained for this project; all project meetings; coordination; furnishing, installing, and maintaining Contractor's facilities; providing work area security; coordinating work area access; coordinating and maintaining access to other properties; installing and removing temporary access roads/ramps or other features required by Contractor; development, implementation, and maintenance of appropriate health and safety

plan; providing all electrical, water, telephone, and other utility services required or needed by Contractor to perform the Work; all sequencing and staging activities not paid for separately as a Bid Item; equipment mobilization and demobilization; submittals; obtaining all permits and lockout tagout procedures required of Contractor; identifying and locating utilities as necessary for the Work; relocating all equipment, supplies, and miscellaneous items in the Work area as shown on the Drawings; site cleanup; documentation; and all incidentals and other items not specifically paid for but included in the total scope of Work.

GE.2. Temporary Erosion Control and SWPPP Implementation

- a. Method of measurement: Temporary Erosion Control and SWPPP Implementation shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Temporary Erosion Control and SWPPP Implementation, including but not limited to, SWPPP compliance and maintenance requirements, concrete washout management area, construction entrance, culvert/inlet protection, erosion control blanket, flotation silt curtain, hydromulch, sediment control log, silt fence, spray tackifier, temporary sedimentation basin(s) and outlet structure(s), temporary seeding and mulching, furnished, installed, maintained, and removed at completion of the project, all complete as specified. Ninety-percent of the Lump Sum Price shall be paid for furnishing, installing, and maintaining erosion control and ten-percent of the Lump Sum Price shall be paid upon removal of the erosion control at the completion of the Project.

GE.3. Surveying

- a. Method of measurement: Surveying shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor will be paid a Lump Sum (LS) Price for Surveying, all complete as specified. This item shall include construction staking, certification surveying, and measurement of all quantities of items paid by a Unit Price based on a volume or area measurement.

GE.4. Soil Testing

- a. Method of measurement: Soil Testing shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Soil Testing, all complete as specified. This item shall include all testing of Subgrade, Common Fill, Compacted Clay Liner, Topsoil, Aggregate Base, Gravel Surfacing, Structural Fill, Pipe Bedding, Granular Filter, Pea Stone, Riprap, Buffer Layer, Cover Soil, Coarse Aggregate/Drainage Aggregate, and Sand Drainage Layer soil materials as required

by the Technical Specifications and all other informational soil testing deemed necessary by the Contractor to perform the Work.

GE.5. Traffic Control

- a. Method of measurement: Traffic Control shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Traffic Control, including but not limited to, all warning lights, barricades, informational signs, snow fence, traffic permits, and watchmen, all complete as specified.

GE.6. Clearing and Grubbing

- a. Method of measurement: Clearing and Grubbing shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Clearing and Grubbing, including but not limited to, clearing and grubbing, removing trees, shrubs, stumps, and other plants, hauling, stockpiling, and disposing of materials appropriately, all complete as specified.

GE.7. Demolition and Disposal (Freeway Landfill)

- a. Method of measurement: Demolition and Disposal (Freeway Landfill) shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Demolition and Disposal (Freeway Landfill), including but not limited to, abatement, demolition of structures, pavements, and slabs, sorting of materials, salvaging of gravel for reuse on site (if feasible), removal, transport, and disposal of material, and sealing monitoring wells, all complete as specified.

GE.8. Demolition and Disposal (Freeway Dump)

- a. Method of measurement: Demolition and Disposal (Freeway Dump) shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Demolition and Disposal (Freeway Dump), including but not limited to, abatement, demolition of structures, pavements, and slabs, sorting of materials, salvaging of gravel for reuse on site (if feasible), removal, transport, and disposal of material, and sealing monitoring wells, all complete as specified.

B. Environmental Management (EM)

EM.1. Flood and Water Control

- a. Method of measurement: Flood and Water Control shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor will be paid a Lump Sum (LS) Price for Flood and Water Control, including but not limited to, implementing Contractor's flood control plan, installing and maintaining throughout construction any flood protection berms, diversion channels, temporary waste covers, furnishing, installing, operating, and maintaining pump systems, or other necessary items for managing and protecting the site from flooding (from surface water, stormwater, and groundwater seepage) and dewatering the site to facilitate construction under dry conditions, including all required documentation as defined in these specifications, all complete as specified.

EM.2. Leachate Transfer

- a. Method of measurement: Leachate Transfer shall be measured per Thousand Gallon (TGAL) of leachate transferred to Metropolitan Council Environmental Services (MCES), measured to the nearest Thousand Gallon as measured by Contractor's flow meter.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Thousand Gallon (TGAL) for Leachate Transfer, including but not limited to, managing, storing, testing, furnishing and installing temporary piping and pumps, pumping, discharging, and other necessary items for transferring leachate from within the construction area. This Bid Item does not include the MCES fee (Owner will pay MCES fee directly).

EM.3. Dust Control

- a. Method of measurement: Dust Control shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Dust Control, including but not limited to, providing water and water tank trucks equipped with water cannons and other necessary items and methods for controlling dust, all complete as specified.

EM.4. Odor and Volatile Organics Control

- a. Method of measurement: Odor and Volatile Organics Control shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Odor and Volatile Organics Control, including but not limited to, monitoring for, furnishing, installing, and implementing control measures for the presence of odors, volatile organics, and air quality in excess of the criteria specified, all complete as specified.

EM.5. Litter Control

- a. Method of measurement: Litter Control shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Litter Control, including but not limited to, monitoring for, furnishing, installing, and implementing control measures for the presence of litter/debris and vectors in excess of the criteria specified, providing temporary/daily cover, cleaning, and preventing and recovering blown trash, all complete as specified.

C. Mass Excavation and Embankment Construction (ME)

ME.1. Strip and Place Cover Soils and Topsoil

- a. Method of measurement: Strip and Place Cover Soils and Topsoil shall be measured per Cubic Yard (CY), measured to the nearest Cubic Yard. Volumes will be calculated using AutoCAD Civil 3D surfaces generated from existing topography and bottom of cover soils surveys.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Cubic Yard (CY) for Strip and Place Cover Soils and Topsoil, including but not limited to stripping/excavating, segregating Topsoil and Cover Soil, hauling, stockpiling, placing, and grading cover soil materials , all complete as specified.

ME.2. Place Topsoil (Imported)

- a. Method of measurement: Place Topsoil (Imported) shall be measured based on weight in tons (TON), measured to the nearest Ton. Place Topsoil (Imported) weight will be measured based on weight tickets.
- b. Basis of Payment: Contractor shall be paid a Unit Price per ton (Ton) for Place Topsoil (Imported), including but not limited to, furnishing, hauling, stockpiling placing, and grading topsoil, all complete as specified.

ME.3. Common Fill Excavation/Placement

- a. Method of measurement: Common Fill Excavation/Placement shall be measured per Cubic Yard (CY), measured to the nearest Cubic Yard. Volumes will be calculated using AutoCAD Civil 3D surfaces generated from top of common fill excavation and bottom of common fill excavation surveys.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Cubic Yard (CY) for Common Fill Excavation/Placement, including but not limited to excavating, hauling, stockpiling, processing, placing, compacting, and grading common fill materials, all complete as specified.

ME.4. Common Fill (Imported)

- a. Method of measurement: Common Fill (Import) shall be measured based on weight in tons (TON), measured to the nearest Ton. Common Fill (Import) weight will be measured based on weight tickets.
- b. Basis of Payment: Contractor shall be paid a Unit Price per ton (Ton) for Common Fill (Import), including but not limited to, furnishing, hauling, stockpiling, processing, placing, compacting, and grading common borrow (import), all complete as specified.

ME.5. Peat Excavation

- a. Method of measurement: Peat Excavation shall be measured per Cubic Yard (CY) excavated, measured to the nearest Cubic Yard. Volumes will be calculated using AutoCAD Civil 3D surfaces generated from top of peat and bottom of peat surveys.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Cubic Yard (CY) for Peat Excavation, including but not limited to excavating, hauling, stockpiling, and placing of peat all complete as specified.

ME.6. Bedrock Excavation

- a. Method of measurement: Bedrock Excavation shall be measured per Cubic Yard (CY) excavated, measured to the nearest Cubic Yard. Volumes will be calculated using AutoCAD Civil 3D surfaces generated from top of bedrock and bottom of bedrock surveys.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Cubic Yard (CY) for Bedrock Excavation, including but not limited to, excavating, cutting, chipping, hauling, stockpiling, and placing of bedrock, all complete as specified.

ME.7. Structural Fill

- a. Method of measurement: Structural Fill shall be measured based on weight in tons (TON), measured to the nearest Ton. Structural Fill weight will be measured based on weight tickets.
- b. Basis of Payment: Contractor shall be paid a Unit Price per ton (Ton) for Structural Fill, including but not limited to, furnishing, hauling, stockpiling, processing, placing, compacting, and grading structural fill, all complete as specified.

D. Landfill Liner (LL)

LL.1. Compacted Clay Liner

- a. Method of measurement: Compacted Clay Liner shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Compacted Clay Liner will be the two-dimensional area.

- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Compacted Clay Liner, including but not limited to, furnishing, hauling, stockpiling, processing, placing, compacting, and grading Compacted Clay Liner, all complete as specified.

LL.2. Geosynthetic Clay Liner (GCL)

- a. Method of measurement: Geosynthetic Clay Liner (GCL) shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Geosynthetic Clay Liner (GCL) will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Geosynthetic Clay Liner (GCL), including but not limited to, furnishing and installing geosynthetic clay liner (GCL), all complete as specified.

LL.3. High Density Polyethylene (HDPE) Geomembrane Liner

- a. Method of measurement: High Density Polyethylene (HDPE) Geomembrane Liner shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for HDPE Geomembrane Liner will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for High Density Polyethylene (HDPE) Geomembrane Liner, including but not limited to, furnishing, installing, seaming, and testing the materials as required for HDPE geomembrane liner (smooth and textured), all complete as specified.

LL.4. Drainage Layer Placement

- a. Method of measurement: Drainage Layer Placement shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Drainage Layer Placement will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Drainage Layer Placement, including but not limited to, furnishing, hauling, placing, and grading drainage layer, all complete as specified.

LL.5. Leak Location Survey

- a. Method of measurement: Leak Location Survey shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Leak Location Survey will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Leak Location Survey, including but not limited to, providing a leak location survey, including all required documentation as defined in these specifications, all complete as specified.

E. Leachate Collection, Storage, and Transfer (LE)

LE.1. Leachate Collection Piping and Appurtenances

- a. Method of measurement: Leachate Collection Piping and Appurtenances shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Leachate Collection Piping and Appurtenances, including but not limited to, furnishing and installing leachate collection pipes, cleanouts, manifold systems, sidewall risers pipes, geotextile, and all associated appurtenances (excluding Aggregate, and Pumps and Panel, transducers, discharge piping, and Forcemain Piping and Appurtenances, which are included under different Bid Items), all complete as specified.

LE.2. Drainage Aggregate

- a. Method of measurement: Drainage Aggregate shall be measured on a single Lump Sump (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Drainage Aggregate, including but not limited to, furnishing, hauling, placing, and grading aggregate, all complete as specified.

LE.3. Riser Vault

- a. Method of measurement: Riser Vault shall be measured per Each (EA) installed.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Each (EA) for Riser Vault, including but not limited to, furnishing and installing Riser Vault all complete as specified.

LE.4. Pumps and Panel

- a. Method of measurement: Pumps and Panel shall be measured per Each (EA) landfill sump installed.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Each (EA) landfill sump for Pumps and Panel, including but not limited to, furnishing and installing panel, and furnishing, installing, and maintaining pumps, discharge piping, and transducers for the landfill (spare pumps will be considered incidental to this Bid Item) (excluding Forcemain Piping and Appurtenances, which is included under different Bid Item, all complete as specified.

LE.5. Forcemain Piping and Appurtenances

- a. Method of measurement: Forcemain Piping and Appurtenances shall be measured on a single Lump Sum (LS) unit.

- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Forcemain Piping and Appurtenances, including but not limited to, furnishing, trenching for, backfilling for, and installing leachate forcemain pipes, pipe bedding, leachate transfer pipe cleanouts manholes, valves and valve manholes, meter and meter manhole, and connection to MCES (excluding Leachate Tanks and Truck Loadout, which is included under a different Bid Item), all complete as specified.

LE.6. Leachate Tanks and Truck Loadout

- a. Method of measurement: Leachate Tanks and Truck Loadout shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Leachate Tanks and Truck Loadout, including but not limited to, furnishing, trenching for, backfilling for, and installing Leachate Tanks and associated pumps and floats and Truck Loadout slab, leachate loadout pipe, overhead leachate loadout support and piping, leachate spill sump and drain with gate valves, pipe bedding, all complete as specified.

F. Waste Excavation and Placement (WE)

WE.1. Waste Excavation and Placement (from Freeway Landfill)

- a. Method of measurement: Waste Excavation and Placement (from Freeway Landfill) shall be measured per Cubic Yard (CY) relocated, measured to the nearest Cubic Yard. Volumes will be calculated using AutoCAD Civil 3D surfaces generated from top of waste and bottom of waste excavation surveys.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Cubic Yard (CY) for Waste Excavation and Placement (from Freeway Landfill), including but not limited to, excavating, hauling, stockpiling, placing, compacting, and grading waste from the existing landfill, all complete as specified.

WE.2. Waste Excavation and Placement (from Freeway Dump)

- a. Method of measurement: Waste Excavation and Placement (from Freeway Dump) shall be measured per Cubic Yard (CY) relocated, measured to the nearest Cubic Yard. Volumes will be calculated using AutoCAD Civil 3D surfaces generated from top of waste and bottom of waste excavation surveys.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Cubic Yard (CY) for Waste Excavation and Placement (from Freeway Dump), including but not limited to, excavating, hauling, stockpiling, placing, compacting, and grading waste from the existing landfill, all complete as specified.

G. Landfill Cap (LC)

LC.1. Geocomposite Drainage Layer

- a. Method of measurement: Geocomposite Drainage Layer shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Geocomposite Drainage Layer will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Geocomposite Drainage Layer, including but not limited to, furnishing and installing geocomposite drainage layer, all complete as specified.

LC.2. Linear Low Density Polyethylene (LLDPE) Geomembrane Cover

- a. Method of measurement: Linear Low Density Polyethylene (LLDPE) Geomembrane Cover shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Linear Low Density Polyethylene (LLDPE) Geomembrane Cover will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Linear Low Density Polyethylene (LLDPE) Geomembrane Cover, including but not limited to, furnishing, installing, seaming, and testing the materials as required for LLDPE geomembrane cover (smooth and textured), all complete as specified.

LC.3. Buffer Layer

- a. Method of measurement: Buffer Layer shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Buffer Layer will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Buffer Layer, including but not limited to, furnishing (as needed), hauling, placing, and grading buffer layer, all complete as specified.

LC.4. Stormwater Management – Landfill Cap

- a. Method of measurement: Stormwater Management – Landfill Cap shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Stormwater Management – Landfill Cap, including but not limited to, controlling and managing stormwater from the landfill cap, through the embankment, and in and out of the stormwater pond throughout the duration of the work, furnishing, trenching for, backfilling for, and installing stormwater manholes, stormwater piping, pipe bedding, corrugated polyethylene drainage tubing, coarse aggregate, riprap, granular filter, granular cushion, geotextile, and all associated apprentices, all complete as specified.

H. Gas Management (GM)

GM.1. Vertical Extraction Well Drilling and Installation

- a. Method of measurement: Vertical Extraction Well Drilling and Installation shall be measured per Vertical Foot (VF) installed, measured to the nearest Vertical Foot.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Vertical Foot (VF) for Vertical Extraction Well Drilling and Installation, including but not limited to, drilling, furnishing and installing extraction well piping and associated appurtenances, coarse aggregate, pea gravel, bentonite, geotextile, silty-sand, and disposal of waste, all complete as specified.

GM.2. Vertical Extraction Well Surface Completions

- a. Method of measurement: Vertical Extraction Well Surface Completions shall be measured per Each (EA) installed.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Each (EA) for Vertical Extraction Well Surface Completions, including but not limited to, furnishing and installing wellhead assembly, piping, fittings, valves, couplings, and associated appurtenances, pipe boot penetrations, well bore reinforcement gate, and GCL all complete as specified.

GM.3. Gas Piping and Appurtenances

- a. Method of measurement: Gas Piping and Appurtenances shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Gas Piping and Appurtenances, including but not limited to, furnishing, trenching for, backfilling for, installing, and testing for gas piping, condensate drains, valves, cleanouts, pipe bedding, condensate tanks, and all associated appurtenances, all complete as specified.

GM.4. Blower/Flare Installation

- a. Method of measurement: Blower/Flare Installation shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Blower/Flare Installation, including but not limited to moving, placing and installing the Blower/Flare and all associated appurtenances and connections, demonstrating full functionality of the installed equipment, all complete as specified. This Bid Item does not include the cost to furnish and deliver the Blower/Flare to the Site which will be paid for by Owner.

Restoration (RE)

RE.1. Temporary Seeding and Mulching

- a. Method of measurement: Temporary Seeding and Mulching shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Temporary Seeding and Mulching will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Temporary Seeding and Mulching, including but not limited to, furnishing and installing seed and mulch, all complete as specified.

RE.2. General Seeding, Mulching, and Fertilizing

- a. Method of measurement: General Seeding, Mulching, and Fertilizing shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for General Seeding, Mulching, and Fertilizing will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for General Seeding, Mulching, and Fertilizing, including but not limited to, furnishing and installing seed, mulch, and fertilizer, all complete as specified.

RE.3. Seeding and Fertilizing - Landfill Cap

- a. Method of measurement: Seeding and Fertilizing – Landfill Cap shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Seeding and Fertilizing – Landfill Cap will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Seeding and Fertilizing – Landfill Cap, including but not limited to, furnishing and installing seed and fertilizer, all complete as specified.

RE.4. Erosion Control Blanket

- a. Method of measurement: Erosion Control Blanket shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Erosion Control Blanket will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Erosion Control Blanket, including but not limited to, furnishing and installing erosion control blanket, all complete as specified. Repair or replacement caused by damage from the Contractor will be at Contractor's time and expense.

RE.5. Wetland Buffer Seeding

- a. Method of measurement: Wetland Buffer Seeding shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Wetland Buffer Seeding will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Wetland Buffer Seeding, including but not limited to, furnishing and installing wetland buffer seeding, all complete as specified.

RE.6. Wetland Restoration Seeding

- a. Method of measurement: Wetland Restoration Seeding shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Wetland Restoration Seeding will be the two-dimensional area.
- b. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Wetland Restoration Seeding, including but not limited to, furnishing and installing wetland restoration seeding, all complete as specified.

J. Road Improvements (RI)

RI.1. Access Road Improvements

- a. Method of measurement: Access Road Improvements shall be measured on a Single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Access Road Improvements, including but not limited to, cutting and removing existing road, spreading and compacting aggregate base, installing bituminous pavement, furnished and installed, all complete as specified.

RI.2. Access Road Repair

- a. Method of measurement: Access Road Repair shall be measured on a Single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Access Road Repair, including but not limited to, cutting and removing top course of improved road, and installing bituminous pavement, furnished and installed, all complete as specified.

RI.3. Gravel Surfacing – Quarry Access Road and Ramp

- a. Method of measurement: Gravel Surfacing – Quarry Access Road and Ramp shall be measured on a Single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Gravel Surfacing – Quarry Access Road and Ramp, including but not limited to, furnishing and installing geotextile, and furnishing, hauling, placing, compacting, grading, and maintaining gravel, all complete as specified.

RI.4. Gravel Surfacing – Landfill Perimeter Road

- a. Method of measurement: Gravel Surfacing – Landfill Perimeter Road shall be measured on a Single Lump Sum (LS) unit.

- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Gravel Surfacing – Landfill Perimeter Road (including ramp up to the landfill top), including but not limited to, furnishing and installing geotextile, and furnishing, hauling, placing, compacting, grading, and maintaining gravel, all complete as specified.

RI.5. Bituminous Pavement - Transfer Station Access Road

- a. Method of measurement: Bituminous Pavement - Transfer Station Access Road shall be measured on a Single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Bituminous Pavement - Transfer Station Access Road, including but not limited to, spreading and compacting aggregate base, installing bituminous pavement, furnished and installed, all complete as specified.

RI.6. Temporary Transfer Station Road

- a. Method of measurement: Temporary Transfer Station Road shall be measured on a Single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Temporary Transfer Station Road, including but not limited to, furnishing, hauling, placing, compacting, grading, maintaining, and removing gravel, all complete as specified.

RI.7. Stormwater Management – Roads

- a. Method of measurement: Stormwater Management – Roads shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Stormwater Management – Roads, including but not limited to, controlling and managing stormwater from the roads throughout the duration of the work, furnishing, trenching for, backfilling for, and installing stormwater piping, pipe bedding, riprap, granular filter, geotextile, and all associated apprentices, all complete as specified.

K. Miscellaneous (MI)

MI.1. Storage Garage

- a. Method of measurement: Storage Garage shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Storage Garage, including but not limited to, foundation, building, roof, HVAC, all furnished and installed, all complete as specified.

MI.2. Utility Company Allowance

- a. Method of measurement: Utility Company Allowance shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Utility Company Allowance, as specified in paragraph 1.06 of this Section, all complete as specified.

MI.3. Electrical

- a. Method of measurement: Electrical shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Electrical, including but not limited to, furnishing and installing all electrical, lighting, controls, and communication work (excluding utility company allowances, Transfer Station Utility Replacement, and Transfer Station Temporary Utilities, which are included under different Bid Items), furnished and installed, all complete as specified.

MI.4. Transfer Station Utility Replacement

- a. Method of measurement: Transfer Station Utility Replacement shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Transfer Station Utility Replacement, including but not limited to, all replacement electrical, communication, watermain, and sanitary forcemain utilities (excluding utility company allowances, which is included under a different Bid Item), furnished, installed, and tested, all complete as specified.

MI.5. Transfer Station Temporary Utilities

- a. Method of measurement: Transfer Station Temporary Utilities shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Transfer Station Temporary Utilities, including but not limited to, all temporary electrical, communication, watermain, and sanitary forcemain utilities (excluding utility company allowances, which is included under a different Bid Item), furnished, installed, tested, and removed, all complete as specified.

MI.6. Transfer Station Temporary Fencing and Gates

- a. Method of measurement: Transfer Station Temporary Fencing and Gates shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Transfer Station Temporary Fencing and Gates, including but not limited to, furnishing,

installing, and removing all temporary fencing, gates, and associated appurtenances, all complete as specified.

MI.7. Transfer Station Fencing and Gates

- a. Method of measurement: Transfer Station Fencing and Gates shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Transfer Station Fencing and Gates, including but not limited to, furnishing and installing, all transfer station fencing, gates, and associated appurtenances, all complete as specified.

MI.8. Landfill Fencing and Gates

- a. Method of measurement: Landfill Fencing and Gates shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Landfill Fencing and Gates, including but not limited to, furnishing and installing, all landfill fencing, gates, and associated appurtenances, all complete as specified.

MI.9. Dump Fencing and Gates

- a. Method of measurement: Dump Fencing and Gates shall be measured on a single Lump Sum (LS) unit.
- b. Basis of Payment: Contractor shall be paid a Lump Sum (LS) Price for Dump Fencing and Gates, including but not limited to, furnishing and installing, all dump fencing, gates, and associated appurtenances, all complete as specified.

1.06 ALLOWANCES

- A. Allowances shall be included in Contractor's Utility Company Allowance Lump Sum Price listed on the Bid Proposal, see paragraph 1.05K.MI.2 for additional information. Contractor's cost for overhead and profit shall be excluded in the allowance. Upon completion of allowance Work, provide receipts to Engineer. The Contract Price will be adjusted by Change Order if the actual cost is more than or less than the cost as specified in the allowance listed below.

B. Schedule of allowances:

| Allowance | Amount | Description |
|------------------|-----------------|---|
| 1 | \$25,000 | Utility company charges allowance: <ul style="list-style-type: none">• Utility companies charges to provide temporary and final service for Existing Transfer Station |
| 2 | \$40,000 | Utility company charges allowance: <ul style="list-style-type: none">• Utility company charges to provide and set the new transformer/pad and associated services for new landfill infrastructure and heat trace indicated on the Drawings. |
| Total | \$65,000 | |

1.07 ALTERNATE BID ITEMS

Alt-A. Native General Seeding, Mulching, and Fertilizing

1. Method of measurement: Native General Seeding, Mulching, and Fertilizing shall be measured per Acre (AC) installed, measured to the nearest tenth of an Acre. Area for Native General Seeding, Mulching, and Fertilizing will be the two-dimensional area.
2. Basis of Payment: Contractor shall be paid a Unit Price per Acre (AC) for Native General Seeding, Mulching, and Fertilizing, including but not limited to, furnishing and installing seed, mulch, and fertilizer, all complete as specified.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 29 00

SECTION 01 31 00

PROJECT COORDINATION AND MEETINGS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes required meetings.

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 COORDINATION

- A. Coordinate all aspects of the Work and assure that the Work of the various Specification Sections is completed in an orderly sequence incorporating all interdependent elements.

1.04 PRECONSTRUCTION MEETING

- A. Engineer will schedule a preconstruction conference that shall be attended by Contractor and Subcontractors. Representatives of Owner and Engineer will also attend. The meeting will be scheduled prior to the beginning of any Work at the Site. The purpose of the meeting will be to ensure that all parties understand their responsibilities and the procedures that will be used to assure efficient and proper completion of the Work.
- B. The agenda for the preconstruction conference is anticipated to include the following topics:
 - 1. Distribution of Contract Documents;
 - 2. Designation of responsible personnel for all parties, lines of communication, and lines of authority;
 - 3. Role of Owner, Engineer, and Contractor;
 - 4. Scope of Work;
 - 5. Distribution and discussion of the tentative construction schedule;
 - 6. Critical Work sequencing;
 - 7. Procedures for submittal and field test reporting;
 - 8. Record documents and reporting;

9. Site safety and security procedures;
10. Material import/export;
11. SWPPP compliance and other permit compliance;
12. Erosion control, tree protection, and turf establishment;
13. Traffic management, controls, and signage;
14. Quality Assurance and Quality Control Procedures
15. List of major subcontractors;
16. Procedures for processing Change Orders;
17. Use of Site (including remote Sites) including equipment, material storage, staging areas, temporary facilities and temporary controls;
18. Major equipment deliveries;
19. Housekeeping procedures; and
20. Other items for consideration during construction activities.

1.05 PROGRESS MEETINGS

- A. Progress meetings will be scheduled by Engineer at a frequency, time, and location mutually agreeable to Owner, Contractor and Engineer.
- B. Each Application for Payment may be reviewed during one Progress Meeting each month prior to Contractor's submittal.
- C. Attend all meetings and coordinate the attendance of subcontractors whose Work may be in progress at the time, or whose presence may be required for any purpose.
- D. The agenda for the progress meetings is anticipated to include the following topics:
 1. Construction site safety issues;
 2. Schedule/progress update;
 3. Technical/construction issues;
 4. Design issues;
 5. SWPPP and other environmental issues;

6. Review status of required submittals;
7. Resolution of issues from previous meeting;
8. Contractor's anticipated activities for upcoming week; and
9. Administrative/purchasing issues.

1.06 PRE-INSTALLATION MEETINGS

- A. Pre-installation meetings (when required) will be scheduled by Contractor a minimum of 2 weeks prior to Work requiring such meetings being performed.
- B. Attendees at these meetings shall include Contractor, installing contractor, material supplier, Owner, and Engineer/Architect.
- C. Meeting agenda items will include, but are not limited to, schedule and sequence, mock-up construction, product delivery and storage, material compatibility, Site restrictions, and coordination of any required testing and observation.

1.07 UNSCHEDULED MEETINGS

- A. Attend unscheduled meetings that may be reasonably requested by Engineer or Owner.

1.08 SAFETY MEETINGS

- A. Contractor shall, at a minimum, schedule daily safety meetings to discuss security issues, close calls, near misses and other safety related items in compliance with Specification 01 35 00, Construction Safety and Security.

1.09 AFTER HOUR CONTACTS

- A. Prior to beginning any Work at the Site, submit to Engineer the names of at least three (3) employees of Contractor who may be contacted after normal working hours in the event of an unanticipated condition requiring immediate attention.
- B. At least one person should be available at all times for immediate response to the Site within 2 hours of being called. That person shall have authority to make field decisions for Contractor.

1.10 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 31 00

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes submittal procedures.

1.02 GENERAL SUBMITTAL PROCEDURES

- A. Transmit via email a PDF copy of each submittal labeled in sequential number order with the Project name, name of the submittal, and Specification Section and page number of these Contract Documents in which the submittal was requested. Indicate the type or purpose of the submittal, as more fully described elsewhere in this Section with regard to the Schedule of Submittals. A transmittal letter stating the same information shall accompany each submittal.
- B. Transmit all submittals to Owner and Engineer at the email addresses given below:
 - 1. Stephanie Ryno (as Owner) – stephanie.ryno@state.mn.us
 - 2. Bryan Pitterle (as Engineer) - bpitterle@barr.com
- C. Apply Contractor's stamp, signed or initialed certifying that review and verification of products required, field dimensions, adjacent construction activities, and coordination of information, is in accordance with the requirements of the Work and Contract Documents. Unstamped or unsigned submittals and submittals that have not been thoroughly checked by Contractor will be returned without action. Submittals from Subcontractors or vendors will be returned without action.
- D. Owner and Engineer will accept submittals only from Contractor. Submittals from subcontractors, vendors, suppliers, or others will be returned without review or action.
- E. Schedule submittals to expedite Project, and in accordance with the Schedule of Submittals to be prepared by Contractor. Coordinate submission of related items.
- F. Identify all variations or deviations from the Contract Documents and identify alternative products or system limitations that may be detrimental to successful performance of the completed Work.
- G. Provide an area for Contractor and Engineer review, stamps and comments.
- H. Revise and resubmit submittals as required. Identify all changes made since previous submittal. Completion date extensions will not be granted for required submittal revisions.

- I. Promptly distribute reviewed submittals to Subcontractors, Suppliers, and other concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- J. Do not proceed with any Work requiring review by Engineer until submittals have been reviewed and returned to Contractor.
- K. All submittals that are made that are not specifically required by the Contract Documents will be returned without action.
- L. All engineering data shall be identified by use of the nomenclature established by the Contract Documents. Equipment drawings shall have the equipment name and number clearly displayed. Material drawings shall have the structure name and structure number (when applicable) clearly displayed.

1.03 SCHEDULE OF OPERATIONS

- A. Submit Schedule of Operations as described below within 10 days of Notice of Award.
- B. The Schedule of Operations shall be a detailed progress schedule indicating the starting and completion dates of the various stages of the Work. Include adequate contingencies for unanticipated conditions such as resubmittals, bad weather and material shortages.
- C. The Schedule of Operations shall be in the form of a horizontal bar chart (Gantt chart) with a separate line for each detailed portion of the Work. The chart shall have vertical lines showing the first work day of each week. Indicate early and late start dates, early and late finish dates, and duration of tasks. Sufficiently annotate the bar chart to define all symbols and abbreviations used.
- D. If an extension in the Contract Time is granted in accordance with the terms of the Contract Documents, revise and resubmit the Schedule of Operations within 7 calendar days following the execution of the Change Order authorizing the change in Contract Time.
- E. The Schedule of Operations will be reviewed by Engineer to determine if adequate detail has been presented for Engineer and Owner to schedule their activities. Engineer's review is not intended to include the adequacy of the schedule to meet the contract terms between Contractor and Owner. It is Contractor's sole responsibility to schedule its operations and provide all resources necessary to complete the Work in accordance with the approved Schedule of Operations. If Engineer requests additional detail in the Schedule of Operations, correct such deficiencies and resubmit the Schedule.
- F. The Schedule of Operations shall be reviewed and updated by Contractor and provided to Owner and Engineer for review prior to weekly meetings.

1.04 SCHEDULE OF VALUES

- A. Submit an electronic copy of Schedule of Values as described below within 10 days of Notice of Award.

- B. The Schedule of Values shall be a detailed cost breakdown for all of the Work and shall include quantities and unit prices of items aggregating the Contract Price. This schedule shall subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such unit prices shall include an appropriate amount of overhead and profit applicable to each item of Work.
 - C. The Schedule of Values shall be organized in a tabular format with the following columns (clearly labeled) as a minimum:
 - 1. ITEM NUMBER: Number items according to the Section of these Specifications to which it corresponds.
 - 2. ITEM DESCRIPTION: Written description of what item consists of.
 - 3. UNIT: The unit of measure upon which the unit price is based.
 - 4. NUMBER OF UNITS: The number of units upon which the total price for the item will be based.
 - 5. TOTAL UNIT PRICE: Sum of unit material price, unit labor price, and unit overhead and profit price.
 - 6. EXTENSION: The total price for the item determined by multiplying the number of units by the total unit price.
 - D. The Schedule of Values shall include a row labeled TOTAL EXTENSION that shall be the sum of the extension column for each of the individual items. The dollar value shown as the total extension shall match exactly the Contract Price as shown in the Agreement.
 - E. Progress payments will not be made for shop-fabricated materials prior to delivery to the Site.
 - F. The Schedule of Values shall be accompanied by a schedule of anticipated monthly payment requests. This shall be based on the Schedule of Operations and Schedule of Values.
 - G. The Schedule of Values is subject to the review and approval of Engineer and Owner. If in the opinion of Engineer or Owner, the Schedule of Values does not contain sufficient detail or appears to be unbalanced, Engineer (or Owner) may ask Contractor to revise and resubmit the Schedule of Values and/or provide documentation to justify Contractor's distribution. Correct such deficiencies and resubmit.
- 1.05 SCHEDULE OF SUBMITTALS
- A. Submit an electronic copy of Schedule of Submittals as described below within 10 days of Notice of Award.
 - B. The Schedule of Submittals shall be in tabular form listing all submittals required by the Contract Documents and the date on which Contractor will make submittal. As a minimum, the Schedule of Submittals shall consist of the following columns:

1. SUBMITTAL NUMBER: Number consecutively.
2. SECTION NO.: Section number or description of location in Contract Documents where submittal is requested.
3. PAGE NO.: Page number of section in Contract Documents where submittal is requested.
4. ITEM: Description of item or items to which submittal pertains.
5. SUBMITTAL REVIEW TYPE: A letter code indicating what type of submittal was requested. The type key shall be as follows:
 - a. Submittal for Information or Documentation
 - b. Submittal for Review
 - c. Submittal for Approval
6. DEFICIENCIES: Manner in which submittal or proposed alternate product does not meet the requirements of the Contract Documents.
7. ANTICIPATED SUBMITTAL DATE: Date on which Contractor anticipates submittal to be delivered to Engineer.
8. RESPONSE REQUIRED: Indicate "yes" if Contractor anticipates response from Engineer and "no" if no response is anticipated.

1.06 REVIEW OF SUBMITTALS

- A. Engineer's review of engineering data will cover only general conformity of the data to the Specifications and Contract Documents, external connections, and interfaces with equipment and materials furnished under separate specifications. Engineer's review does not indicate a thorough review of all dimensions, quantities, and details of the equipment, material, device, or item indicated or the accuracy of the information submitted; nor shall review by Engineer be construed as relieving Contractor from any responsibility for errors or deviations from the requirements of the Contract Documents.
- B. All engineering data submitted, after final processing by Engineer and acceptance by Owner shall become a part of the Contract Documents and the work indicated or described thereby shall be performed in conformity therewith unless otherwise required by Owner.

1.07 SUBMITTAL FOR INFORMATION OR DOCUMENTATION

- A. Submit 1 electronic copy to Engineer and 1 electronic copy to Owner.
- B. Submittal shall be made at least 5 working days before the subject of the submittal is to be incorporated into the Work.

- C. Submittal is for the purpose of formal verification that the subject of the submittal conforms to the requirements of the Specifications, for formal documentation of the Work, or both.
- D. No action is required by Engineer. Engineer will generally notify Contractor if deficiencies are identified. However, Contractor is solely responsible for ensuring that the subject of the submittal conforms to the requirement of the Specifications.

1.08 SUBMITTAL FOR REVIEW

- A. Submit 1 electronic copy to Engineer and 1 electronic copy to Owner.
- B. Submittal shall be made at least 10 working days before the subject of the submittal is to be incorporated into the Work. Engineer will respond within 5 working days from receipt of submittal.
- C. Submittal is for the purpose of providing opportunity to Engineer for review and comment on the subject of the submittal.
- D. Engineer will respond to the submittal either with a list of comments or indicating no comments.
- E. If Engineer's comments indicate a deficiency with respect to the requirement of the Specifications, Contractor shall amend the submittal and resubmit. Engineer will again respond to the resubmittal.
- F. If Engineer's comments are in regards to an issue which, based upon the Contract, is at Contractor's discretion, Contractor shall furnish additional information, provide justification, and otherwise cooperate in addressing and resolving Engineer's comments.
- G. Contractor shall remain solely responsible for ensuring that the subject of the submittal conforms to the requirements of the Specifications.

1.09 SUBMITTAL FOR APPROVAL

- A. Submit 1 electronic copy to Engineer and 1 electronic copy to Owner.
- B. Submittal shall be made at least 15 days before the subject of the submittal is to be incorporated into the Work. Engineer will respond within 7 days from receipt of submittal.
- C. Submittals shall be stamped with Contractor's approval. Contractor's stamp shall be a representation that Contractor has assumed full responsibility for determining the submittal requirements and verifying that the subject of the submittal conforms to the requirements of the Specifications. Submittals not bearing Contractor's stamp will be returned without review or action.
- D. Engineer will review, make notations as appropriate, stamp, and return submittals to Contractor. Engineer's stamp and Contractor's required action are described below:

1. APPROVED. Contractor may proceed without further action.
 2. APPROVED AS NOTED:
 - a. RESUBMITTAL NOT REQUIRED. Contractor shall review Engineer's notations and revise subject of submittal as required to conform to the requirements of the Drawings and Specifications before proceeding with the Work. Then, Contractor may proceed without further action.
 - b. REVISE AND RESUBMIT. Contractor shall review Engineer's notations and revise subject of submittal as required to conform to the requirements of the Drawings and Specifications before proceeding with the Work. Then, Contractor shall submit a revised copy of the submittal and may proceed without further action.
 3. NOT APPROVED (RESUBMIT). Contractor shall review Engineer's notations, revise subject of submittal as required to conform to the requirements of the Drawings and Specifications, and resubmit to Engineer for additional action.
 4. NOT REVIEWED. Engineer has not reviewed the submittal but will keep the submittal with the project records.
- E. No Work shall be performed in connection with the fabrication or manufacture of equipment and materials until the data therefor have been reviewed by Engineer except at Contractor's own risk and responsibility. Work may proceed when submittals have been returned marked APPROVED or APPROVED AS NOTED, provided the Work is performed in accordance with Engineer's notations.
- F. If changes are made at the project site to correct manufacturing errors, revised drawings incorporating the changes shall be prepared and submitted to Engineer.
- G. Drawings shall be in enough detail to indicate the kind, size, and arrangement of component materials and devices; the external connections, anchorages, and supports required; the dimensions needed for installation and correlation with the foundations; and other information specifically requested herein.
- H. Each drawing submitted shall be black line on white background or blue line on white background. Print size shall not exceed 24 inches by 36 inches.
- I. Each drawing submitted shall be clearly marked with the name of the project, the specification title, the specification number, Engineer's assigned number when so advised, and Contractor's name. If catalog pages are submitted, the applicable items shall be indicated.
- 1.10 RECORD DOCUMENTS
- A. Submit record documents prior to Substantial Completion.
 - B. Record documents shall accurately reflect the as-constructed condition.

1.11 WARRANTY AND GUARANTEE CERTIFICATES

- A. Submit warranty and guarantee certificates prior to Substantial Completion.
- B. Warranty and guarantee certificates shall be signed by Contractor, Installer, Manufacturer, and others as required by the Specifications.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit operation and maintenance instructions for all equipment and systems furnished.
- B. Operating instructions shall be prepared specifically for each system or piece of equipment installed under this contract and shall consider the specific equipment and controls included.
- C. All references, pictures, and diagrams regarding items not part of furnished equipment and systems shall be deleted. Instructions shall be complete for each separate system and shall cover:
 - 1. Equipment functions, normal operating characteristics, and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for start-up routine and normal operation: regulations and control; shutdown; and emergency conditions.
 - 4. Lubrication and maintenance schedules and instructions.
 - 5. Guide to "troubleshooting."
 - 6. Parts list with manufacturer's part numbers and parts diagrams.
 - 7. Outline, cross sections, and assembly drawings; engineering data; and wiring diagrams.
 - 8. Test data and performance curves, where applicable.
- D. Submittal of operation and maintenance instructions shall be made prior to Final Completion.

1.13 ALTERNATE PRODUCTS

- A. If Contractor proposes to use substitute products, then Contractor shall submit written application as required by the General Conditions. Alternate products or substitutions will not be pre-approved during bidding process, but can be evaluated after award of contract.
- B. Submit copies of literature, drawings, and any other data necessary to substantiate that proposed substitute is equivalent or equal to the item named, and otherwise meets the conditions established in the General Conditions.

- C. Do not proceed with product installation or use until written approval by Engineer is received in accordance with the General Conditions.

1.14 REQUESTS FOR INFORMATION

- A. Contractor shall submit all requests for information to Engineer in writing on a standardized form, or accessible internet-based software as approved by the Owner. Requests for information shall be numbered sequentially and shall include the related specifications section number or drawing number.
- B. Engineer will provide any revisions to the Specifications or Drawings in writing.
- C. Contractor shall request written confirmation of any interpretations or clarifications provided verbally by Engineer or Company.

1.15 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 33 00

SECTION 01 35 00

CONSTRUCTION SAFETY AND SECURITY

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes health, safety, and security requirements.
- B. Contractor shall be solely and completely responsible for safety procedures and programs in connection with the Work, including safety of Site conditions and the safety and health of all persons and property on portions of the Work Area affected by or used by Contractor, Contractor's employees, Subcontractors, Agents, and others during performance of the Work. This requirement will apply continuously and not be limited to normal working hours.
- C. Observation of the Work and Contractor's performance by Owner, Owner's On-Site Representative, and Engineer is not intended to include review of the adequacy of Contractor's safety and health procedures and programs on or near the construction site. Contractor is solely responsible for the protection of property and the safety and health of its employees, subcontractors, suppliers, agents, and others on or near the site.
- D. Contractor shall have authority to temporarily restrict anyone, including Engineer and/or Owner's On-Site Representative, from the Work Area who is not complying with Contractor's Health and Safety Plan (HASP). Any person so restricted from the Work Area shall be allowed to return to the area after meeting all provisions of Contractor's HASPs.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. Occupational Safety and Health Administration (OSHA) Construction Industry Regulations (29CFR), specifically those set forth in Parts 1910 and 1926, in particular 1910.120 (Hazardous Waste Operations and Emergency Response)

1.03 SUBMITTALS

- A. Submit Health and Safety Plan (HASP) for review within 5 days after Notice to Proceed. Work shall not proceed until HASP has been reviewed and written authorization to proceed has been issued.
 - 1. Submittal of Contractor's HASP is to inform Owner, Owner's On-Site Representative, and Engineer so they can comply with HASP during performance of their on-site responsibilities.

2. Submittal of Contractor's HASP shall neither impose on Owner's, Owner's On-Site Representative's, and Engineer's responsibility for adequacy of HASP nor relieve Contractor from full responsibility therefore.

B. Provide Safety data sheets for all products brought to the Site.

C. Submit temporary fencing plan for review.

1.04 FEDERAL, STATE, AND MUNICIPAL REQUIREMENTS

- A. The Work shall comply with all applicable Laws and Regulations, including, but not limited to, the Federal Occupational Safety and Health Administration (OSHA) regulations for construction and work at Hazardous Waste Operations and Emergency Response (HAZWOPER) sites, specific requirements under the Minnesota Pollution Control Agency (MPCA), state of Minnesota, and any local requirements of the County of Dakota County and the City of Burnsville that apply to the Work.

1.05 HEALTH AND SAFETY REQUIREMENTS

- A. Contractor shall be solely and completely responsible for job-site conditions and safety procedures and programs on the Site, including safety of all persons and property during performance of the Work. This requirement will apply continuously and not be limited to normal working hours. Observation of the Work by Owner or Engineer is not intended to include review of the adequacy of Contractor's safety procedures and programs on or near the Site.

B. Comply with all relevant OSHA standards.

- C. Implement and enforce health and safety requirements and take necessary precautions and provide protection for the following:

1. Personnel working on or visiting Site, irrespective of employer.
2. Work and materials or equipment to be incorporated in Work area (on-site or off-site).
3. Other property at or adjacent to Site.
4. Public exposed to job-related operations or potential release of toxic or hazardous materials.

D. Submit site-specific Health and Safety Plan (HASP)

1. Contractor solely responsible for adequacy, preparation, monitoring, management, and enforcement of the HASP. The Contractor's HASP shall, at a minimum, meet the regulatory requirements set forth by OSHA, specifically those set forth in the Code of Federal Regulations (CFR) at 29 CFR Parts 1910 and 1926, in particular 1910.120 (Hazardous Waste Operations and Emergency Response), and shall comply with all other appropriate state and federal safety regulations.

2. Submit for review HASP within 5 days after Notice to Proceed. Work shall not proceed until HASP has been received.
 - a. Submittal of Contractor's HASP is to inform Owner and Engineer so they can comply with HASP during performance of their on-site responsibilities.
 - b. Submittal of Contractor's HASP shall neither impose on Owner's or Engineer's responsibility for adequacy of HASP nor relieve Contractor from full responsibility therefore.
3. HASP to address, at a minimum, the following:
 - a. Site description.
 - b. Project activities and coordination.
 - c. Hazard evaluation.
 - d. On-site safety responsibilities.
 - e. Work zones, if applicable.
 - f. Worker medical surveillance.
 - g. Personnel training.
 - h. Atmospheric monitoring, if applicable.
 - i. A detailed description of any work tasks that can be completed without HAZWOPER certification (e.g., truck drivers that do not exit the cab within an exclusion zone).
 - j. A detailed description of the planned movement of labor, equipment and materials from and between work areas as work progresses, including measures to be employed to prevent recontamination of previously cleaned areas and contamination of areas that do not now contain hazardous materials.
 - k. A detailed description of the personnel decontamination facilities to be employed including the planned phasing of decontamination facilities between work areas as the work progresses and the methods to be used to collect, store, treat, and ultimately dispose of personnel protective equipment and decontamination waters and wastes.
 - l. A schematic and detailed description of the washdown area for decontamination of vehicles and equipment (aka, decontamination pad) and the methods to be used to collect above, treat and ultimately dispose of washdown decontamination waters and sediments. The decontamination pads shall, at minimum, consist of a shallow basin approximately 10 feet wide by 20 feet long covered with crushed

rock. A rattle plate shall then be placed on top of the rock. Decontamination pad shall be lined with 30 mil plastic (LLDPE or similar).

- m. Personal protective equipment (PPE) to be used and conditions for use.
 - n. Personal hygiene and decontamination procedures for personnel.
 - o. Respirator protection program and procedures.
 - p. Emergency procedures, phone numbers, emergency vehicle routes, and nearest medical assistance.
 - q. Emergency, first aid, and fire protection equipment and supply.
 - r. Dust and particulate emission control.
 - s. Monitoring and mitigation of worker heat and cold stress.
 - t. The types of materials and substances likely to be encountered in the course of the Work.
 - u. Job and task hazard analyses.
 - v. Site visitors.
 - w. Site security, Site access, and Site control.
 - x. A spill containment program meeting the requirements of 29 CFR 1910.120 (j).
- E. Contractor's HASP shall state that Contractor is responsible for exposure monitoring in accordance with 1910.120(b)(4)(ii)(E): *"Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used."*
- F. Contractor is responsible for its Subcontractors and Suppliers and shall ensure they follow Contractor's HASP.
- G. Contractor's HASP shall designate a qualified individual to act as Contractor's Site Safety Officer for purposes of assuring compliance by all persons with Contractor's HASP. Contractor's Site Safety Officer shall be present on the Site during all activities that could potentially result in exposure to contaminated soil and/or groundwater, specifically including but not limited to, excavation and backfilling, and demolition activities. At other times of routine construction, Contractor shall determine the need for the presence of the designated Site Safety Officer. However, the Site Safety Officer (or a designated alternate) shall be available by telephone continuously during the Contract Time, and shall be available to respond to the Site within two hours at any time following request by Contractor, Engineer, or Owner.

- H. Contractor shall hold daily safety meetings that shall be attended by Contractor's Site Safety Officer. That meeting shall also be attended by Contractor's resident supervisors, all Contractor's employees at the Site, and Subcontractors involved in the Work during the day. Owner's On-Site Representative may attend safety meetings. The topic of the meeting shall be limited to safety and security, and attendees shall, at a minimum, discuss safety problems, security, close calls, near misses, the potential risk of planned activities, coordination of equipment movement/Work Area, and requirements related to upcoming Work.
- I. Contractor will not be required to supply personal protective equipment or monitoring equipment for any persons other than Contractor's employees, as well as any subcontractors and suppliers. However, Contractor shall make decontamination facilities available to those persons who reasonably require access to the Work, including Owner, Engineer, and regulatory authorities. Contractor shall be solely responsible for assuring that all persons comply with Contractor's HASP. Contractor shall not unreasonably restrict access to the Work Area and shall not proceed with Work that Owner's On-Site Representative requests to observe during such time as Owner and Owner's On-Site Representative are being denied access to the Work Area because of non-compliance with Contractor's HASP.
- J. Owner or Owner's Representative will also prepare a HASP for its employees to follow when on Site. At Contractor's request, Owner or Owner's Representative will make HASP available as a reference.
- K. Inform Owner immediately of accidents, near misses, and potential hazards and be responsible for giving the required notice of accidents to government authorities as required by law.
- L. Contractor shall be responsible for general safety and conduct of employees and ensure that:
 - 1. Equipment is operated and maintained only by persons qualified by adequate training and experience.
 - 2. Employees do not trespass beyond boundaries established for work of this Contract unless required to do so in pursuance of work of this Contract.
 - 3. All protective personnel safety equipment is worn or used in keeping with the hazards of work being carried out and as required by Owner.
 - 4. Ensure employees are familiar with safety rules and regulations on the site.
- M. Contractor shall be responsible for any safety violation and/or fine that may occur because of any neglect by Contractor, Contractor's employees, Contractor's subcontractors, or any third party under Contractor's supervision or direction.
- N. Contractor shall provide safe access to all portions of the Work for use by Owner, Engineer, and regulatory entities having jurisdiction in the performance of their observation duties. Said access shall conform to applicable Laws and Regulations and to all requirements of any regulatory agency or entities who claim jurisdiction over the safety of the Project area. If Owner is unable to observe Contractor's Work, due to conditions, which in the opinion of Owner are, unsafe,

Owner's payment for such Work may be withheld until Work has been determined to be in compliance with the Contract Documents.

- O. Provide suitable barricades around all excavations, openings and other potentially dangerous areas and remove the barricades when they are no longer necessary.
- P. Provide adequate lighting at all excavations, openings and other potential dangerous areas during the hours of darkness.
- Q. Remove snow as necessary for safe and adequate performance of the work.
- R. Provide and use Ground Fault Interrupters (GFI's) in any damp, wet, or any conditions requiring such protection.
- S. Provide locks for each employee for the purpose of locking out equipment.

1.06 HAZARD COMMUNICATION PROGRAMS

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets or other hazard communication required to be made available to or exchanged among Contractor, Subcontractors, Engineer, and/or Owner, in accordance with Laws and Regulations, Owner's requirements, or as specified in the Contract Documents.

1.07 EMERGENCIES

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

1.08 SITE SECURITY

- A. Submit temporary fencing plan to address, at a minimum, the following:
 - 1. Necessary measures to maintain the perimeter, prevent unauthorized access to Site, and protect Contractor, Owner, public, and existing facilities.
 - 2. Temporary fencing phasing.
- B. Provide temporary commercial grade chain link fencing, barricades, and gates until final fencing is installed as necessary.
- C. Contractor shall be responsible for site security throughout construction activities.

- D. Maintain security measures and infrastructure throughout construction activities.
- E. Maintain access to and security around Transfer Station at all times.

1.09 FUEL STORAGE AND SPILLS

- A. Contractor shall be responsible for safe and proper fuel storage in accordance with the material data sheet, legal requirements, and Owner requirements. At a minimum, temporary fencing and barricades shall be 6' high.
- B. Contractor shall be responsible for safe and proper refueling and fuel handling in accordance with the material data sheet, legal requirements, and Owner requirements.
- C. All spills shall be contained and reported immediately in compliance with Contractor's HASP, the material data sheet, legal requirements, and Owner requirements.

1.10 CONTROLLED SUBSTANCE

- A. Alcoholic beverages, drugs, or personnel under their influence are not allowed on Site. Any Contractor's employee in violation of this policy will be permanently barred from the property.

1.11 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 35 00

SECTION 01 45 00

QUALITY CONTROL

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes general quality control, including workmanship, manufacturer's instructions and certificates, and code compliance.
- B. Contractor shall retain an independent registered land surveyor licensed in the State of Minnesota for performing quality control on line and grade of the Work. The quality control survey data shall be available for review at all times by Owner or Engineer.
- C. Contractor shall retain an independent soil testing firm for performing soil material verification and compaction testing. The quality control compaction testing data shall be available for review at all times by Owner or Engineer.

1.02 GENERAL

- A. Maintain quality control over Suppliers, manufacturers, products, services, Site conditions, and workmanship to produce Work of the specified quality.
- B. Maintain records of tests and results for reference by Engineer and Owner at any time.
- C. Furnish copies of all test results and quality control procedures as part of Record Documents.
- D. Comply fully with manufacturer's instructions, including each step in sequence.
- E. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- F. Obtain copies of, and meet the requirements of, reference specifications. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.
- G. Comply with specified reference standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- H. Perform Work by persons qualified to produce workmanship of specified quality. Use persons licensed to perform Work where required by these Specifications or Laws and Regulations.
- I. Secure products and Work in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

- J. Materials furnished and finished or intermediate stages of the Work shall be sampled, tested and inspected as specified in the individual Specification Sections and as required by reference specifications.
- K. Performance of tests or observations by Engineer or Owner are for the sole benefit of Engineer and Owner, and are not intended to replace Contractor's quality control program. Contractor is solely responsible for establishing and implementing a quality control program to ensure that the Work is in accordance with the Contract Documents.
- L. It is Contractor's responsibility to notify Engineer when Contractor believes Work (or intermediate stages or parts of Work) is of specified quality, and to permit Engineer to perform independent tests or analyses.
- M. The contractual relationship of the parties to the Agreement shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society for Testing and Materials (ASTM)
 - a. C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - b. D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
 - c. D1140: Standard Test Methods for Determining the Amount of Material Finer than 75-mm (No. 200) Sieve in Soils by Washing
 - d. D1556: Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
 - e. D2216: Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
 - f. D2434: Standard Test Method for Permeability of Granular Soils (Constant Head)
 - g. D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - h. D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)
 - i. D4373: Standard Test Method for Rapid Determination of Carbonate Content of Soils

- j. D5084: Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
- k. D5519: Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials
- l. D5856: Standard Test Method for Measurement of Hydraulic Conductivity of Porous Material Using a Rigid-Wall, Compaction-Mold Permeameter
- m. D6913: Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- n. D6938: Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.04 SUBMITTALS

A. Quality Control Program

- 1. Quality control program that describes the process for ensuring that materials, measurements, and workmanship meet the Project requirements.
- 2. Provide specifications and quality assurance/quality control (QA/QC) criteria describing how Contractor will collect and evaluate survey data and verify all drawing dimensions used to guide Work operations.

B. Submit for review the testing company qualifications for field testing and laboratory testing including testing firm's name, address, contact name, and phone number.

C. Survey plan.

D. Results of the required surveys.

- 1. Submit for review within 24 hours of receipt all certification survey results. Engineer will respond within 24 hours. The submittal must be approved by Engineer before placement of overlying materials.
- 2. Submit survey data on a daily basis for each day that survey work is performed.
- 3. Prior to acceptance of the Work, Contractor shall submit for documentation a tabulation, reproducible paper, and electronic (AutoCAD) format, of all results of survey work performed. The tabulation shall be certified by the registered land surveyor. The tabulation shall contain the following information for each survey location:
 - a. A unique identification number.
 - b. Project coordinates.

- c. Elevation of the finished surface of each material (existing ground, bottom of excavation, top of common fill, top of topsoil, top of pipe, etc.).
 - d. Thickness of each material.
- E. Certification Survey Record Drawings
 - 1. Submit for record certification survey record drawings containing the unique identifications numbers and material thicknesses for each survey point. The drawings shall use a scale of 1 inch = 50 feet, shall schematically represent the facility similar to the coordinate and elevation data sheet in the Drawings, and shall be submitted in reproducible paper and electronic (AutoCAD) format. The drawings shall be prepared and the reproducible paper plot certified by the RLS who performed the certification surveys during construction. At a minimum, the following plan views shall be submitted:
 - a. Top of existing ground
 - b. Top of waste to be excavated
 - c. Bottom of excavation
 - d. Top of common fill
 - e. Top of geomembrane liner subgrade
 - f. Edge of geomembrane liner
 - g. Top of sand drainage layer
 - h. Top of relocated waste
 - i. Top of geomembrane cover subgrade
 - j. Top of topsoil
 - k. Top of piping (including, leachate collection, leachate forcemain, drainage collection, downslope drainage, storm sewer, culverts, gas, potable, and sanitary sewer)
 - l. Topographic survey of the completed site including roads, fencing, and ditches.
- F. Submit for review results from borrow source evaluation testing (if applicable). Submit one copy to Engineer a minimum of 10 days prior to delivery of material to the Site.
- G. Draft copies of field testing daily, or on a frequent and regular basis, as directed. All field testing results submitted to Engineer shall be submitted in either hardcopy or electronic PDF format.

- H. Submit for documentation the results of all soil material and compaction testing performed. Test results shall be submitted on a daily basis for each day that compaction testing is performed. Test results shall also be compiled in a report-format and submitted prior to substantial completion of Work.
- I. Certified written report of each inspection, test, or similar service.
 - 1. All reports shall be submitted either in hardcopy or electronic PDF format. Submittals shall be in accordance with Section 01 33 00 Submittal Procedures.
 - 2. Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue
 - b. Project title and number
 - c. Name, address, and telephone number of testing agency
 - d. Dates and locations of samples and tests or inspections
 - e. Names of individuals making the inspection or test
 - f. Designation of the Work and test method
 - g. Identification of product and specification section
 - h. Complete inspection or test data
 - i. Test results and an interpretation of test results
 - j. Ambient conditions at the time of sample taking and testing
 - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements
 - l. Name and signature of Inspector
 - m. Recommendations on retesting
 - 3. Upon Substantial Completion of Work, Contractor shall submit a certified Record Test Report of all tests performed for record documentation.
 - a. The Record Test Report shall contain all test reports generated during the Work. All test reports shall be organized by date.
 - b. The Record Test Report shall include an index of all documentation enclosed in the report.

- c. The Record Test Report shall be submitted to Engineer in either hardcopy or electronic PDF format.

1.05 RESPONSIBILITIES

A. Contractor Responsibilities

1. The Contractor shall be responsible for all testing not explicitly assigned to the Owner.
2. All inspections, tests, retests and other quality-control services specified elsewhere in the Agreement and required by authorities having jurisdiction shall be at the expense of Contractor.
3. Unless otherwise indicated as the responsibility of another identified entity, Contractor shall schedule all inspections, tests, and other quality-control services specified elsewhere in the Agreement and required by authorities having jurisdiction.
4. Where individual sections specifically indicate that certain inspections, tests, and other quality-control services are Owner's responsibility, Contractor shall aid in coordinating to schedule these services if necessary. Owner shall employ and pay a qualified independent testing agency to perform these quality-control services. Costs for these services are not included in the Contract Sum.
5. Contractor shall coordinate with Engineer and Owner's On-Site Representative to obtain clarification of Agreement, Specifications and testing criteria when necessary.
6. Contractor shall coordinate with Engineer and Owner's Representative to furnish Engineer and Owner's On-Site Representative with access to witness and observe all sampling, testing activities and samples.
7. Contractor shall furnish all submittals as specified. All submittals by Contractor shall be at Contractor's expense.
8. Contractor shall retain an independent registered land surveyor licensed in the State of Minnesota for performing quality control on line and grade of the Work. The quality control survey data shall be available for review at all times by Owner or Engineer.
9. Contractor shall retain an independent soil testing firm for performing soil material verification and compaction testing. The quality control compaction testing data shall be available for review at all times by Owner or Engineer.

- B. Retesting. Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Agreement requirements, regardless of whether the original test was Contractor's responsibility.

1. The cost of retesting Work, revised or replaced by Contractor, is Contractor's responsibility where required tests performed on original Work indicated noncompliance with Agreement requirements.
 2. All activities to correct Work and retesting shall be at the expense of the Contractor until all Work meets specified criteria and acceptable test results are obtained on the Work.
- C. Contractor shall cooperate with Engineer, Owner, Owner's On-Site Representative and agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Contractor shall notify the entity sufficiently in advance of operations to permit personnel to perform testing or to witness and observe testing. Auxiliary services required include, but are not limited to, the following:
1. Provide access to the Work.
 2. Furnish incidental labor and facilities necessary to facilitate safe inspections and tests.
 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 4. Provide facilities for storage and curing of test samples.
 5. Deliver samples to testing laboratories.
 6. Provide information, mix designs or other product information requested by the entity performing, witnessing or observing testing.
 7. Provide security and protection of samples and test equipment at the Project site.
- D. Owner Responsibilities
1. At Owner's or Engineer's discretion, supplemental inspection and testing services may be performed by Owner, Engineer, or testing agency to verify compliance with Contract Document requirements. These services are at the expense of Owner and are intended to supplement, but not replace, the testing services at the expense of Contractor. These services do not relieve Contractor of responsibility to comply with Contract Document requirements and may be used to identify or demonstrate needed work to ensure compliance.
 2. Engineer and Owner reserve the right to witness and observe all testing.
 3. The Owner or Owner's Representative will be responsible to collect and send out the geomembrane seam destructive test samples for the Independent Third Party laboratory testing. The Owner will be responsible for all costs associated with the Third Party laboratory testing. The Contractor shall provide destructive samples of geomembrane seams as required in Section 31 05 19.16, Geomembranes for Earthwork.
- E. Engineer Responsibilities

1. Engineer will provide survey control of the Work Area as shown on Drawings.
2. Engineer will coordinate with Contractor to observe all sampling and testing activities.
3. Engineer will review all submittals in timelines specified in Section 01 33 00 Submittal Procedures.
4. Engineer will collect additional samples or conduct additional testing deemed necessary by Engineer or Owner.

1.06 CONSTRUCTION QUALITY CONTROL - SURVEY

- A. Contractor shall provide construction survey staking based on primary survey control to establish line and grade of the Work.
- B. Visually inspect lines between survey points to verify uniform slopes. Irregularities which would cause concentration of runoff, impede sheet flow of runoff, or would otherwise make the slope more susceptible to erosion, as determined by Engineer or Owner's On-Site Representative, shall be corrected as directed by Engineer or Owner's On-Site Representative.
- C. Contractor shall retain an independent registered land surveyor (RLS) licensed in the State of Minnesota for performing certification surveys of the Work. Contractor shall be responsible to conduct certification surveys signed by a RLS of features identified below and as shown on the Drawings before work is covered. Contractor shall notify Engineer or Owner's On-Site Representative prior to completing the certification surveys to allow on-site review. The certification surveys shall be conducted on a minimum 50-foot by 50-foot grid including shots at all major grade breaks designated by Engineer. The survey grid shall be established in all final covered areas. Contractor's RLS will conduct certification surveys for the following features:
 1. Top of existing ground
 2. Top of waste to be excavated
 3. Bottom of excavation
 4. Top of common fill
 5. Top of geomembrane liner subgrade
 6. Edge of geomembrane liner
 7. Top of sand drainage layer
 8. Top of relocated waste
 9. Top of geomembrane cover subgrade
 10. Top of topsoil

11. Top of piping (including, leachate collection, leachate forcemain, drainage collection, downslope drainage, storm sewer, culverts, gas, potable, and sanitary sewer)
 12. Topographic survey of the completed site including roads, fencing, and ditches.
- D. For elevation and grade verification on the piping (leachate collection, leachate forcemain, drainage collection, downslope drainage, storm sewer, culverts, gas, potable, and sanitary sewer), the following points shall be surveyed:
1. Survey shots should be taken on the top of pipe elevations at a maximum of 25-foot intervals (lineal) in the areas where pipe has little or no significant change in elevation, and at changes in grade. Coordinate the location of these shots with the Owner's On-Site Representative.
- E. Contractor shall not cover work on which survey or measurements are required until Engineer and Owner's On-Site Representative has approved the Work. Contractor's RLS shall meet with Owner's On-Site Representative at the end of each day that certification survey data is collected and record, via handwriting, every survey shot collected that day. All certification survey shots shall be checked for specification compliance, including adequate shot frequency, by the RLS and Owner's On-Site Representative at the end of each day. Engineer shall be immediately notified if a certification shot is found to be out of compliance.
- F. Contractor shall be responsible for the cost of additional surveys for any work that does not meet specified grade or thickness tolerances at the time the initial certification survey is conducted on any area.

1.07 CONSTRUCTION QUALITY CONTROL – SOIL TESTING

- A. Contractor shall retain an independent soil testing firm. Contractor's independent soil testing firm shall verify that soil material and compaction during construction is in conformance with these Specifications. Compaction test results will be used by Owner to demonstrate compliance with requirements. Soil testing shall be performed by Contractor in accordance with Table 1. Tests shall be performed at random locations as such that the test results may be considered representative of the entire area. Testing shall be performed at locations identified by the Owner's On-Site Representative at the minimum frequency described in Table 1.
- B. It is Contractor's sole responsibility to perform pre-construction testing deemed necessary to satisfy the requirements of these Specifications.
- C. Work failing to meet these Specifications shall be repaired and retested at Contractor's expense.

1.08 QUALITY ASSURANCE

- A. Qualifications for Service Agencies. Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.
2. Test personnel shall be qualified and hold certifications to perform quality control testing work.
3. All inspection and testing service agencies shall be pre-approved by the Owner.

1.09 NON-CONFORMANCE OR DEVIATIONS

- A. Any (a) condition that may have a potential adverse effect on the safety, operability, reliability, integrity, operational life, or maintenance of the material or component, or (b) any failure to comply with any quality assurance or quality control requirement in the Agreement, shall be a non-conformance or deviation. Examples include (i) physical defects in equipment, structures, systems, or components, (ii) test failures, (iii) any equipment out-of-tolerance, or (iv) any failure to comply with specifications, inspection or test procedures. No deviation or non-conformance from the Agreement requirements shall be acceptable unless approved in writing by Owner and only upon prior full disclosure by Contractor to Owner of all relevant facts and circumstances. Such written approval by Owner shall not be unreasonably withheld. All notifications and approvals related to any such non-conformances shall be in written form and shall be retained by Contractor.
- B. Document all non-conformances and deviations in detail and promptly submit such documentation to the Owner's representative for review, acceptance, and resolution. Promptly (but in any event within twenty-four (24) hours) notify Owner of all non-conformances of material and components dispositioned as use-as-is or repair and shall provide Owner with copies of all non-conformance reports relating thereto within ten (10) days of Contractor's discovery of any such non-conformance.
- C. Promptly (but in any event within twenty-four (24) hours) notify Owner of all non-conformances in material or components that Contractor intends to remediate through rework and shall provide Owner with copies of all non-conformance reports relating thereto.
- D. All notifications and approvals related to any non-conformances shall be in written form and shall be retained by Contractor.
- E. Make an initial response within thirty (30) days of receipt of all inspection/source verification deficiency reports and surveillance finding reports initiated by Owner.
- F. Owner reserves the right to charge to Contractor any additional cost of inspection when material or workmanship is not ready at the time specified by Contractor for inspection, or when re-inspection is necessitated by prior rejection. If required by Owner, Work must be uncovered for observation and/or inspection purposes and replaced at Contractor's expense.
- G. In the event Owner places conditions or restrictions on Contractor as a result of non-conformances or sub-standard implementation of the Quality Management Program

requirements, Contractor shall allow Owner to perform additional surveillance and inspection activities to ensure corrective actions are satisfactory to Owner for the identified conditions or restrictions, at no additional cost to Owner.

1.10 MILL TESTS

- A. Mill or shop tests shall be conducted, and test results, certificates and/or affidavits shall be submitted, as required in the individual Specification Sections. Make submittals in accordance with the requirements of Specification Section 01 33 00, Submittal Procedures. Mill tests refer to those tests typically performed as part of the manufacturer's standard quality control program, and not specifically performed for this Project.
- B. Mill or shop tests shall be accomplished by the manufacturer, fabricator, or Supplier of the product. Mill tests may be conducted by an independent testing laboratory, and shall be conducted in accordance with specific or standard procedures as specified. Applicable ASTM procedures shall be used if other procedures are not specifically required.
- C. The cost of mill tests shall be incidental, and no additional compensation will be provided.

1.11 FACTORY TESTS AND OBSERVATION

- A. Factory tests shall be conducted and test results, certificates and/or affidavits shall be submitted as required in the individual Specification Sections. Make submittals in accordance with the requirements of Specification Section 01 33 00, Submittal Procedures. Test results shall be submitted prior to the shipment of the tested equipment.
- B. Factory tests shall be conducted to establish the performance, capacity, rating, efficiency, or function of process, mechanical, electrical, or other equipment or materials. Factory tests refer to those tests made by manufacturers, fabricators, Suppliers, or Contractor specifically for this Project.
- C. Factory tests shall be conducted in the factory or shop where the item is being fabricated. The test shall be set up and accomplished by the equipment manufacturer who shall provide all shop space, tools, equipment, instruments, personnel, and other facilities required for the satisfactory completion of each test.
- D. Factory tests may be witnessed by Owner, or Engineer, or their representatives. Notify Engineer at least 10 working days in advance of testing to allow Engineer or Owner opportunity to witness. Failure of Contractor to notify will be grounds for rejection of the test results, and Contractor may be required to repeat testing and/or replace affected Work.
- E. The cost of factory tests shall be incidental, and no additional compensation will be provided.

1.12 LABORATORY TESTS

- A. Laboratory tests shall be conducted, and test results, certificates, and/or affidavits shall be submitted, as required in the individual Specification Sections. Make submittals in accordance with the requirements of Specification Section 01 33 00, Submittal Procedures. Laboratory tests refer to those tests made by manufacturers, fabricators, Suppliers, or Contractor specifically for this Project and conducted by an independent testing laboratory.
- B. All laboratory tests shall be made by an independent testing laboratory approved by Owner or Engineer. Those tests shall be performed in accordance with the specified procedures or in accordance with applicable ASTM procedures if no reference is included.
- C. Laboratory tests may be witnessed by Owner, or Engineer, or their representatives. Notify Engineer at least 2 working days in advance of testing to allow Engineer opportunity to witness. Failure of Contractor to notify will be grounds for rejection of the test results and may require Contractor to repeat testing and/or replace affected Work.
- D. Contractor shall conduct routine testing of materials used in the Work to satisfy itself that the quality of the Work meets the requirements of the Contract Documents. Owner or Engineer may also conduct routine sampling and analysis to ascertain the same. Where laboratory testing or material specifications or quality control requirements are specified in the individual Specification Sections, Contractor shall not proceed with phases of the Work until Owner or Engineer have had opportunity to collect samples or conduct testing necessary to establish the specified quality of the Work. Such instances may include, but are not limited to, soil compaction control, soil gradation testing, moisture content testing, testing of finishes, testing for chlorine residual or other water quality parameters, testing of roofing samples, or any other specified tests.
- E. Contractor shall pay for all specified laboratory testing. Owner will pay for testing Owner desires other than that required by these Specifications. If testing by Owner identifies defective Work, Contractor shall pay for all subsequent sample collection and testing costs performed by Owner or Engineer that are required by Engineer or Owner to convince Owner that the defective Work has been repaired or replaced.

1.13 FIELD TESTS

- A. Conduct field tests and submit test results, certificates, and/or affidavits as required in the individual Specification Sections. Make submittals in accordance with the requirements of Specification Section 01 33 00, Submittal Procedures.
- B. Conduct field tests in accordance with the individual Specification Sections to establish the quality of complete systems or individual components of process, mechanical, and electrical equipment including, but not limited to, piping systems, electrical systems, control systems, ventilation systems, heating systems, water mains, sewers and drains, tanks and vessels, and similar facilities.

- C. Conduct field tests to establish the performance, capacity, function, efficiency, tightness, leakage, operating characteristics, or other special requirements. Conduct tests in accordance with specified procedures or standards. Use applicable standards or codes where none are specified.
- D. Field tests shall be set up and conducted by party responsible for performing the test. Provide all tools, equipment, instruments, personnel and other facilities required for the satisfactory completion of each test, and observation of such tests by Owner or Engineer.
- E. Field tests may be witnessed by Owner, or Engineer, or their representatives. Notify Engineer at least 4 working days in advance of testing to allow Owner or Engineer opportunity to witness. Failure of Contractor to notify will be grounds for rejection of test results and Contractor may be required to repeat testing and/or replace affected Work.

1.14 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 45 00

Table 1: Minimum Frequencies of Construction Material Tests

| Construction Material | Test Description | Test Method | Sampling Location | Minimum Preconstruction Source Testing Frequency | Minimum Construction Testing Frequency |
|---|------------------------------------|---|-------------------|--|---|
| Common Fill / Subgrade | Soil Description | ASTM D2488 | Source/In-Place | 1/10,000 CY (Import only) | Road Embankment: 1/2,000 CY General Common Fill: 1/10,000 CY Liner Subgrade: 1/Acre |
| | Soil Classification | ASTM D2487 | Source/In-Place | 1/10,000 CY (Import only) | Road Embankment: 1/2,000 CY General Common Fill: 1/10,000 CY Liner Subgrade: 1/Acre |
| | Particle Size Distribution | ASTM D6913, D1140 | Source/In-Place | 1/10,000 CY (Import only) | Road Embankment: 1/2,000 CY General Common Fill: 1/10,000 CY Liner Subgrade: 1/Acre |
| | Moisture Density | ASTM D698 | Source/In-Place | 1/10,000 CY (Import only) | Road Embankment: 1/2,000 CY General Common Fill: 1/10,000 CY Liner Subgrade: 1/Acre |
| | Moisture Content | ASTM D2216 | Source/In-Place | 1/10,000 CY (Import only) | Road Embankment: 1/2,000 CY General Common Fill: 1/10,000 CY Liner Subgrade: 1/Acre |
| | In-Place Density and Water Content | ASTM D6938 or D1556 | In-place | N/A | Road Embankment: 1/2,000 CY General Common Fill: 1/10,000 CY Liner Subgrade: 1/Acre |
| Compacted Clay Liner | Soil Description | ASTM D2488 | Source | 1/3,000 CY | N/A |
| | Soil Classification | ASTM D2487 | Source | 1/3,000 CY | N/A |
| | Particle Size Distribution | ASTM D6913, D1140 | Source | 1/3,000 CY | N/A |
| | Atterberg Limits | ASTM D4318 | Source | 1/3,000 CY | N/A |
| | Moisture Density (4 point Proctor) | ASTM D698 | Source | 1/3,000 CY | N/A |
| | Permeability | ASTM D5084 and D5856 | Source/In-Place | 2/source | 1 per 15,000 CY |
| | Moisture Content | ASTM D2216 | Source/In-Place | 1/3,000 CY | 100-foot grid each lift. Offset grid 50 feet both directions each lift |
| Topsoil | In-Place Density and Water Content | ASTM D6938 or D1556 | In-place | N/A | 100-foot grid each lift. Offset grid 50 feet both directions each lift |
| | Soil Description | ASTM D2488 | Source/In-Place | 3/source (Import only) | 1/10,000 CY (Borrow only) |
| | Soil Classification | ASTM D2487 | Source/In-Place | 3/source (Import only) | 1/10,000 CY (Borrow only) |
| | Particle Size Distribution | ASTM D6913, D1140 | Source/In-Place | 3/source (Import only) | 1/10,000 CY (Borrow only) |
| | Nutrient Content & pH | Per Agricultural Soils Testing Laboratory | Source/In-Place | 2/source (Import only) | 1/15,000 CY (Borrow only) |
| | Organic Content | Per Agricultural Soils Testing Laboratory | Source/In-Place | 2/source (Import only) | 1/15,000 CY (Borrow only) |
| Aggregate Base/Gravel Surfacing/ Structural Fill/Pipe Bedding/Granular Filter/Pea Stone | Fertilizer Requirements | Per Agricultural Soils Testing Laboratory | Source/In-Place | 2/source (Import only) | 1/15,000 CY (Borrow only) |
| | Particle Size Distribution | ASTM D6913, D1140 | Source | 2/source | - |
| | Moisture Density | ASTM D698 | Source | 2/source | - |
| | In-Place Density and Water Content | ASTM D6938 or D1556 | In-Place | - | as directed by Owner |

Table 1: Minimum Frequencies of Construction Material Tests

| Construction Material | Test Description | Test Method | Sampling Location | Minimum Preconstruction Source Testing Frequency | Minimum Construction Testing Frequency |
|---------------------------------------|------------------------------------|---|-------------------|--|--|
| Riprap | Soil Classification | ASTM D2487 | Source | 2/source | N/A |
| | Particle Size Distribution | ASTM D5519 | Source | 2/source | N/A |
| Buffer Layer | Soil Description | ASTM D2488 | Source/In-Place | 3/source | 1/1,000 CY (minimum of 3) |
| | Soil Classification | ASTM D2487 | Source/In-Place | 3/source | 1/1,000 CY (minimum of 3) |
| | Particle Size Distribution | ASTM D6913 | Source/In-Place | 3/source | 1/1,000 CY (minimum of 3) |
| | Moisture Density | ASTM D698 | Source/In-Place | 3/source | 1/1,000 CY (minimum of 3) |
| | In-Place Density and Water Content | ASTM D6938 or D1556 | In-place | N/A | 100-foot grid each lift. Offset grid 50 feet both directions each lift |
| | Proof Roll/Engineer Inspection | Visual Confirmation of Cover Subgrade Suitability | In-place | N/A | All cover subgrade areas |
| Cover Soil | Soil Description | ASTM D2488 | Source/In-Place | 3/source (Import only) | 1/15,000 CY (Borrow only) |
| | Soil Classification | ASTM D2487 | Source/In-Place | 3/source (Import only) | 1/15,000 CY (Borrow only) |
| | Particle Size Distribution | ASTM D6913 | Source/In-Place | 3/source (Import only) | 1/15,000 CY (Borrow only) |
| Coarse Aggregate / Drainage Aggregate | Soil Description | ASTM D2488 | Source/In-Place | 1/3,000 CY | 1/1,000 CY |
| | Soil Classification | ASTM D2487 | Source/In-Place | 1/3,000 CY | 1/1,000 CY |
| | Particle Size Distribution | ASTM C136 | Source/In-Place | 2/source | 1/1000 CY |
| | Calcium Carbonate Content | ASTM D4373 | Source | 1/source | N/A |
| | Soil Description | ASTM D2488 | Source/In-Place | 3/source | 1/2,500 CY |
| Sand Drainage Layer | Soil Classification | ASTM D2487 | Source/In-Place | 3/source | 1/2,500 CY |
| | Particle Size Distribution | ASTM D6913 | Source/In-Place | 3/source | 1/2,500 CY |
| | Permeability (Constant Head) | ASTM D2434 | Source/In-Place | 3/source | 1/2,500 CY |

SECTION 01 51 00
TEMPORARY UTILITIES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes temporary utilities
- B. Related Sections
 - 1. Section 33 05 28 Trenching and Backfilling for Utilities
 - 2. Section 33 10 00 Water Utilities
 - 3. Section 33 30 00 Sanitary Utilities
 - 4. Section 33 40 00 Storm Drainage Utilities

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 TEMPORARY UTILITIES

- A. Water
 - 1. Provide potable water for Contractor's personnel use at the Site.
 - 2. Obtain and supply non-potable water for on-site moisture conditioning of soils and dust control as needed at the Site.
 - 3. Water will be used only to the extent required by construction.
- B. Sanitary Facilities
 - 1. Provide sanitary facilities for use by Contractor's employees, Subcontractors, and Suppliers working on the Site, as well as for use by Engineer and Owner.
 - 2. Provide sanitary facilities with lockable doors when in use.
 - 3. Maintain in a clean and useable condition.
 - 4. Maintain until completion of the Work, unless Engineer or Owner approves earlier removal.

C. Electricity and Lighting

1. Contractor shall arrange for and furnish all electric power as necessary for completion of the Work. Should Contractor need electric power service for Contractor's purposes, it shall be the Contractor's responsibility to arrange for and pay for such service. Contractor shall include costs for electric power in Contract Price and no additional compensation will be provided.
2. Provide temporary lighting to sufficiently illuminate Work areas. Protect lights with guard cages.
3. Comply with all applicable OSHA requirements.
4. Provide identification warning signs at power outlets which are other than 110-120 volt power. Provide polarized outlets for plug-in type outlets, to prevent insertion of 110-120 volt plugs into higher voltage outlets.
5. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for use with power tools and equipment. Provide only grounded extension cords and use "hard service" cords where exposed to abrasion or traffic. Use single lengths of extension cord or waterproof connectors to connect separate lengths of extension cords.

D. Fire Protection

1. Contractor shall make all arrangements necessary to assure that the Site and the Work have adequate fire protection services throughout the duration of the Work.

E. Telephone/Internet/Wi-Fi

1. Contractor shall arrange for and furnish telephone and internet service and equipment to the extent deemed necessary by contractor.
2. At a minimum, Contractor to provide high speed internet service with wireless router for use in Contractor's field office and Owner's and Owner's On-Site Representative's field office.

1.04 COORDINATION

- A. Coordinate any required utility connections with Owner and utility companies.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 TEMPORARY UTILITIES

- A. Examine and verify site acceptability to receive and construct temporary utilities.
- B. Provide and maintain temporary utilities and facilities required for personnel use and construction-related project work.
- C. Disconnect any temporary power and water supply upon project completion and remove Contractor-supplied sanitary facilities upon project completion.

END OF SECTION 01 51 00

SECTION 01 52 00

CONSTRUCTION FACILITIES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes construction facilities.

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 FIELD OFFICE

- A. Field Office
 1. Provide a weather-tight field office for use by Contractor and Subcontractors.
 2. Field office to include designated space for use by Owner and Owner's On-Site Representative in location approved by Owner.
 - a. The space shall have a minimum of 120 square feet of floor area, be equipped with a desk, a table, and three chairs. The space shall be furnished with electrical service, operable lighting, heat, and air conditioning. This office space may be located in a trailer with other facilities but must be accessible to Owner and Owner's On-Site Representative at all times and must be secured by a separation wall and lockable door.
 3. Coordinate Field Office location with Owner.

1.04 TEMPORARY ENCLOSURES AND HEAT

- A. Provide secure, weathertight temporary enclosures and closures as required to retain heat so that specified temperatures can be maintained for the performance of the Work and to protect previously completed Work.
- B. Unless specifically stated otherwise, temperatures inside the enclosures shall be not less than 60°F for 48 hours prior to and during the time when concrete work, cement finishing, masonry work, or painting or sealing are being done or being cured, and not less than 50°F where any personnel are working or where pipes contain water or other fluids that could freeze.
- C. Provide temporary closures over wall and floor openings.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 52 00

SECTION 01 55 00

TRAFFIC CONTROL

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes access and traffic control.

1.02 SUBMITTALS

A. Traffic Control Plan

- 1. Submit traffic control plan to the City of Burnsville and Dakota County for approval and to Engineer for documentation prior to implementation. Plan shall include proposed signage and proposed location of all signage, flagmen and detours. Plan must be approved by the City and County prior to implementation.

B. Transfer Station Temporary Access Road Plan

- 1. Submit transfer station temporary access road plan for approval. Plan shall include proposed temporary access road location, widths, and grades and proposed schedule for transfer station temporary and final access roads.

1.03 ROADS

- A. Maintain roads to provide access to the Work and all of Owner's and other's facilities for the entire duration of the construction. Roads shall be passable for their intended use at all times in all weather conditions and shall be maintained in a graded and rut-free condition.
- B. Sequence Work within the right-of-way of public roads to minimize public disturbance.
- C. Provide and maintain temporary surfacing of roads and driveways necessary to maintain those in passable condition under all weather conditions by typical passenger vehicles. Temporary surfacing shall consist of graded rock and granular material as required to provide a stable driving surface.

1.04 SIGNS, FENCES, BARRICADES, TRAFFIC, AND WATCHPERSON

- A. No signs, billboards, or other advertisements shall be erected on the premises by Contractor without Owner's written permission.
- B. Furnish and maintain all warning lights, barricades, informational signs, and watchperson as needed for the execution of the Work as required by the Contract Documents, Laws and

Regulations, for the protection of persons and property, and control of traffic in accordance with applicable manuals for Uniform Traffic Control Devices.

- C. Contractor shall coordinate with Engineer and Owner on the use of all barricades, warning lights, and traffic control signage on all public roadways.
- D. If required by the Contract Documents or Laws and Regulations, provide and maintain warning lights, barricades, informational signs, and watchmen for the protection of the Work, the protection of persons and property, and control of traffic. From sunset to sunrise, provide each barricade located in public streets or areas of potential pedestrian traffic with at least two operational lights.
- E. Barricades shall be painted a color visible at night, and shall consist of, at a minimum, snow fence or a similar material securely anchored to prevent entry of small children or unknowing persons.
- F. At a minimum, barricades shall be required at all excavations that have potential to contain standing water, and at all excavations more than 18 inches deep with side slopes on any exposure steeper than 3 units of horizontal run to 1 unit of vertical rise.
- G. At a minimum, warning lights shall be required at both ends of all excavations within public streets where the original pavement surface has been removed until a paved surface has been restored to grade.
- H. Barricades, warning lights, and traffic control signage within public streets shall, at a minimum, meet the technical requirements of the Institute of Transportation Engineers and the latest edition of the Minnesota Department of Transportation Standard Specifications for Construction.

1.05 TRAFFIC AND PEDESTRIAN SAFETY CONTROL MEASURES

- A. In accordance with generally accepted construction practices, Contractor is responsible for job-site conditions and safety procedures and programs, including safety and health of all persons and property, on those portions of the project area affected by or used by Contractor, employees, subcontractors, agents, and others during performance of the work. This requirement will apply continuously and not be limited to normal working hours. Contractor is responsible for the protection of property and the safety and health of its employees, subcontractors, suppliers, agents and others within the project area.
- B. Contractor shall be responsible for keeping the site perimeter, crosswalks and trail crossings safe for the public on or adjacent to site for the duration of the work. Contractor shall be responsible for all site safety precautions.

1.06 TRAFFIC PERMITS

- A. Contractor shall obtain any permits from federal, state or local agencies necessary for traffic control or road closings necessary for completion of the Work. Contractor shall perform Work in accordance to requirements of all permits.

1.07 TRAFFIC PUBLIC NOTICE

- A. Contractor shall be responsible for any public notice regarding work in the right of way, road closings or detours as required by federal, state, or local agencies.

1.08 ACCESS

- A. Limit access to each work area as shown on the Drawings unless other arrangements are approved by Owner.
- B. All public roadways and private driveways not shown as closed shall remain in service during construction, unless noted otherwise.
- C. Inspect and sweep paved surfaces to prevent dirt and mud from being tracked off site.

1.09 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 55 00

SECTION 01 57 13

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes temporary erosion and sediment control.
- B. Section includes Contractor responsibility for compliance with the Minnesota Pollution Control Agency (MPCA) General Stormwater Construction Permit (MNR 100001) and associated Stormwater Pollution Prevention Plan (SWPPP) required for this project.
- C. Related Sections
 - 1. Section 01 57 19 Temporary Environmental Controls
 - 2. Section 31 25 00 Erosion and Sedimentation Control

1.02 SUBMITTALS

- A. The Contractor shall maintain a record of all SWPPP inspections of the site, and shall include:
 - 1. The project Contract Documents and inspection records shall be available at the construction site in either the field office, or the inspector's vehicle, or the Contractor's vehicle, for inspection by federal, state, and local officials.
 - 2. Weekly/storm event inspection forms with date and time of inspection.
 - 3. Corrective actions taken (including date and time)
 - 4. Documentation of changes to the Temporary Erosion and Sediment Control Plan made during construction.
 - 5. Date of all rainfall events (including total precipitation)
 - 6. Submit all inspection records completed to Owner at the end of the project.
 - 7. All documentation required as part of the Stormwater Pollution Prevention Plan (SWPPP).

1.03 STORM WATER SEDIMENT AND EROSION CONTROL

- A. Owner is responsible for obtaining the MPCA General Stormwater Construction Permit (MNR 100001) for authorization to discharge storm water associated with the project construction activity under the National Pollutant Discharge Elimination System (NPDES) program and

providing a copy of the permit to Contractor prior to beginning construction activities at the Site. Contractor will be required to co-sign the MPCA Stormwater Permit Application and is jointly responsible for compliance with Parts II.B, Part II.C, and Part IV of the MPCA Stormwater Construction Permit (MNR 100001), and other Parts if applicable. The MPCA General Stormwater Construction Permit can be found on the MPCA's website at the following link:

<https://www.pca.state.mn.us/water/construction-stormwater#permit-and-forms-84534d2d>

- B. Owner is responsible for preparing the Storm Water Pollution Prevention Plan (SWPPP) required under the General Stormwater Construction Permit (MNR 100001) and providing a copy of the SWPPP to Contractor prior to beginning construction activities at the Site.
- C. Contractor is responsible for conducting all construction activities in full compliance with the requirements of the MPCA General Stormwater Construction Permit (MNR 100001), the SWPPP and any additional requirements that may be contained in any City, Town or County permits. Owner will provide Contractor with copies of all relevant permits and the SWPPP prior to the start of construction activities.
- D. Contractor is responsible for compliance with all requirements specified in paragraph 1.03 C until construction is complete, and the construction site has undergone final stabilization. Once Owner is satisfied that these conditions have been met, Owner will prepare and submit the Notice of Termination (NOT) to the MPCA.

1.04 EROSION AND SEDIMENT CONTROL

- A. See Specification Section 31 25 00, Erosion and Sedimentation Control.

1.05 WATER MANAGEMENT/CONTROL

- A. See Specification Section 01 57 19, Temporary Environmental Controls.

1.06 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 EROSION AND SEDIMENT CONTROL PRODUCTS

- A. See Specification Section 31 25 00 Erosion and Sedimentation Control.

PART 3: EXECUTION

3.01 EROSION AND SEDIMENT CONTROL MEASURES

- A. Contractor shall install, routinely inspect and maintain all sediment and erosion control measures for duration of Project in compliance with MPCA General Stormwater Construction Permit (MNR 100001), the associated SWPPP, and as shown on the Drawings.

END OF SECTION 01 57 13

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes temporary environmental controls and clean-up.
- B. Related Sections
 - 1. Section 01 35 00 Construction Safety and Security
 - 2. Section 31 23 16 Waste Excavation and Consolidation
 - 3. Section 31 23 19 Dewatering

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 WATER MANAGEMENT AND CONTROL

- A. Contractor shall implement all requirements of the project-specific Stormwater Pollution Prevention Plan (SWPPP).
- B. Non-Contact Water
 - 1. Definition: water (stormwater, groundwater, or surface water) that does not come in contact with waste material
 - 2. Non-contact stormwater shall be handled in accordance with the SWPPP
- C. Contact Water
 - 1. Definition: water (stormwater, groundwater, or surface water) that comes in contact with waste material
 - 2. Contact Stormwater shall be managed in one of the following manners:
 - a. Maintained within existing area of waste and allowed to infiltrate within an open excavation
 - b. Collected and discharged to sanitary sewer, in accordance with requirements of the MCES permit (to be obtained by Owner)

- c. Discharged to the ground or on-site surface water body, in accordance with requirements of MPCA Groundwater Pump-Out General Permit (to be obtained by Contractor)
 - 3. Contact Water shall not be pumped or discharged from the Site without proper controls or in violation of permit conditions.
 - D. See Section 31 23 19 – Dewatering for additional requirements.
 - E. Waterways
 - 1. Care shall be taken at all times to prevent uncontrolled discharge to surface water bodies, including the Minnesota River, wetland complexes, ditches, and intermittent streams.
 - F. Floods
 - 1. Contractor shall maintain flood control berm prior to excavation within the Flood Protection Berm Requirement Boundary, as shown on the Drawings.
 - 2. Contractor shall monitor Minnesota River elevation predictions and plan work such that the site is controlled prior to flood events. Waste materials, whether stockpiled or in an excavation, shall not be exposed to flood waters.
- 1.04 NOISE CONTROL
- A. Conduct operations to minimize noise produced by construction operations and comply with applicable local ordinances.
 - B. Equip compressors, hoists, and other apparatus with mechanical devices necessary to minimize noise and dust. Equip compressors with silencers on intake lines.
 - C. Equip gasoline or oil-operated equipment with silencers or mufflers on intake and exhaust lines.
 - D. Line storage bins and hoppers with material that will deaden sounds.
- 1.05 DUST CONTROL
- A. Contractor shall take special care in providing and maintaining temporary roadways, existing and new roads, haul roads, and public roads used for construction operations in clean, dust-free conditions during construction operations.
 - B. No visible dust shall be present leaving the construction site.
 - C. Comply with local environmental regulations and direction of Owner or Owner's On-Site Representative for dust control. If Contractor's dust control measures are considered inadequate, Owner or Owner's On-Site Representative shall have the authority to require Contractor to take additional dust control measures.

- D. Contractor shall supply water tank trucks equipped with water cannon capable of delivering water through either front or rear-mounted nozzles. Tank trucks shall be of sufficient size and mobility and carry a sufficient quantity of water to control dust generated by Contractor's activities.
- E. Water used for dust control is not available on site and must be obtained and supplied by Contractor.

1.06 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and air from discharge of noxious substances and pollutants produced by construction operations.
- B. Have on hand materials and equipment for cleanup of spills or releases and take immediate action to mitigate the effects and prevent further impact to the environment caused by a spill or release.
- C. Immediately report spills and releases to local authorities, Owner, Owner's Representative, and any others that require notification.

1.07 CLEANING

- A. Clean the working area each day, remove all trash and waste materials, and maintain the Site in a neat and orderly condition throughout the construction period.
- B. Remove all garbage, litter, debris, and other materials, attributable to the Work or construction activities, that accumulates in the vicinity of the Site.
- C. See Specification Section 01 77 00, Closeout Procedures for additional cleaning information.

1.08 ODOR CONTROL

- A. See Specification Section 31 23 16, Waste Excavation and Consolidation for odor control requirements.

1.09 VECTOR CONTROL

- A. See Specification Section 31 23 16, Waste Excavation and Consolidation for vector control requirements.

1.10 VOLATILE ORGANIC CONTROL

- A. See Specification Section 31 23 16, Waste Excavation and Consolidation for volatile organic control requirements.

1.11 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 CONTACT WATER MINIMIZATION

- A. Contractor shall implement measures to minimize the generation of Contact Water
- B. Examples of such measures include, but are not limited to, the following: keeping excavations free of water to the extent possible, routing stormwater around or away from excavations, and limiting the amount of waste material that is exposed at any time.

3.02 DUST CONTROL

- A. Apply water to roads used by Contractor's equipment to control dust generated by wind or by Contractor's activities.
- B. Apply water to ground surfaces within the construction limits to control dust generated by Contractor's activities at the Site.
- C. Sweep public roads in vicinity of Site when Contractor's operations create mud and dirt on roads or when dusty conditions develop.

END OF SECTION 01 57 19

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes product requirements.

1.02 SUBMITTALS

- A. Submit all manufacturer's instructions for information.

1.03 PRODUCT REQUIREMENTS

- A. Material and Equipment incorporated into Work:
 - 1. Conform to applicable specifications and standards.
 - 2. Comply with size, make, type, and quality specified or as specifically approved.
- B. Manufactured and Fabricated Materials and Equipment:
 - 1. Design, fabricate, and assemble in accordance with engineering and shop practices standard with industry.
 - 2. Material and equipment shall be suitable for service conditions.
- C. Do not use material or equipment for purpose other than for which it is designed or specified.

1.04 MANUFACTURER'S INSTRUCTIONS

- A. Installation of materials shall comply with manufacturer's instructions. Obtain and distribute printed copies of such instructions to parties involved in installation, including two copies to Owner's On-Site Representative.
 - 1. Maintain one set of complete instructions at job site during installation until completion of entire Project.
- B. Handle, store, install, connect, clean, condition, and adjust materials in accordance with manufacturer's written instructions and in conformance with Specifications.
 - 1. If job conditions or specified requirements conflict with manufacturer's instructions, consult Engineer for further instructions.

2. Do not proceed with Work without written instructions.

1.05 ALTERNATE PRODUCTS

A. See Section 01 33 00, Submittal Procedures for alternate products requirements.

1.06 BASIS FOR COMPENSATION

A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 71 13

MOBILIZATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all supervision, materials, equipment, and labor and performing all operations necessary to:
 - 1. Perform all work that must be performed before beginning Work on the various items described elsewhere in these Specifications.
 - 2. Furnish all insurance/bonding required specifically for this Work.
 - 3. Obtain all licenses, permits, and approvals required for the Work except for those which will be obtained by Engineer or Owner as listed in Section 01 11 00, Summary of Work.
 - 4. Provide project management, perform project coordination, provide updates and attend project conferences and routine weekly meetings.
 - 5. Movement of personnel, equipment, materials, supplies, and incidentals to the Project Site.
 - 6. Establishment of all Contractor's offices and buildings or other facilities necessary to complete the Work.
 - 7. Establish temporary facilities and controls.
 - 8. Establish Site security measures.
 - 9. Locate underground facilities and utilities, including but not limited to, filing a ticket with Gopher State One Call.

1.02 SUBMITTALS

- A. Submit copies of all Permits and Notices which are obtained or produced specifically for this Work.
- B. Submit Materials Handling Plan and Health and Safety Plan (HASP), for approval prior to beginning any Work at the Site.
- C. After Hour Contacts

1. Prior to beginning any Work at the Site, submit to Engineer the names of at least three (3) employees of Contractor who may be contacted after normal working hours in the event of an unanticipated condition requiring immediate attention.
2. At least one person should be available at all times for immediate response to the Site within 2 hours of being called. That person shall have authority to make field decisions for Contractor.

1.03 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

- 3.01 Stage equipment in Owner designated location or as shown on the Drawings.

END OF SECTION 01 71 13

SECTION 01 71 14

DEMobilIZATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all supervision, materials, equipment, and labor and performing all operations necessary to demobilize personnel, equipment, supplies, and incidentals from the Work Area.

1.02 SUBMITTALS

- A. Submit written certification that all Work has been completed in accordance with the Contract Documents.

1.03 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 SITE VERIFICATION OF CONDITIONS

- A. Verify the following with the Engineer and Owner prior to demobilization:
 - 1. Engineer and Owner agree that Final Completion of the Work has been achieved.
 - 2. Written certification by the Contractor that all Work has been completed in accordance with the Contract Documents has been submitted.
 - 3. The Engineer determines and the Owner agrees that the Work is acceptable under the Contract Documents.
 - 4. Document conditions set forth in all applicable Permits and communicate such documentation to the Engineer and the Owner.

3.02 DEMOBILIZATION

- A. Demobilization activities must not be initiated until the Owner provides the Contractor with written permission to proceed.
- B. Remove all equipment, personnel, structures, supplies, materials, incidentals, temporary survey markers, and utility markers necessary to perform the Work from the Site within 10 business days after receiving written permission to proceed with demobilization.

END OF SECTION 01 71 14

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes procedures for record documents, substantial completion, final completion (final acceptance), and project closeout.

1.02 SUBSTANTIAL COMPLETION

- A. The Project shall be considered substantially complete when the Work is available for its intended use and meets the conditions of Substantial Completion as defined within the General Conditions.

1.03 RECORD DOCUMENTS

- A. Maintain at the Site (or in Contractor's possession) one set of record documents including all Drawings, Specifications, Change Orders, field test records (if applicable), associated permits, redline record drawings, and documentation of construction activities as required, in good condition and legibly annotated to show changes made during construction. Store record documents separate from documents used for construction and clearly mark them and make accessible to Owner, Owner's On-Site Representative and Engineer at all times.
- B. Record information on record documents concurrent with construction progress. Owner, Owner's On-Site Representative and Engineer may require Contractor to improve its performance with regard to recording information during the construction process.
- C. Record for each product listed in the Specifications, a description of the actual products installed, including the following:
 - 1. Manufacturer's name and product model number.
 - 2. Product substitutions or alternates used.
 - 3. Changes made by Change Order.
 - 4. Quality control procedures and test results.
- D. At a minimum, the following items shall be legibly marked on the record drawings to record actual construction:
 - 1. Approved version of all Shop Drawings.

2. Measured depths or elevations of foundations in relation to a clearly defined, reproducible datum.
 3. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements or survey markers.
 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 5. Changes made by Change Order and all minor field changes of dimension and detail.
 6. Details not shown on original Drawings.
- E. Do not conceal Work until required information is recorded.
- F. Submit record documents and all operations and maintenance manuals and other submittals required by other Sections of these Specifications.
- G. Maintain at site one record copy of:
1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change orders and other modifications to the Contract.
 5. Field orders, written instructions or clarifications.
 6. Approved Submittals.
 7. Field test records, including figures showing locations of sampling and chain of custody for any samples shipped off site for laboratory analyses.
 8. Associated permits, permit plans, and regulatory approvals.
 9. Elevation and thickness verification surveys by qualified land surveyor.
 10. Landfill disposal records.
 11. Truck weight tickets.
 12. Signed construction SWPPP.
 13. Modifications made to the SWPPP during the course of the Project.
 14. Inspection logs and response action summaries.

15. MPCA construction stormwater coverage card (post in construction trailer).
16. Safety Data Sheets (SDS) of all contractor chemicals used onsite.

1.04 SITE CLEANUP

- A. Keep the Site free from accumulations of waste materials, rubbish and other debris resulting from the Work. At the completion of the Work, remove all waste materials, rubbish and debris from the premises as well as all tools, construction equipment and machinery, temporary facilities, and surplus materials. Leave the Site clean and ready for occupancy by Owner.
- B. Prior to final acceptance, provide final cleaning of the Sites, including, but not limited to the roads, sidewalks, structures and Site improvements, so that the Project will be ready for use by Owner without further cleaning.
- C. Debris shall not be buried on site.

1.05 FINAL ACCEPTANCE

- A. When Contractor considers that the Work is complete and ready for final acceptance, provide written notice to Engineer.
- B. Contractor shall certify by written notice to Engineer that:
 1. Contract Documents have been thoroughly reviewed and Work has been inspected by Contractor and complies with the Contract Documents.
 2. Work is completed and ready for final acceptance.
- C. Upon receipt of such notice, Engineer and Owner will make a final review of the Work with Contractor and will notify Contractor in writing of all particulars in which this review reveals that the Work is incomplete or defective. Contractor shall take such measures as are necessary to remedy such deficiencies.
- D. Upon remedy of all such defects and deficiencies noted by Engineer and Owner in part 1.05 C, above, Engineer will issue a recommendation for final acceptance to Owner.

1.06 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, and maintenance materials in quantities specified in each Specification Section, in addition to that required for completion of the Work. Coordinate with Engineer and deliver to facility prior to Final Application for Payment.

1.07 GUARANTIES AND WARRANTIES

- A. Contractor shall guarantee all Work and material against all defects as specified in the General Conditions (and Supplementary Conditions), or as otherwise required for specific items in these Specifications. Warranty requirements noted in individual Specification Sections that exceed the minimum correction period prescribed in the General Conditions shall apply for the stipulated time for both material and labor.
- B. Standard product warranties are defined as preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to Owner.
- C. Special Warranties are defined as written warranties required by, or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for Owner.
- D. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.
- E. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.
 - 1. Repair or replace any such defective Work to conform to the provisions of the Contract and without expense to Buyer, within 10 working days after notification in writing by Buyer or Engineer of such defective Work.
 - 2. If the noted repairs are not made by Contractor, or it has not made arrangements for the correction thereof within the period specified above, Owner may do so, and may charge the cost of same to Contractor.
 - 3. Contractor shall perform repair Work so as to cause Owner a minimum of inconvenience and interruption of services.
- F. When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- G. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of warranty on the Work that incorporates the products.
- H. Written warranties made to Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights or remedies. Owner reserves the right to reject warranties and to limit

selections to products with warranties not in conflict with requirements of the Contract Documents.

- I. Owner reserves the right to refuse to accept Project Work where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- J. Submit duplicate, notarized copies of written warranties to Engineer prior to the date certified for Substantial Completion in accordance with the requirements of Specification Section 01 33 00, Submittal Procedures. Engineer's certificate of Substantial Completion shall be the commencement date for warranties. When a designated portion of the Work is completed and occupied or used by Owner, by separate agreement with Contractor during the construction period, submit properly executed warranties to Engineer within 15 days of completion of that designated portion of the Work. For items of Work delayed beyond the date of Substantial Completion, provide updated submittal within ten days of acceptance by Owner, listing date of acceptance as start of warranty period.
- K. When a special warranty is required to be executed by Contractor, or Contractor and a Subcontractor, Supplier, or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to Owner through Engineer for approval prior to final acceptance.
 1. Execute and assemble documents from Subcontractors, Suppliers, and manufacturers.
 2. Refer to individual Specification Sections for specific content requirements, and particular requirements for submittal of special warranties.
- L. At final acceptance, compile two copies of each required warranty and bond properly executed by Contractor, or by Contractor, Subcontractor, Supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- M. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch by 11-inch paper.
 1. Identify each binder on the front and the spine with the typed or printed title "Warranties and Bonds," the Project title or name, and the name of Contractor and Subcontractor.
 2. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.08 FINAL APPLICATION FOR PAYMENT

- A. Final Application for Payment shall be accompanied by a written Final Statement of Account. The Final Statement of Account shall reflect all adjustments to Contract Price including, but not limited to:
1. The original Contract Price.
 2. Additions and deductions resulting from:
 - a. Previous change orders,
 - b. Allowances,
 - c. Unit prices,
 - d. Deductions for uncorrected Work,
 - e. Deductions for liquidated damages,
 - f. Deductions for re-inspection payments, or
 - g. Other adjustments.
 3. Total Contract Price, as adjusted.
 4. Previous payments.
 5. Sum remaining due.
- B. Final Application for Payment shall be submitted in accordance with the procedures and accompanied by the other materials described in Specification Section 01 33 00, Submittal Procedures.
- C. Contractor shall complete all submittals required by these Contract Documents prior to the payment of Contractor's Final Application for Payment by Owner. Final payment shall not become due and payable until 10 days after all submittals have been made acceptable to Engineer or as provided in the General Conditions, whichever is later.
- D. Complete items on the list of items to be completed, and correct items related to deficiencies that become apparent following demonstration, commissioning, or acceptance testing.
- E. Submit the required construction records, including record drawings, to Engineer.
- F. Contractor and all Subcontractors shall furnish a certificate showing that they have complied with the provisions of M.S.A. 290.92 requiring withholding of income tax on wages at the source. Said certificates shall be executed by the Commissioner of Taxation. IC-134 forms for

certifications may be obtained from the Department of Revenue, Centennial Building, 658 Cedar Street, St. Paul, Minnesota 55155.

G. Seller shall submit Consent of Surety for final payment.

1.09 BASIS FOR COMPENSATION

A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION (NOT USED)

END OF SECTION 01 77 00

Division 02

Existing Conditions

SECTION 02 41 00

DEMOLITION

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all supervision, labor, equipment, and materials necessary to:
1. Complete any necessary pre-demolition surveys and obtain required permits for demolition of structures and abandonment of utilities
 2. Perform any required hazardous material abatement for structures noted on the Drawings.
 3. Demolish the structures and systems as noted on the Drawings.
 4. Salvage, load, and haul off-site all recyclable materials.
 5. Remove concrete and bituminous materials as shown on the Drawings.
 6. Place all other demolition materials, debris, and rubble in newly constructed lined facility or load, transport, and dispose off-site
 7. Remove underground utility pipes, manholes, and catch basins as shown on the Drawings.
 8. Seal select monitoring wells by a state licensed well driller.
 9. Protect items adjacent to the Work that are to remain in place.
- B. Related Sections
1. Section 01 35 00 Construction Safety and Security
 2. Section 31 01 00 Site Preparation
 3. Section 31 10 00 Clearing and Grubbing
 4. Section 32 10 00 Bases and Pavements
 5. Section 32 31 00 Fences and Gates
 6. Section 33 10 00 Water Utilities
 7. Section 33 30 00 Sanitary Sewer Utilities

8. Section 33 40 00 Stormwater Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. American National Standards Institute (ANSI)
 - a. ANSI A10.6 – Safety and Health Requirements for Demolition Operations.
2. Code of Federal Regulations (CFR) 40 CFR 61 subpart M, asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP)
3. Minnesota Rules Chapter 4725, Wells and Borings
4. Dakota County Ordinance No. 114
 - a. Section 11 – Well Sealing
5. Minnesota Pollution Control Agency's Pre-Demolition Environmental Checklist and Guide (<http://www.pca.state.mn.us/publications/w-sw4-20.pdf>)
6. Occupational Safety and Health Administration (OSHA) Construction Industry Regulations (29CFR)

1.03 SUBMITTALS

A. Demolition plan including:

1. Sequence, methods to be employed, and equipment required;
2. Recycling and disposal sites with proposed haul routes;
3. Requirements for temporary signs, barriers, and walkways; and
4. Indication that safety measures will be in accordance with applicable codes.

B. Record drawings showing:

1. The location and elevation of all utilities that have been abandoned in place, and
2. Any necessary revisions to the contract documents discovered during demolition.

C. Demolition Debris Disposal Documentation: Contractor shall keep record of location of demolition debris disposal. For off-site disposal, submit legible copies of all load tickets or receipts, or other acceptable evidence, documenting the weight and acceptance of demolition debris that are taken to each off-site disposal or recycling facility.

- D. Hazardous Materials Disposal Documentation: Contractor shall submit documentation of actual disposal of abated hazardous materials, including ACM, at a designated landfill. Documentation including manifests, weight tickets and disposal receipts shall be submitted by the Contractor.
- E. All necessary documentation to perform well sealing in compliance with state and local regulations.

1.04 DEFINITIONS

- A. *Demolish* – is to completely remove a specified pipe, fitting, housing, feature, or structure without regard for the conditions of the item after being removed.
- B. *Salvage* – is to remove an item in a condition that allows its reuse for a similar purpose.
- C. *Abandon* – is to leave in place with appropriate measures taken to prevent disturbance of the surrounding Work.
- D. *Protect* – is to take necessary precautions to leave an item unharmed by the Work.
- E. *Reuse* – is to allow specific suitable items be reused in the Work after salvage.

1.05 JOB CONDITIONS

- A. Contractor shall be solely responsible for evaluating existing facilities and Site conditions and considering all factors that may affect the progress or performance of the Work. No consideration to extra fees or extended schedule will be considered as a result of Work or materials required that were available for review prior to receipt of bids.
- B. Contractor shall become the owner of materials generated by the demolition efforts and shall dispose or recycle all of the demolition debris in accordance with all applicable laws and regulations.
- C. In the event that asbestos containing material (ACM), underground storage tanks or containers, or other hazardous materials are encountered during demolition activities, Contractor shall immediately stop work in that area and notify Engineer and establish a hazardous materials abatement and demolition plan.
- D. Deterioration. Contractor shall perform inspections of all materials and structures to be removed prior to rigging, cutting, or other demolition activities to assess the existing conditions. Inspection and demolition planning/methods shall consider the deterioration of materials and structures due to corrosion, wear, tear, damage, weathering, and lack of maintenance.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate demolition activities with Owner to provide adequate site access for Work.
- B. Coordinate demolition activities to avoid damaging any portion of the Work.

- C. Take precautions to ensure that structural elements are not overloaded at any point during the demolition and construction Work.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Provide marking materials suitable for duration of service required.
- B. Provide well sealing materials suitable for well conditions, in accordance with state and local regulations.

PART 3: EXECUTION

3.01 GENERAL

- A. Site Verification of Conditions
 1. Inspect existing conditions and note dimensions, clearances, access, utilities and protections required.
 2. Mark the limits of the civil, architectural, structural, process piping, mechanical, and electrical demolition. Mark any hazardous materials requiring abatement.
 3. Note items to be salvaged for reuse in the Work.
 4. Note items to be salvaged and returned to Owner.
 5. Provide required protective measures before beginning demolition.
- B. Protection
 1. Perform demolition in such a manner as to:
 - a. Eliminate hazards to persons and property,
 - b. Minimize interferences with adjacent spaces, and
 - c. Minimize interruption of existing utilities.

2. Provide safeguards per ANSI A10.6, including warning signs, warning lights, barricades, temporary fences, chutes, and nets as required for protection of personnel, adjacent structures, utilities to remain, and new Work during demolition Work.
 3. Provide dust control as required to avoid hazardous or nuisance conditions in the surrounding area.
 4. Do not use water for dust control if it results in hazardous conditions such as ice, flooding, or pollution.
 5. Protect monitoring wells that are not identified for sealing. If damaged, Contractor to replace at own expense.
- C. Explosives will not be permitted.
- D. Demolish and remove existing construction only to the extent required by new construction and as indicated on the Drawings.
- E. If unforeseen conditions are encountered, or if additional hazardous materials are suspected, obtain instruction from Engineer before proceeding with demolition.
- F. In the event of demolition of items not scheduled to be demolished, promptly replace to the approval of Engineer at no additional cost to Owner.
- G. Salvage
1. Salvage existing items as indicated on the Drawings.
 2. Disconnect, remove, protect, and store salvaged items in a manner that will prevent damage.
 3. Reinstall salvaged items to be reused.
 4. Deliver salvaged items not reused in the work to Owner.
- H. Demolition debris including furniture, fixtures, brick, concrete, stones, metals, plastic, mechanical equipment, electrical equipment, vegetation, and earth not intended for reuse in the Work shall become the property of Contractor.
- 3.02 PAVEMENT
- A. Saw cut to a full depth, all extents of bituminous pavement to be removed.
- 3.03 BELOW GRADE UTILITY DEMOLITION/ABANDONMENT
- A. Field verify utilities shown on the Drawings.

- B. Protect utilities that will not be abandoned or removed.
- C. Remove or abandon utilities as shown on Drawings.
- D. Buried pipes to be abandoned:
 - 1. 6-inch or less: securely cap pipe.
 - 2. 8-inch or greater: fill with grout or flowable fill and cap.
- E. Coordinate the removal of non-Owner utilities with the appropriate utility owner.
- F. Maintain a record drawing of the location of utilities that have been abandoned in place.

3.04 STRUCTURAL DEMOLITION

- A. Demolish structures as indicated on the Drawings.
- B. Saw cut to a full depth, all extents of concrete slabs and structural members to be removed.

3.05 MECHANICAL/ELECTRICAL SYSTEMS

- A. Demolish mechanical and electrical systems as indicated on the Drawings.

3.06 HAULING AND TRANSPORTATION OF DEMOLITION DEBRIS

- A. Contractor shall be responsible for and shall complete all the work necessary to ensure that material removed from the Site will be accepted by the disposal or recycling facility(s).
- B. Contractor shall arrange for and provide transportation of demolition debris to off-site disposal or recycling facilities.
- C. Contractor shall provide all equipment, materials, and labor to load all vehicles planned for transportation of demolition debris.
- D. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Federal, state, and local laws and regulations regarding hauling and disposal shall apply. If wet loads have the potential to shed water, then side-dumps or gasketed end dumps shall be utilized.
- E. Contractor shall prepare all forms necessary for waste profiling, acceptance, transportation, and disposal.
- F. Materials removed from the Site shall be transported directly to the recycling and/or disposal facility. The Contractor shall not change either route or mode of transport after commencing offsite transportation without Company's written approval.

- G. All transport vehicles shall be visually clean of soil, dust or other materials prior to vehicle departure from the Site.
- H. Contractor is responsible for arranging weighing of transport vehicles for travel on public roadways.
- I. Contractor shall maintain strict compliance with all federal, state and local laws, regulations, or requirements when transporting hazardous and non-hazardous soil or other materials from the Site to recycling and/or disposal facilities.
- J. Any spill caused by Contractor's handling of any material shall be cleaned up at the Contractor's sole expense. All spills shall adhere to the Site's and Company's spill reporting plan.

3.07 DEMOLITION DEBRIS (NON-HAZARDOUS) DISPOSAL

- A. Burning of materials will not be permitted on the site.
- B. At least weekly, remove demolition debris to maintain suitable site access.
- C. Transport demolition debris to newly constructed landfill or dispose of at a suitable location off-site in compliance with applicable regulations.
- D. On completion of demolition and after removal of all debris, leave site in a clean condition satisfactory to Engineer.

3.08 WELL SEALING

- A. Contractor shall be responsible for the proper sealing of the well in compliance with state and local regulations.
- B. Well sealing shall be completed by a licensed well driller with current registration in Minnesota.
- C. Only the wells designated for abandonment on the Drawings, or other wells as designated by the Owner, shall be sealed and abandoned. All other wells shall be protected.
- D. Contractor is responsible for all permits and fees.
- E. Contractor shall submit all regulatory submittals, including sealing records, to Owner within 30 days of sealing. Contractor shall also file records with state and local jurisdictions.

END OF SECTION 02 41 00

Division 03

Concrete

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes
 - 1. Form work
 - 2. Shoring
 - 3. Form accessories
 - 4. Form coatings
- B. Related sections
 - 1. Section 03 20 00 Concrete Reinforcement
 - 2. Section 03 30 00 Cast-in-place Concrete

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary
 - 2. ACI 347, Guide to Formwork for Concrete
 - 3. ACI SP-4, Formwork for Concrete

1.03 SUBMITTALS

- A. No submittals are required from this Section.

1.04 QUALITY ASSURANCE

- A. Design and engineering of formwork:
 - 1. Responsibility of Contractor.

2. Designed for loadings, lateral pressures and allowable stresses in accordance with ACI 347 and ACI SP-4.
3. Designed, erected, supported, and maintained to safely support all vertical and lateral loads that might be applied, including construction loads and loads resulting from the placement and vibration of concrete.
4. Formwork supported on ground: Provide satisfactory foundations to carry the loads imposed during and after construction without appreciable settlement.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protected from deterioration, weather and shrinkage prior to concreting by proper storage, oiling, wetting, or other appropriate methods.
- B. Keep free of rust, rot, or other detrimental forms of deterioration.

1.06 SEQUENCING

- A. Forms designed so they may be removed in proper sequence and without damage to the concrete.
- B. Sequence form erection and removal to match any concrete pours, curing, and any other adjacent or related work which may affect the placement, removal or availability of any concrete formwork.

1.07 WARRANTIES AND GUARANTEES

- A. Contractor shall be responsible for the stability, performance, and structural integrity of all formwork.

1.08 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Forms: Wood, metal, or other approved material providing a smooth continuous surface in contact with concrete.
- B. Chamfer Strips:

1. Uniform in cross-section dimensions without rounded corners.
2. Smooth on all sides.
3. ¾-inch sides, unless noted otherwise on Drawings.

C. Form Accessories:

1. Commercially manufactured ties and hangers embedded in the concrete.
2. Type which leaves no metal closer than 1 inch from the surface of the finished concrete.

D. Form Coatings:

1. Non-staining chemical release agent which prevents bonding to concrete.
2. Compatible with the type of form materials used.
3. Acceptable agents include: North Central Form Release, Eucoslip Form Release, Nox-Crete form coating and Crembeton 103.

2.02 FABRICATION

- A. Type: pre-manufactured or constructed on-site.

PART 3: EXECUTION

3.01 PREPARATION

- A. Thoroughly clean of all dirt, mortar, sawdust, and other foreign matter prior to use. Bottoms of forms inaccessible from within to be provided with access panels to permit removal of extraneous materials before placing concrete.
- B. Forms for exposed concrete:
1. Treated with non-staining release agent per manufacturer's recommendation.
 2. Avoid placement of release agent on reinforcing steel, embedded anchorages, anchor bolts, bearing plates, or other items which require bonding to concrete.
- C. Openings in formwork:
1. Provide to accommodate any conduits, fixtures, or other appurtenances extending through the formwork.
 2. Accurately locate, securely support, level, plumb, and straight items directly embedded into concrete.

3. Provide inspection hole as requested by Engineer to verify consolidation of concrete.

3.02 INSTALLATION

- A. Conform to the shape, lines, and dimensions of the components shown on the Drawings, true to line, plumb and level as required in ACI 117.
- B. Construct forms for exposed concrete to minimize deflection in order to eliminate bulges, off-sets, or other unsightly features in the finished surfaces.
- C. Provide camber to compensate for anticipated deflections in the formwork due to the weight and pressure of the plastic concrete and construction loads.
- D. Provide forms tight to prevent leakage of grout or cement paste.
- E. Items which will be directly embedded into concrete shall be accurately located, securely supported, level, plumb, and straight. This shall include items such as anchors, bearing plates, connection plates, manholes, and other inserts.

3.03 FORMWORK REMOVAL

- A. Forms shall be removed in a manner to ensure complete safety of the structure.
- B. Minimum time before removal after placing concrete, unless permitted otherwise:
 1. Footings and slab edges: 24 hours
 2. Walls and piers: 48 hours (24 hours for metal-lined form)
 3. Time specified above represents cumulative time during which temperature of concrete is maintained above 50 degrees F.
- C. In any event, do not remove forms or shoring until concrete has acquired sufficient strength to safely support its own weight and construction loads.
- D. Avoid hammering or prying against concrete surfaces to prevent damage to concrete.
- E. Do not place live loads on concrete structures prior to completion of the specified 28-day curing time without approval.
- F. Procedures for re-shoring shall follow the recommendations outlined in ACI 347R.

3.04 INSPECTION AND ACCEPTANCE

- A. Make formwork accessible for inspection of reinforcing, embedments, and any other necessary portions of the concrete work required by Owner's On-Site Representative.

3.05 FIELD QUALITY CONTROL

- A. Establish and maintain quality control for Work covered under this Section of the Specifications to assure compliance with Contract requirements. Maintain records, available to Owner's On-Site Representative, regarding quality control measures.

END OF SECTION 03 10 00

SECTION 03 20 00
CONCRETE REINFORCEMENT

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Reinforcing steel
2. Prestressing tendons
3. Welded wire fabric
4. Tie wire
5. Reinforcing support

B. Related Sections

1. Section 03 10 00 Concrete Forms and Accessories
2. Section 03 30 00 Cast-in-Place Concrete

1.02 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary
2. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures
3. ACI 318, Building Code Requirements for Structural Concrete and Commentary
4. ASTM A1064 / A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
5. ASTM A416/A416M, Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete
6. ASTM A615/A616M, Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement

7. ASTM A706/A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
8. ASTM A970/970M, Standard Specification for Headed Steel Bars for Concrete Reinforcement
9. ASTM A996/A996M, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
10. CRSI, Manual of Standard Practice

1.03 SUBMITTALS

- A. Shop Drawings
 1. Submit at least 15 days prior to start of work.
 2. Show fabrication dimensions, bar sizes, location for placing reinforcing, and lap locations.
- B. Manufacturer's mill certificates:
 1. Properties of the steel (i.e., mill tests).

1.04 QUALITY ASSURANCE

- A. Identify bar bundles with waterproof mark numbers on tags.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store above the surface of the ground on platforms, skids or other supports.
- B. Protect from injury and surface deterioration caused by exposure to conditions producing rust.

1.06 SEQUENCING AND SCHEDULING

- A. Schedule placement and securing of reinforcing steel and formwork so that reinforcing work may be reviewed by Engineer before it becomes inaccessible.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Reinforcing bars: ASTM A615, A706, or A996 (Type R), A970, Grade 60.
- B. Welded wire fabric: ASTM A185.
- C. Prestressing tendons: ASTM A416.
- D. Bar supports: CRSI Manual of Standard Practice
 - 1. Cold-drawn steel wire.
 - 2. Type C plastic protected or type E stainless steel protected.
 - 3. Precast concrete block.
- E. Tie wire: black annealed wire, 16 gauge or heavier.

2.02 FABRICATION

- A. Bent cold to the dimensions required before placing.
- B. Diameter of hooks and bends: ACI 315.

PART 3: EXECUTION

3.01 PREPARATION

- A. Prior to placement of new concrete, clean reinforcement of loose rust and mill scale, earth, ice, cement, mortar, and other materials which reduce or prevent complete bond with concrete.

3.02 INSTALLATION

- A. Do not install bars with kinks or bends not shown on Drawings.
- B. Provide adequate chairs, ties, etc. to prevent bars or welded wire fabric from sagging or deflecting and to hold the reinforcement rigidly against displacement of the concrete.
- C. Precast concrete blocks may be used for concrete placed against ground.
- D. Tie reinforcing with wire at all cross points.
- E. Placement tolerance: ACI 117.

- F. Minimum concrete cover (unless otherwise specified):
 - 1. Concrete subject to high water flow and abrasion: 6 inches.
 - 2. Concrete cast against and permanently exposed to earth: 3 inches
 - 3. Concrete exposed to weather: 2 inches.
 - 4. Concrete not exposed to weather or in contact with ground: 1½ inches.
- G. Tack welding of reinforcement is not permitted.
- H. Tension lap splices: ACI 318, Class B, unless noted otherwise on Drawings.

3.03 INSPECTION AND ACCEPTANCE

- A. Do not place concrete until reinforcing steel has been directly observed and accepted by Engineer or Owner's On-Site representative for general conformance with the contract documents.
- B. Notify Engineer 24 hours minimum prior to scheduled pour.

END OF SECTION 03 20 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Concrete
2. Concrete curing
3. Cast-in-place anchor bolts
4. Embedded metal
5. Expansion joint material
6. Joint sealer
7. Bonding agent
8. Vapor barrier
9. Waterstop

B. Related Sections

1. Section 03 10 00 Concrete Forms and Accessories
2. Section 03 20 00 Concrete Reinforcement

1.02 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges.
2. ASTM A36/A36M, Standard Specification for Carbon Structural Steel
3. ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
4. ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished

5. ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field
7. ASTM C33/C33M, Standard Specifications for Concrete Aggregates
8. ASTM C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
9. ASTM C94/C94M, Standard Specification for Ready Mixed Concrete
10. ASTM C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete
11. ASTM C150/C150M, Standard Specification for Portland Cement
12. ASTM C171, Standard Specification for Sheet Materials for Curing Concrete
13. ASTM C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
14. ASTM C260/C260M, Standard Specification for Air Entraining Admixtures for Concrete
15. ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
16. ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete
17. ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
18. ASTM C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.
19. ASTM C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.
20. ASTM C1602, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
21. ASTM D1751, Standard Specification for Preferred Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
22. ASTM E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials
23. ASTM E1745, Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
24. ASTM F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 KSI Yield Strength

25. ACI 117, Specifications for Tolerances for Concrete Construction and Materials and Commentary
26. ACI 207.1R, Guide to Mass Concrete.
27. ACI 301, Specifications for Structural Concrete.
28. ACI 302.1R, Guide for Concrete Floor and Slab Construction.
29. ACI 305.1, Specification for Hot Weather Concreting.
30. ACI 306.1, Standard Specification for Cold Weather Concreting.
31. ACI 308.1, Standard Specification for Curing Concrete.
32. ACI 309R, Guide for Consolidation of Concrete.
33. ACI 318, Building Code Requirements for Structural Concrete and Commentary.
34. ACI 347R, Guide to Formwork for Concrete.
35. CSRI Manual of Standard Practice.
36. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Manufacturer's descriptive literature and product specifications for each product.
- B. Shop Drawings:
 1. Steel reinforcing (see Section 03 20 00)
 2. Embedded steel, inserts, anchor bolt and accessories locations
- C. Batch Plant Qualifications
 1. Plant's name
 2. Address
 3. Phone number
 4. Distance and travel time to site
- D. Concrete Mix Design

1. Submit for each mix at least 15 days prior to start of work
 - a. Basis for mix design (by concrete production facility or laboratory trial mixes)
 - b. Identification of aggregate source and compliance test to ASTM requirements
 - c. Compressive strength at 28 days
 - d. Scale weights of each aggregate
 - e. Absorbed water in each aggregate
 - f. Brand, type, and amount of cementitious material in mix
 - g. Proportions of each material required per cubic yard
2. Do not change mix designs and supplier unless new batch plant qualifications and mix designs are submitted.
3. Concrete placement plan: identification of placement sequence, equipment, and techniques.
4. Load tickets.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications: 5 years minimum experience on comparable concrete projects.
- B. Workmen Qualifications:
 1. Competent and experienced foreman in placing the types of concrete specified.
 2. Trained and experienced concrete finishers.
- C. Contractor:
 1. For each batch of concrete delivered to the jobsite provide one signed copy of the delivery ticket in accordance with ASTM C94 to Owner's On-Site Representative as proof of acceptance or rejection of concrete.
- D. Independent Testing Agency:
 1. Trial mix
 - a. Obtain samples
 - b. Perform laboratory testing

- c. Provide reports on materials, concrete design mixed, and testing performed
 - 2. Field testing: see Part 3
- 1.05 BASIS FOR COMPENSATION
 - A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

- 2.01 CEMENTIOUS MATERIAL
 - A. Portland Cement: ASTM C150, Type I or Type IA.
 - 1. Free from water-soluble salts or alkalis, which will cause efflorescence on exposed surfaces.
 - B. Pozzolanic Mineral Admixture
 - 1. Fly Ash: ASTM C618, Class C or F
 - 2. Minimum amount (if used): 15%, by weight, of total cementious material.
 - 3. Silica fume: ASTM C1240.
 - 4. Slag cement: ASTM C989, Grade 100 or 120.
 - C. Use only one brand and type of cementious materials.
- 2.02 AGGREGATES
 - A. Fine Aggregates: ASTM C33 for grading.
 - B. Coarse Aggregates: ASTM C33 for grading.
 - 1. Maximum aggregate size
 - a. 3/4-inch: concrete sections 12 inches and less in thickness.
 - b. 1½ inches: footing, wall, and concrete sections greater than 12 inches in thickness.
 - C. Aggregates: Crushed quarry or mine trap rock (basalt, diabase, gabbro, or other related igneous rock types), quartzite, gneiss, or granite. Other igneous or metamorphic quarry or mine rock may be used only with Engineer's specific approval. Limestone aggregate will not be acceptable.

2.03 WATERSTOP

- A. Unless otherwise noted, waterstop shall be hydrophilic waterstop as manufactured by Greenstreak (Swellstop), Sika (Sikaswell), or approved equal. Use compatible primer for waterstop per manufacturer's recommendations.
- B. PVC waterstop where indicated on the Drawings shall be 9"x3/8" PVC serrated with center bulb as manufactured by Greenstreak, Sika, or approved equal.

2.04 WATER

- A. ASTM C1602. Clean, potable, and free from injurious amounts of oils, acids, alkalies, salts, organic materials, or other substances that may be deleterious to concrete or steel.

2.05 ADMIXTURES

- A. No admixtures, except air-entraining agent and water reducing admixture without approval of the Engineer. Do not use calcium chloride.
- B. Air-entraining agent: ASTM C260
 - 1. Acceptable products:
 - a. AEA-2 by Euclid Chemical Co.
 - b. Darex II by W.R. Grace
 - c. MasterAir Series by BASF Corporation.
 - d. Approved equal.
- C. Water-reducing admixture: ASTM C494, Type A
 - 1. Acceptable products:
 - a. Eucon WR 91 by Euclid Chemical Co.
 - b. WRDA-82 by W.R. Grace
 - c. MasterPozzolith Series or MasterPolyheed Series by BASF Corporation.
 - d. Approved equal.

2.06 MIXES

- A. Base proportioning of materials on previous field experience of concrete production facility or by laboratory trial mixes in accordance with ACI 301 or ACI 318.

- B. Minimum 28-day specified compressive strength and required average compression: ASTM C39.

| | Specified Compressive Strength f_c' | Required Average Compressive Strength f_{cr}' |
|--|---|---|
| 1. Type 1: Footings, pedestals, exterior concrete pads, slabs, sidewalks | 4500 psi | 5700 psi |
| 2. Type 2: Lean concrete fill | 1500 psi | 2500 psi |

Concrete exposure classes (see table above for type description):

| | Freezing and Thawing (F) | Sulfate (S) | Permeability (P) | Corrosion Protection (C) |
|--------|---------------------------------|--------------------|-------------------------|---------------------------------|
| Type 1 | Class F2 | Class S0 | Class P1 | Class C1 |

- C. Required average compressive strength: produce concrete of average compressive strengths unless documented test results substantiate a lower permissible average strength based on the standard deviation established in ACI 301 or ACI 318.

- D. Cementious Material Content

- Quantity required to meet the specified requirements for strength, water-cement ratio, durability, and finishing ability.
- Floors

| Nominal Max. Size Coarse Aggregate | Minimum Cementious Material Content, lb/cy |
|---|---|
| 3/8 inch | 610 |
| ¾ inch | 540 |
| 1 inch | 520 |
| 1½ inch | 470 |

- E. Water-Cement Ratio:

- 0.45 maximum

- F. Air-Entrainment

1. For concrete exposed to freezing and thawing:

| Nominal Max. Size Coarse Aggregate | Total Air Content |
|---|--------------------------|
| ¾ inch | 6% ± 1.5 |
| 1 inch | 6% ± 1.5 |
| 1½ inch | 5½% ± 1.5 |

- G. Slump: Per mix designer, except that slump should not be more than 9 inches for concrete containing high-range water-reducing admixtures.

- H. Workability

1. Mix workability and handling characteristics shall be demonstrated by past field experience or through a trial slab as suggested in ACI 301.

- I. Shrinkage Potential:

1. Perform ASTM C157 on trial mix to determine length change of concrete with 7 days of moist curing followed by 21 days of drying.
2. Change in length shall not exceed 0.05%.

2.07 READY-MIX CONCRETE

- A. Provide concrete from an established, certified ready-mix plant.
- B. Certified ready-mix plant equipment and facilities per Mn/DOT Standard Specification 2461.3F.

2.08 CURING MATERIALS

- A. Waterproof paper (non-staining): ASTM C171, regular or white.
- B. Burlap: commercial quality and non-staining.
- C. Polyethylene Sheeting: ASTM C171 (4 mil minimum thickness).
- D. Membrane Curing Compound: ASTM C309.
 1. Acceptable products:
 - a. CS-309 Curing & Sealing Compound (VOC) as manufactured by W. R. Meadows, Inc.
 - b. MasterKure CC 180 WB (formerly Kure-N-Seal) by BASF Corporation.

c. Approved equal.

2.09 CAST-IN-PLACE ANCHOR RODS

- A. Anchor rods: ASTM F1554.
- B. Heavy hex nuts: ASTM A563.

2.10 EMBEDDED METAL

- A. Embedded plates, bars, and steel shapes: ASTM A36.
- B. Welded Studs: ASTM A108
 - 1. As manufactured by the Nelson Stud Welding Co.
 - 2. Approved equal (unless noted otherwise).
- C. Pipe: ASTM A53, Grade B.

2.11 EXPANSION JOINT MATERIAL

- A. Expansion and isolation material used for interior applications with a sealant. Polyethylene closed-cell joint filler:
 - 1. Ceramar as manufactured by W. R. Meadows, Inc.
 - 2. Approved equal
- B. Expansion and isolation material used for exterior applications without a sealant. Fiber expansion joint filler conforming to ASTM D1751.

2.12 JOINT SEALER

- A. Sealant for use in floor slab isolation and contraction joints: 2-component polyurethane sealant, MasterSeal SL2 Sealant as manufactured by Master Builders Solutions, or approved equal.
- B. Sealant for use in wall joints:
 - 1. 1-component gun grade polyurethane sealant MasterSeal NP1 as manufactured by Master Builders Solutions
 - 2. Sikaflex-1a as manufactured by Sika
 - 3. Approved equal
- C. Primer: As recommended by the sealant manufacturer.

2.13 BONDING AGENTS

- A. Polymer bonding agent
 - 1. Acceptable products:
 - a. Weldcrete" by Larsen Products Corporation.
 - b. "Intralok" by W.R. Meadows.
 - c. Or approved equal.
 - 2. Use to bond surfaces of existing concrete to new concrete.

2.14 UNDERSLAB VAPOR BARRIER

- A. Vapor barrier: ASTM E1745, Class C
 - 1. Reinforced polyethylene vapor barrier with a perm rating of less than 0.1 (ASTM E96, Procedure A).
 - 2. Rufco 400 SSB by Raven Industries.
 - 3. Approved equal.

2.15 EPOXY GROUT FOR CRACK REPAIR

- A. Acceptable Products meeting ASTM C881, Type I, Grade 1, Class C
 - 1. Sika, Sikadur 35 Hi-Mod LV
 - 2. Strongtie Crack-Pac Injection Epoxy

PART 3: EXECUTION

3.01 PREPARATION

- A. Remove water from excavations before concrete is deposited. Divert any flow of water through proper side drains and remove without flowing over freshly deposited concrete.
- B. Do not place concrete on frozen ground.
- C. Apply form coating on formwork (see Section 03 10 00). Apply prior to placing reinforcing steel, anchoring devices, and embedded items.

- D. Prior to concrete placement, install, prepare, and inspect concrete reinforcement per Section 03 20 00.
- E. Subgrade to be well drained, free of frost, and moisture at the time of concrete placement. If necessary, dampen with water in advance of concrete placement, but no free water standing on either the subgrade or any muddy or soft spots when the concrete is placed.
- F. Screeds: Properly support to maintain required thickness of slabs. Place bulkheads to construction joint limits.
- G. Remove laitance from previously placed or existing concrete; thoroughly clean surface and apply bonding agent before placing concrete.
- H. Install items to be embedded in concrete. Fasten embedded items securely into position before placing concrete.
- I. Anchor rod placement
 - 1. Layout: use experienced construction surveyor.
 - 2. Set anchor rods using plywood, steel, and embedded templates (if necessary). Secure with nuts on each side of template.
 - 3. Anchor rod protection.
 - a. Coat anchor rod threads with grease and wrap with burlap.
 - b. Plug or cap anchor rod sleeves.
 - 4. Tolerances: AISC 303, Section 7.5.1.

3.02 TRANSPORTING CONCRETE: ASTM C94

- A. Discharge and place in its final position concrete delivered to the site in watertight revolving-drum trucks within 90 minutes, or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

3.03 PLACING CONCRETE

- A. Remove hardened concrete debris and foreign materials from the inner surfaces of conveying equipment.
- B. Weather Protection
 - 1. Cold Weather

- a. Applies to concrete placed when the ambient temperature is below 40 degrees F.
 - b. Conform to recommendations and requirements of ACI 306.1.
 - c. Concrete damaged by freezing to be removed and replaced at Contractor's expense.
2. Hot Weather
 - a. Applies to concrete placed when the ambient temperature exceeds 90 degrees F.
 - b. Conform to recommendations and requirements of ACI 305.1.
- C. Mass concrete:
1. Mass concrete: any concrete pour with smallest dimension (length, width, or height) greater than 3 feet.
 2. Demonstrate and meet the following temperature requirements. Adequate demonstration techniques include pre-project test pours with thermocouple measurements, on-site thermocouple measurements, submitted heat flow calculations based on PCA Design and Control of Concrete Mixtures, or measures to either reduce heat generation in accordance with ACI 207.1R.
 - a. Maximum temperature differential between core and face: 35 degrees Fahrenheit
 - b. Maximum temperature: 160 degrees Fahrenheit
- D. Place concrete continuously in each section until complete. Concrete surfaces not permitted to stand more than 30 minutes before new concrete is placed against them.
- E. Avoid segregation during placement. Place in uniform lifts not to exceed 18 inches.
- F. Do not drop concrete more than 5 feet. When greater drops are required, employ drop chutes or other approved means.
- G. Consolidation:
1. Consolidate concrete by vibration so that concrete is worked around the reinforcement, around embedded items, and into corners of forms.
 2. Use internal vibrators of the largest size and the most powerful that can be properly used in the Work, per ACI 301.
 3. Vibrators to be operated by competent workmen.
 4. Do not use vibrators to transport concrete within forms.

3.04 FINISHING

A. Unformed Surface

1. Top of Walls and Other Unformed Surfaces: Strike smooth and float to a texture consistent with finish of adjacent formed surface.

B. Formed Surface

1. Patch tie holes. Repair surface defects according to ACI 301.
2. Rough form finish of concrete not exposed: Chip off or rub off fins exceeding ½ inch in height.
3. Smooth form finish of exposed concrete: Remove fins exceeding 1/8 inch in height.

C. Exterior Concrete Walks and Parking Areas: ACI 302.1R, Class 3

1. Screed with straight edge immediately after placing concrete, bring surface to required elevations.
2. Initial Floating: Bull float by hand, before any excess moisture or bleeding water is present on surface.
3. Waiting: no subsequent operations performed until concrete is stiff enough to sustain foot pressure with approximately ¼ inch indentation.
4. Edge joints for contraction joints not saw-cut, provide joint ¼ of depth of slab.
5. Final Floating: Use either hand float or power float, cut down any ridges and fill troughs with mortar. Remove excess material.
6. Steel-trowel concrete surfaces, immediately after final floating, to a smooth, dense, uniform surface free of blemishes, ripples, and trowel marks.
7. Final finish: lightly broom, non-slip finish of freshly troweled concrete.
8. Finish slabs to a surface tolerance of not more than 1/4 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

D. Slab-on-Grade Flatwork: ACI 302.1R, Class 4

1. Screed with straight edge immediately after placing concrete, bring surface to required elevations.
2. Initial Floating: Bull float by hand, before any excess moisture or bleeding water is present on surface.

3. Waiting: no subsequent operations performed until concrete is stiff enough to sustain foot pressure with approximately $\frac{1}{4}$ inch indentation.
 4. Final Floating: Use either hand float or power float, cut down any ridges and fill troughs with mortar. Remove excess material.
 5. Steel-trowel concrete surfaces, immediately after final floating, to a smooth, dense, uniform surface free of blemishes, ripples, and trowel marks.
 6. Provide second and third trowelings.
 7. Floor Flatness/Levelness Numbers: F_F-25 , F_L-20 .
 8. Protect finished concrete surfaces from damage.
- E. Repair of Surface Defects: ACI 301
1. Surface defects include tie holes, honeycombed areas, and spalled and pitted areas resulting from concrete sticking to the forms.
 2. Fill tie holes with patching mortar after being cleaned and thoroughly dampened.
 3. Repair of surface defects other than tie holes:
 - a. Provide $\frac{1}{2}$ inches to $\frac{3}{4}$ inch deep saw cut around perimeter
 - b. Remove unsound concrete
 - c. Dampen patch area plus an additional 6 inches beyond perimeter
 - d. Apply bonding agent by thoroughly brushing into surface
 - 1) Bonding Grout: One part cement, one part fine sand with water to consistency of thick cream.
 - e. Apply batching mortar when bond coat loses water sheen.
 - f. Patching mortar
 - 1) Same materials as concrete to be patched with no coarse aggregate.
 - 2) Do not use more than one part cement to $2\frac{1}{2}$ parts sand by loose volume.
 - 3) For exposed surfaces, make trial batch to check color compatibility with repair surface. Substitute white cement if color is too dark.
 - 4) Use mortar at a stiff consistency. Add no more mixing water than required for handling and placing.

- g. Do not use proprietary compounds for adhesion or as patching ingredients without approval.

3.05 CURING AND PROTECTION: ACI 301 AND 308.1

- A. General: All concrete shall be protected against mechanical damage until the completion of Work.
- B. Curing: Concrete shall be cured in accordance with ACI 301 and 308, using either wet cure or curing compound.
- C. Start curing as soon as free water has disappeared from unformed surfaces or immediately after forms are removed.
- D. Accomplish curing and protection by preventing loss of moisture, rapid temperature change, mechanical injury, or damage from rain, frost, or flowing water for at least 7 days.
- E. Formed surfaces may be cured by leaving forms in place.
- F. Unformed surfaces, slab surfaces, and surfaces from which forms have been removed: Cure by one of the following application methods:
 - 1. Absorptive mats or fabric kept continuously wet.
 - 2. Waterproof sheet materials.
 - 3. Curing compound.
 - a. Apply the compound according to manufacturer's directions
 - b. Apply immediately after finishing operations are completed or after forms are removed.
 - c. Apply sufficient quantity to ensure the formation of a continuous unbroken film over the entire area of the exposed surface. Re-spray surfaces damaged by subsequent construction operations during the curing period.
 - d. Keep surfaces coated with curing compound free of foot and vehicular traffic and other sources of abrasion during the curing period.
 - e. Do not use of any membrane material which will impart a slippery surface to the concrete or alter its natural color.
 - f. If the concrete surfaces, which are to receive curing compound, are expected to be exposed to freezing temperatures within 5 days, do not use the membrane-curing compound.

3.06 FLOOR HARDENER

- A. Treat interior concrete floor areas exposed in the finished work with floor hardener applied in accordance with manufacturer’s instructions. Before treatment application, thoroughly cure and free of oil, grease, or other foreign materials which might interfere with penetration of the hardener into the pores of the cement surface.
- B. Areas to receive carpet, resilient flooring, or other types of finish-floor material will not require a floor-hardening treatment.

3.07 CAST-IN-PLACE CONCRETE TOLERANCES: ACI 117

3.08 FIELD TESTING

- A. Performed by an Independent Testing Agency retained and paid for by Owner:
- B. Test Frequency

| Test | Frequency |
|-------------------------|---|
| Air Content (ASTM C231) | Pre-test first load before unloading and test each time a set of compressive strength test cylinders are cast. In addition at least two air content tests on randomly selected batches for each class of concrete produced during each 8-hour or less period of concrete production each day. |
| Slump (ASTM C143) | Pre-test first load before unloading and test each time a set of compressive strength test cylinders are cast. In addition at least two slump tests on randomly selected batches for each class of concrete produced during each 8-hour or less period of concrete production each day. |
| Temperature | Hourly when air temperature is less than 40°F and greater than 80°F |

| Test | Frequency |
|------------------------------------|---|
| Concrete Test Cylinders (ASTM C31) | Set of four 6-by-12 in. cylinders or set of five 4-by-8 in. cylinders for each class of concrete, for initial 50 cy and then for every subsequent 100 cy each day or one set each day. If total volume of concrete is such that frequency of testing required would provide less than five strength tests for a given class of concrete, test shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used. |
| Compressive Strength (ASTM C39) | 1 test cylinder at 7 days 2 (6"12") or 3 (4"x8") test cylinders at 28 days 1 test cylinder retained for future testing |

- C. Perform additional tests when excessive variation in workability is observed.
- D. Samples will be taken at the point of delivery in accordance with ACI 301. However Contractor is responsible for delivering the concrete to the placement site at the stipulated air content and slump. If Contractor's material or transportation methods cause air content or slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by Owner's On-Site Representative. Air content or slump at the mixer shall be controlled as directed.
- E. Plot results on control charts which at all times are readily available to Owner's On-Site Representative.
- F. Whenever air content or slump does not meet the requirements, immediately adjust the amount of admixtures batched. As soon as is practical after each adjustment, conduct another test to verify the result of the adjustment.

Air Content Testing: Plot test results on control charts which shall at all times be readily available to Owner's On-Site Representative and submitted weekly. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, perform a second test immediately. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment in 2.05.E. Set an upper warning limit and a lower warning limit line 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper

warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points.

- G. Air Content Corrective Action: Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.
- H. Slump Testing: Plot test results on control charts which shall at all times be readily available to Owner's On-Site Representative and submitted weekly. Keep copies of the current control charts in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, immediately perform a second test. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Set limits on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 1/2 inch below the maximum allowable slump specified in paragraph Slump in 2.05.D for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 2 inches.
- I. Slump Corrective Action: Whenever points on the control charts for slump reach the upper warning limit, make an adjustment immediately in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, halt the concreting operation immediately, and take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.
- J. Excessive slump or concrete not meeting specification requirements to be rejected and removed from the site at Contractor's expense.
- K. Laboratory-cured Test Cylinders
 - 1. Cover and keep at air temperature between 60 degrees and 80 degrees F for the first 24 hours. At end of 24 hours, carefully transport cylinders to testing laboratory.

2. Acceptance test results are the strengths of the two specimens tested at 28 days.
- L. Field-cured Test Cylinder (if Contractor or Owner requests)
1. Use for determination of form removal
 2. Check adequacy of curing
 3. Provide additional confirmation of 28-day strength
 4. Place the cylinder as near as possible to the final location of the concrete from which the sample was taken.
 5. Provide the same curing and protection as the adjacent concrete.
- M. In the event that tests indicate that concrete placed does not conform to specifications, take corrective measures to correct the deficiency at no additional cost to Owner.
- 3.09 CLEANUP
- A. After completion of concrete Work, leave the structure and surrounding area clean and neat for commencement of subsequent construction or equipment installation.

END OF SECTION 03 30 00

SECTION 03 60 00

GROUTING

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Cement grout
2. Non-shrink grout
3. Epoxy grout

B. Related Sections

1. Section 03 10 00 Concrete Forms and Accessories
2. Section 03 20 00 Concrete Reinforcement
3. Section 03 30 00 Cast-in-Place Concrete

1.02 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. ASTM C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 inch or 50 mm cube specimens)
2. ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

1.03 SUBMITTALS

A. Manufacturer's literature: non-shrink grout.

1.04 DELIVERY, STORAGE, HANDLING

A. Deliver in original, unopened containers with manufacturer's name, labels, product identification, and batch numbers. Store as recommended by manufacturer.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 MATERIALS

A. Cement Grout:

1. Portland cement, sand, and water sufficient for placement and hydration.
2. Minimum compressive strength (28 days): 5000 psi

B. Non-Shrink Grout: ASTM C1107

1. Premixed, packaged ferrous or non-ferrous aggregate shrink-resistant grout.
2. Non-metallic, nongas forming, and free of corrosive-type material.
3. Minimum compressive strength (28 days), ASTM C109: 7,000 psi
4. Acceptable products:
 - a. Five-Star non-shrink, non-metallic grout
 - b. Masterflow 928 Grout by BASF Construction Chemicals, LLC Building Systems
 - c. Crystex by L&M Construction Chemicals, Inc.
 - d. Approved equal.

C. Epoxy Adhesive

1. To anchor dowels or anchor bolts into existing concrete
2. Acceptable products:
 - a. Epcon Ceramic 6 Epoxy Anchoring System by ITW Ramset/Red Head
 - b. Sikadur 32, Hi-Mod, 2-component, 100 percent solids, moisture insensitive structural epoxy adhesive by Sika
 - c. Concreative 1420 and 1490 epoxy bonding agent by ChemRex, Inc.
 - d. Approved equal.

2.02 EQUIPMENT

- A. Grouting Equipment: Capable of continuous mechanical mixing that will produce grout free of lumps and undispersed cement.
- B. Clean oil, ice, or other deleterious substances from grouting equipment.

PART 3: EXECUTION

3.01 PREPARATION

- A. Remove all debris, standing water, ice, and any loose or deleterious materials from the surfaces where grout is to be applied before grouting.

3.02 INSTALLATION

- A. Do not grout if it is raining or snowing, or if rain or snow appears imminent and the area of application is not adequately protected.
- B. Protect surface near work area due to the mixing, handling, and application of grout material.
- C. Place grout in a neat and orderly fashion in the designated areas.

END OF SECTION 03 60 00

Division 13

Special Construction

SECTION 13 12 20

PRE-ENGINEERED METAL BUILDING SYSTEMS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes a single-story, double-span, rigid-frame-type pre-engineered buildings of the length, width, eave height, and roof pitch indicated on drawings including hollow metal pass-doors and frames with hardware, gutters and downspouts, flashings and all incidental items for a complete usable system as required and as indicated.
 - 1. Roof system consists of the manufacturer's standard standing-seam roof panels using concealed fasteners, insulated as required by Codes.
 - 2. Exterior walls to be field assembled wall panels attached to framing members using exposed fasteners, insulated as required by Codes.
 - 3. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.
- B. Related Sections
 - 1. Section 03 30 00 Cast-in-Place Concrete

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
- B. International Building Code 2018 with Minnesota State Building Code (MSBC) 2020 amendments
- C. American Society of Civil Engineers (ASCE)
 - 1. ASCE 7-16 Minimum Design Loads for Buildings and Other Structures
- D. American Institute of Steel Construction (AISC):
 - a. AISC Specification for Structural Steel Buildings.
 - b. AISC Serviceability Design Considerations for Low-Rise Buildings
- 2. American Iron and Steel Institute (AISI):

- a. AISI North American Specification for the Design of Cold-Formed Steel Structural Members
3. American Welding Society (AWS):
- a. AWS D1.1 / D1.1M – Structural Welding Code – Steel.
 - b. AWS D1.3 / D1.3M – Structural Welding Code – Sheet Steel
4. ASTM International (ASTM):
- a. ASTM A 36 – Standard Specification for Carbon Structural Steel
 - b. ASTM A 123 – Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - c. ASTM A 307 – Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength
 - d. ASTM A 325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - e. ASTM A 500 – Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - f. ASTM A 529 – Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
 - g. ASTM A 572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - h. ASTM A 992 – Standard Specification for Structural Steel Shapes.
 - i. ASTM E 1646 – Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
 - j. ASTM E 1680 – Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems
 - k. ASTM F 1554 – Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
5. LGSI – Light Gauge Steel Institute
6. FM Global:
- a. FMRC Standard 4471 – Approval Standard for Class 1 Roofs for Hail Damage Resistance, Combustibility, and Wind Uplift Resistance.

- b. Data Sheet 1-28, Design Wind Loads, February 2007
- c. Data Sheet 1-29, Roof Deck Securement and Above-Deck Roof Components, February 2007
- d. Data Sheet 1-54, Roof Loads for New Construction, May 2006
- 7. Metal Building Manufacturers Association (MBMA):
 - a. MBMA Metal Building Systems Manual.
- 8. Underwriters Laboratories (UL):
 - a. UL 580 – Standard for Tests for Uplift Resistance of Roof Assemblies.
- 9. American Iron and Steel Institute (AISI)
 - a. AISI SG-671, Specification for the Design of Cold-Formed Steel Structural Members
 - b. AISI SG-911, Load and Resistance Factor Design Specification for Steel Structural Members
- 10. Society for Protective Coatings (SSPC)
 - a. Steel Structures Painting Manual

1.03 SYSTEM PERFORMANCE REQUIREMENTS

A. Definitions

- 1. Bay Spacing: Dimension between main frames measured normal to frame (at centerline of frame) for interior bays, and dimension from centerline of first interior main frame measured perpendicular to end wall
- 2. Building Length: Dimension of the building measured perpendicular to main framing from end wall to end wall
- 3. Building Width: Dimension of the building measured parallel to main framing from sidewall to sidewall
- 4. Clear Span: Distance between supports of beams, girders, or trusses
- 5. Eave Height: Vertical dimension from finished floor to eave
- 6. Clear Height under Structure: Vertical dimension from finished floor to lowest point of any part of primary or secondary structure, not including crane supports, located within clear span.

7. Terminology Standard: Refer to MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.
- B. General: Engineer, design, fabricate and erect the pre-engineered metal building components to withstand loads from winds, gravity, internal pressure, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.
1. Design each member to withstand stresses resulting from combinations of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual."
- C. Design Code: International Building Code (IBC) 2018 with 2020 Minnesota State Building Code Amendments.
1. Occupancy Category: Storage Low Hazard (S-2) per IBC 2018 Section 311.3
 2. Risk Category: III per ASCE 7-16, Table 1-1
- D. Design Loads: Shall be in accordance with the International Building Code, ASCE 7-05, and MBMA's "Metal Building Systems Manual". Basic design loads, as well as collateral loads, are indicated on the drawing S-001.
1. Basic design loads include live load, wind load, and seismic load, in addition to the dead load.
 2. Collateral loads include additional dead loads over and above the weight of the metal building system such as sprinkler systems, piping and utilities supported from the roof structure and roof mounted mechanical systems.
- E. Load Combinations: Design metal building systems to withstand the most critical effects of load factors and load combinations in accordance with the MBMA and ASCE 7-05.
- F. Structural Framing and Roof and Siding Panels: Design primary and secondary structural members and exterior covering materials for applicable loads and combinations of loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practices Manual."
1. Structural Steel: Comply with the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.
 2. Light Gage Steel: Comply with the American Iron and Steel Institute's (AISI) "Specification for the Design of Cold Formed Steel Structural Members" and "Design of Light Gage Steel Diaphragms" for design requirements and allowable stresses.

3. Welded Connections: Comply with the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for welding procedures.
 4. Primary Frame Type: Rigid solid-member structural-framing system without interior columns.
 5. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load and end-wall columns.
 6. Secondary Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- G. General Serviceability Limits: Deflection Limits shall be in accordance with the applicable provisions of the Metal Building Systems Manual (MBMA), latest edition or no greater than the following, whichever is more stringent.
1. Purlins and Rafters: Vertical deflection of 1/240 of the span.
 2. Girts: Horizontal deflection of 1/240 of the span.
 3. Metal Roof Panels: Vertical deflection 1/240 of the span.
 4. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
- H. Air Infiltration for Roof Panels: Provide roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed roof area when tested according to ASTM E 1680 at a static-air-pressure difference of 4 lbf/sq. ft.
- I. Water Penetration for Roof Panels: Provide roof panel assemblies with no water penetration as defined in the test method when tested according to ASTM E 1646 at a minimum differential pressure of 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.
- J. Wind-Uplift Resistance: Provide roof panel assemblies that meet the requirements of ASCE-7-16.
- K. Thermal Performance: Provide metal building roof and wall assemblies with the following maximum U-factors and minimum R-values unless otherwise required for Energy Conservation as outlined in Chapter 4 – International Energy Conservation Code:
1. Metal Roof Panel Assemblies:
 - a. R-Value - 30.0 Minimum
 2. Metal Wall Panel Assemblies:
 - a. R-Value: - 13.0 Minimum

1.04 SUBMITTALS

- A. Product data consisting of metal building system manufacturer's product information for following building components and accessories;
1. Structural-framing system.
 2. Roof and wall panels.
 3. Insulation.
 4. Trim and closures.
 5. Doors.
 6. Windows.
 7. Accessories.
- B. Shop drawings for metal building framing system, roofing and siding panels, and other metal building system components and accessories that are not fully detailed or dimensioned in manufacturer's product data.
1. Structural Framing: Furnish complete erection drawings prepared by or under the supervision of a Minnesota registered professional engineer legally authorized to practice in the jurisdiction where the Project is located. Include details showing fabrication and assembly of the metal building system. Show anchor bolts settings and sidewall, endwall, and roof framing. Include transverse cross-sections.
 2. Design Calculations: Complete design calculations signed and sealed by the Minnesota licensed Structural Engineer supervising their preparation may be requested. Calculations shall include design loads, girt design, lateral bracing design, as well as the connection design for all of these members.
 3. Roofing and Siding Panels: Provide layouts of panels on walls and roofs, details of edge conditions, joints, corners, custom profiles, supports, anchorages, trim, flashings, closures, and special details. Include transverse cross-sections.
 4. Building Accessory Components: Provide details of metal building accessory components to clearly indicate methods of installation including the following:
 - a. Pass Doors, frames, and hardware: Submit manufacturer's product data, roughing-in diagrams and installation instructions and details for doors & frames. Provide operating instructions and maintenance information.
 - b. Sheet Metal Accessories: Provide layouts at 1/4-inch scale. Provide details of flashings, gutters, downspouts, and other sheet metal accessories at not less than 1 1/2-inch scale showing profiles, methods of joining, and anchorages.

- C. Provide standard color sample chips for metal roofing and siding panels for factory-applied finishes. Owner will select colors.
- D. Installer certificates signed by metal building manufacturer written certification certifying that the installer complies with requirements included under the "Quality Assurance" Article.
- E. Professional engineer's certificate prepared and signed by a Minnesota registered Professional Engineer, legally authorized to practice in the jurisdiction where Project is located, verifying that the structural framing and covering panels meet indicated loading requirements and codes of authorities having jurisdiction.
- F. Column design reactions and base plate locations and anchor rod arrangement.
- G. Welding Certificates: Copies of certificates for welding procedures and personnel.
- H. Material Certificates: Steel
- I. Door Schedule: For doors and frames. Use same label designations indicated on Drawings. Include details of reinforcement and attachment.
 - 1. Door Hardware Schedule: Include details of fabrication and assembly of door hardware. Organize schedule into door hardware sets, security items, and electronic hardware indicating complete designations of every item required for each door or opening.
 - 2. Keying Schedule: Detail Owner's final keying instructions for locks, security, and electronic hardware. Include schematic keying diagram and index each key set to unique door designations.

1.05 QUALITY ASSURANCE

- A. Metal Building
 - 1. Installer Qualifications: Engage an experienced Installer to erect the pre-engineered metal building components who has specialized in the erection and installation of types of metal buildings systems similar to that required for this project and who is certified in writing by the metal building system manufacturer as qualified for erection of the manufacturer's products.
 - 2. Manufacturer's Qualifications: Provide pre-engineered metal buildings components manufactured by a firm experienced in manufacturing metal buildings systems that are similar to those indicated for this project and have a record of successful in-service performance.
 - 3. Single-Source Responsibility: Obtain the metal building system components, including structural framing, wall and roof covering, and accessory components, from one source from a single manufacturer.

4. Design Criteria: The drawings indicate framing lines, overall dimensions and eave heights, and minimum door and window openings required of the pre-engineered metal building system. Specific openings for mechanical ventilation and ductwork are indicated on the drawings. Metal building systems having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof for equality is on the proposer.
5. See concrete and masonry sections of these specifications for installation of inserts and anchorage devices.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated components, sheets, panels, and other manufactured items so they will not be damaged or deformed. Package wall and roof panels for protection against transportation damage.
- B. Handling: Exercise care in unloading, storing, and erecting wall and roof covering panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight ventilated covering. Store metal wall and roof panels so that water accumulations will drain freely. Do not store panels in contact with other materials that might cause staining, denting or other surface damage.

1.07 WARRANTY

- A. Roofing and Siding Panel Finish Warranty: Furnish the roofing soffit and siding panel manufacturer's written warranty, covering failure of the factory-applied exterior finish on metal wall and roof panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
- B. Warranty period for factory-applied exterior finishes on wall and roof panels is 20 years after the date of Substantial Completion.

1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit roof and wall panel installation to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify metal building system foundations by field measurements before metal building fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions for Foundations: Where field measurements cannot be made without delaying the Work, establish foundation dimensions and proceed with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to verify that actual anchorage dimensions correspond to established dimensions.
2. Established Dimensions for Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating roof and wall panels without field measurements, or allow for field-trimming panels. Coordinate roof and wall construction to verify that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.09 COORDINATION

- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.
- C. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and non-corrosive installation.

1.10 EXTRA MATERIALS

- A. Maintenance Stock: Furnish at least 5 percent excess over required amount of nuts, bolts, screws, washers, and other required fasteners for each metal building. Pack in cartons labeled to identify the contents and store on the site where directed, turn over a list itemizing Owner's stock and labeled to match the cartons.

1.11 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 MANUFACTURERS

- A. Available Metal Building Manufacturers: Subject to compliance with requirements, provide products of one of the following manufacturers:
 1. Butler Manufacturing Co.
 2. Ceco Buildings Division

3. Nucor Building Systems
4. Kelly Klosure Systems
5. Star Building Systems
6. American Buildings Co.
7. Varco – Pruden
8. Or approved equal.

2.02 METAL BUILDING MATERIALS

- A. Hot-Rolled Structural Steel Shapes: Comply with ASTM A 992.
- B. Steel Tubing or Pipe: Comply with ASTM A 500, Grade B, ASTM A 501, or ASTM A 53.
- C. Steel Members Fabricated from Plate or Bar Stock: Provide 42,000 psi minimum yield strength. Comply with ASTM A 529, ASTM A 570, or ASTM A 572.
- D. Steel Members Fabricated by Cold Forming: Comply with ASTM A 607, Grade 50.
- E. Cold-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 366 or ASTM A 568.
- F. Hot-Rolled Carbon Steel Sheet: Comply with requirements of ASTM A 568 or ASTM A 569.
- G. Structural Quality Zinc-Coated (Galvanized) Steel Sheet: Comply with ASTM A 446 with G90 coating complying with ASTM A 525. Grade to suit manufacturer's standards.
- H. Bolts for Structural Framing: Comply with ASTM A 307 or ASTM A 325 as necessary for design loads and connection details.
- I. Paint and Coating Materials: Comply with performance requirements of the federal specifications indicated. Unless specifically indicated otherwise, compliance with COMPOSITIONAL requirements of federal specifications indicated is not required.
 1. Shop Primer for Ferrous Metal: Fast-curing, lead-free, universal primer, selected by the manufacturer for resistance to normal atmospheric corrosion, compatibility with finish paint systems, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure. Comply with FS TT-P-645 and local VOC limitations.
- J. Fabricate and secure continuous 8 inch structural steel jambs anchored to metal building framework as recommended by door manufacturer and similar to existing building slat door jamb construction. Extend wall angles above door opening head to support coil brackets, unless otherwise indicated. Place anchor bolts on exterior wall guides so they are concealed when door is in closed position. Provide removable stops on guides to prevent over-travel of curtain, and continuous bar for holding windlocks.

- K. Weather Seals: Provide vinyl or neoprene weather stripping for exterior doors, except where otherwise indicated. At door heads, use 1/8" thick continuous sheet secured to inside of curtain coil hood. At door jambs, use 1/8" thick continuous strip secured to exterior side of jamb guide.
- L. Painting: All structural steel door jamb frames to be factory primed with lead free rust inhibitive paint.
- M. Door Frame: Structural steel jamb framework to adequately support door, hood and mechanisms.

2.03 STRUCTURAL FRAMING FOR PRE-ENGINEERED METAL BUILDINGS

- A. Rigid Frames: Fabricate from hot-rolled structural steel shapes. Provide factory-welded, shop-painted, built-up "I-beam"-shape frames consisting of tapered or parallel flange beams and tapered columns. Furnish frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly.
 - 1. Provide length of span and spacing of frames indicated. Slight variations in length of span and frame spacing may be acceptable if necessary to meet manufacturer's standard.
- B. Secondary Framing: Provide the following secondary framing members:
 - 1. Framed Openings: "C" shaped sections fabricated from 14-gage (min.) shop painted roll-formed steel.
 - 2. Wall and Roof Purlins: "C"-or "Z"-shaped sections fabricated from 14 gage (min.) shop-painted roll-formed steel. Purlin spacers shall be fabricated from 14-gage (min.) cold-formed galvanized steel sections.
 - 3. Eave Struts: Unequal flange "C"-shaped sections formed to provide adequate backup for both wall and roof panels. Fabricate from 14-gage (min.) shop-painted roll-formed steel.
 - 4. Flange and Sag Bracing: 1-5/8- by 1-5/8 inch angles fabricated from 16-gage (min.) shop-painted roll-formed steel.
- C. Wind Bracing: Provide adjustable wind bracing using 5/8 inch diameter minimum threaded steel rods (min.) V.O.N.; comply with ASTM A 36 or ASTM A 572, Grade D.
- D. Bolts: Provide shop-painted bolts except when structural framing components are in direct contact with roofing and siding panels. Provide zinc-plated or cadmium-plated bolts when structural framing components are in direct contact with roofing and siding panels.
- E. Shop Painting: Clean surfaces to be primed of loose mill scale, rust, dirt, oil, grease, and other matter precluding paint bond. Follow procedures of SSPC-SP3 for power-tool cleaning, SSPC-SP7 for brush-off blast cleaning, and SSPC-SP1 for solvent cleaning.
 - 1. Prime structural steel primary and secondary framing members with the manufacturer's standard rust-inhibitive primer.

2. Prime galvanized members, after phosphoric acid pretreatment, with manufacturer's standard zinc dust-zinc oxide primer.

2.04 ROOFING AND SIDING PANELS

- A. Face Sheets: Fabricate interior & exterior wall panel face sheets to the profile required from 26-gage (0.0179-inch) minimum, structural quality, Grade C, zinc-coated steel sheets.
- B. Standing Seam Roof Panels: Manufacturer's standard factory-formed standing-seam roof panel system designed for mechanical attachment of panels to roof purlins using a concealed clip. Form panels of 26-gage (0.0179-inch) minimum, Grade C, zinc-coated steel sheets. Provide additional panel reinforcing clamps to meet wind and up-lift loadings as required.
 1. Roof panel to comply with Energy Star label requirements and have an emissivity of at least .9 when tested in accordance with ASTM E408. Provide high albedo roof.
 2. Wall Panels - Basis of Design: MBCI, PBA exposed fastener wall panel.
 3. Clips: Provide 16-gage (0.0598-inch) panel clips.
 4. Cleats: Factory-calked, mechanically seamed cleats formed from 24-gage (0.0239-inch), Grade C, zinc-coated steel sheets.
- C. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets, self-locking bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 1. Provide metal-backed neoprene washers under heads of fasteners bearing on weather side of panels.
 2. Use aluminum or stainless steel fasteners for exterior application and galvanized or cadmium-plated fasteners for interior applications.
 3. Locate and space fastenings in true vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of neoprene washer.
 4. Provide fasteners with heads matching color of roofing or siding sheets by means of plastic caps or factory-applied coating.
- D. Accessories: Provide the following sheet metal accessories factory-formed of the same material in the same finish as roof and wall panels:
 1. Gutters. (22 ga.)
 2. Downspouts. (24 ga.)
 3. Flashings and metal edges. (24 ga.)

4. Closers including formed angle closures to steel frames at coiling doors and pass doors.
 5. Fillers.
 6. Ridge covers.
 7. Miscellaneous accessories as required to complete the work for a watertight installation.
- E. Flexible Closure Strips: Closed-cell, expanded cellular rubber, self-extinguishing flexible closure strips. Cut or premold to match configuration of roofing and siding sheets. Provide closure strips where indicated or necessary to ensure weathertight construction.
- F. Sealing Tape: Pressure-sensitive 100 percent solids grey polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape ½ inch wide and 1/8 inch thick.
- G. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone rubber sealant as recommended by the building manufacturer.
- H. Baked Enamel Finish: Provide the manufacturer's standard shop-applied Kynar 500 paint finish to galvanized steel roof and wall panels, and related trim and accessory elements. For roofing and siding, apply finish coat on interior and exterior facings.
1. Clean galvanized steel with an alkaline compound, then treat with a zinc phosphate conversion coating, and seal with a chromic acid rinse.
 2. Apply baked-on thermo-setting modified acrylic enamel to pretreated steel sheets, in one or more coats as standard with the manufacturer to achieve a minimum dry film thickness of 1.5 mils.
 - a. Color: Coordinate with Owner.

2.05 SHEET METAL ACCESSORIES

- A. General: Provide coated steel sheet metal accessories with coated steel roofing and siding panels.
- B. Gutters: Form in approximately 50 foot long sections, complete with end pieces, outlet tubes, and other special pieces as required. Size as indicated. Join sections with riveted and soldered or sealed joints. Provide expansion-type slip joint at center of runs. Furnish gutter supports spaced 36 inches on center, constructed of same metal as gutters. Finish to match roof and wall panels.
- C. Downspouts: Form in 10-foot-long sections, complete with elbows and offsets. Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 8 feet on center in between. Finish to match wall panels.

2.06 FABRICATION

- A. General: Design prefabricated components and necessary field connections required for erection to permit easy assembly and disassembly.
 - 1. Fabricate components in such a manner that once assembled, they may be disassembled, repackaged, and reassembled with a minimum amount of labor.
 - 2. Clearly and legibly mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
- B. Structural Framing: Shop-fabricate framing components to indicated size and section with base plates, bearing plates, and other plates required for erection, welded in place. Provide holes for anchoring or connections shop-drilled or punched to template dimensions.
 - 1. Shop Connections: Provide power riveted, bolted, or welded shop connections.
 - 2. Field Connections: Provide bolted field connections.

2.07 INSULATION MATERIALS

- A. Fire-Test-Response Characteristics for Insulation: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Combustion Characteristics: ASTM E 136.
- B. Glass-Fiber-Blanket Insulation: Thermal insulation, complying with ASTM C 991, Type I, or NAIMA 202, of 0.5-lb/cu. ft. density, thickness required for specified R-Value, with a flame-spread rating of 25 or less, and 2-inch- wide, continuous, vapor-tight edge tabs.
- C. Vapor-Retarder Facing: Complying with ASTM C 1136, with permeance not greater than the following when tested according to ASTM E 96, Desiccant Method:
 - 1. Composition: Polypropylene-faced, scrim-reinforced kraft paper, with permeance not greater than 0.1 perm.or less in accordance with Chapter 24, 1997 ASHRAE Fundamentals Handbook.
- D. Retainer Strips: 0.019-inch- thick, formed, galvanized steel or PVC retainer clips colored to match insulation facing.

2.08 PENETRATIONS

- A. Overhead Doors: Design, engineer, fabricate, and install aluminum overhead doors to withstand the effect of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation. Unless otherwise indicated, provide insulated slats of aluminum material as recommended by door manufacturer for size and type of door required. Provide factory painted finish of color selected from manufacturers full range of colors. Provide electric actuated roll up doors with push button (up, down, stop) and chainfall gear actuated backup, sizes as shown, to be mounted on the inside of building and ordinary classification.
- B. Windows : Provide windows as indicated on the Contract Drawings. Comply with applicable recommended specifications of Commercial Aluminum (AAMA/NWWDA) Windows except to the extent more stringent requirements are indicated.
1. Performance requirements
 - a. General: provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of minimum test size required by AAMA/NWWDA 101/I.S.2.
 - b. Structural Performance: Provide aluminum windows capable of withstanding the following, including wind loads based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Structural Test, as basic wind speed indicated:
 - 1) Deflection: Based on passing AAMA/NWWDA 101/I.S.2, Uniform Load Deflection Test or on glass framing system designed to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on structural computations.
 - 2) Basic Wind Speed: 105 miles per hour in accordance with FM Data Sheets 1 - 28 and 1 - 29.
 2. Glazing
 - a. Glass: 1" overall thickness, clear, insulating-glass.
 - b. Glazing system: Manufacturer's standard factory-glazing system that produces weathertight seal.
 3. Fabrication
 - a. General: Fabricate aluminum windows, in sizes indicated, that comply with requirements and that meet or exceed AAMA/NWWDA 101/I.S.2 performance requirements for the following window type and performance class. Include a complete system for assembling components and anchoring windows.
 - 1) Windows: (heavy commercial).

- b. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
 - c. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.
 - d. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
 - e. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
 - f. Mullions: Provide mullions and cover plates matching window units, complete with anchors for support to structure and installation of window units. Provide mullions for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
 - g. Glazing Stops: Provide snap-on glazing stops. Provide glazing stops to match sash and ventilator frames.
4. Finishes
- a. Aluminum High-Performance Organic Finish Three-coat thermocured system with fluoropolymer coats containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.
 - b. Color and Gloss. As selected from manufacturer's full range and glass.
- C. Fixed Aluminum Louver : Design, engineer, fabricate, and install fixed exterior metal wall louvers to withstand the effect of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and support; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors.
- D. Louver shall be a storm type with drainable blades that direct water to the jambs. Air performance and water penetration shall be rated to meet the Air Movement and Control Association (AMCA) Standards performance requirements. Water penetration shall not be more than 0.02 oz. per sq. ft. of free area when tested for 15 minutes at an air velocity minimum of 600 feet per minute.
- 1. Obtain louvers from a single source
 - a. Color & Finish: Calico Green by Sherwin Williams, #SW0017. Warranty for finish 20 year min.
- E. Doors: Comply with the Steel Door Institute" Recommended specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.

1. Provide metal doors of Steel Door Institute (SDI) grades and models specified below or as indicated on drawings or schedules:
 - a. Exterior Doors: ANSI/SDI-100, Grade III, heavy-duty, Model 4, minimum 16-gage galvanized steel faces.
2. Door Frames: Provide metal door frames for doors and other openings of types and styles as shown on the drawings and schedules.F.

2.09 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 SOURCE QUALITY CONTROL

- A. Owner shall employ an independent testing agency to perform source quality-control testing and special inspections, and to prepare test reports.
 1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
 2. Allow Owner's testing agency access to places where structural framing is being fabricated or produced. Cooperate with Owner's testing agency and provide samples of materials as may be requested for additional testing and evaluation.
 3. Special inspections will not be required when fabrication is performed by a fabricator registered and approved by authorities having jurisdiction to perform such work without special inspection.
- B. Correct deficiencies in or remove and replace structural framing that inspections and test reports indicate do not comply with requirements.
- C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with requirements.
- D. Shop-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

- E. In addition to visual inspection, shop welding will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option:
 - 1. Liquid-Penetrant Inspection: ASTM E 165.
 - 2. Magnetic-Particle Inspection: ASTM E 709, performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Radiographic Inspection: ASTM E 94 and ASTM E 142, minimum quality level 2-2T.
 - 4. Ultrasonic Inspection: ASTM E 164.
- F. Testing agency will report test results promptly and in writing to Contractor and Owner's On-Site Representative.

PART 3: EXECUTION

3.01 ERECTION

- A. Framing: Erect framing true to line, level, plumb, rigid, and secure. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use a non-shrinking grout to obtain uniform bearing and to maintain a level base line elevation. Moist cure grout for not less than 7 days after placement.
- B. Purlins and Girts: Provide rake and gable purlins with tight-fitting closure channels and fascias. Locate and space wall girts to suit door arrangements and heights. Secure purlins and girts to structural framing and hold rigidly to a straight line by sag rods.
- C. Bracing: Provide diagonal rod or angle bracing in roof and sidewall as indicated.
 - 1. Rod or angle bracing will be required to provide roof diaphragm strength to resist wind forces.
- D. Framed Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to building structural frame.

3.02 ROOFING AND SIDING

- A. General: Arrange and nest sidelap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weather-tight enclosure. Avoid "panel creep" or application not true to line. Protect factory finishes from damage.
 - 1. Field cutting of exterior panels by torch is not permitted.

2. Provide weather-seal under ridge cap. Flash and seal roof panels at eave and rake with rubber, neoprene, or other closures to exclude weather.
- B. Standing-Seam Roof Panel System: Fasten roof panels to purlins with concealed clip in accordance with the manufacturer's instructions.
1. Install clips at each support with self-drilling fasteners.
 2. At end laps of panels, install tape calk between panels.
 3. Install factory-calked cleats at standing-seam joints. Machine-seam cleats to the panels to provide a weather-tight joint.
- C. Wall Sheets: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete slab and elsewhere as necessary for waterproofing. Handle and apply sealant and backup in accordance with the sealant manufacturer's recommendations.
1. Align bottom of wall panels and fasten panels with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws. Fasten door frames with machine screws or bolts. When building height requires two rows of panels at gable ends, align lap of gable panels over wall panels at eave height.
 2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- D. Sheet Metal Accessories: Install gutters, downspouts, flashings, louvers, and other sheet metal accessories in accordance with manufacturer's recommendations for positive anchorage to building and weather-tight mounting.
- E. Thermal Insulation: Install insulation concurrently with installation of roof and wall panels in accordance with manufacturer's directions. Install blankets straight and true in one-piece lengths with both sets of tabs sealed to provide a complete vapor barrier. Locate insulation on underside of roof sheets, extending across the top flange of purlin members and held taut and snug to roofing panels with retainer clips. Install retainer strips at each longitudinal joint, straight and taut, nesting with roof rib to hold insulation in place. Install wall insulation similarly.
- F. Install door steel frames and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions, and as specified herein.
- G. Cleaning and Touch-Up: Immediately after erection, clean field welds, bolted connections, rust spots, abraded surfaces, accessories, bearing plates, and abutting structural steel. Apply primer paint to exposed areas using same material as used for shop painting.

- H. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.03 DOOR INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing doors, hardware, operators, and other door components. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for panels.
- B. Personnel Doors and Frames: Install doors and frames straight, level, and plumb. Securely anchor frames to building structure. Set units with maximum 1/8-inch clearance between door and frame at jambs and head and maximum 3/4-inch clearance between door and floor.

3.04 ACCESSORY INSTALLATION

- A. General: Install gutters, downspouts, ventilators, louvers, and other accessories according to manufacturer's written instructions, with positive anchorage to building and weathertight mounting. Coordinate installation with flashings and other components.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
 - 3. Separations: Separate metal from incompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbow at base of downspout to direct water away from building.
 2. Tie downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and roof panels. Fasten and seal to roof panel as recommended by manufacturer.

3.05 ERECTION AND LOCATION TOLERANCES

- A. Structural-Steel Erection Tolerances: Comply with erection tolerance limits of AISC "Code of Standard Practice for Steel Buildings and Bridges."
- B. Roof Panel Installation Tolerances: Shim and align units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- C. Wall Panel Installation Tolerances: Shim and align units within installed tolerance of 1/4 inch in 20 feet on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner's On-Site Representative will engage a qualified independent testing and inspecting agency to provide special inspections, as required by the Massachusetts State Building Code.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Testing agency will report test results promptly and in writing to Contractor and Owner's On-Site Representative.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.07 ADJUSTING

- A. Doors: After completing installation, lubricate, test, and adjust doors to operate easily, free from warp, twist, or distortion.

3.08 CLEANING AND PROTECTION

- A. Touchup Painting: Immediately after erection, clean, prepare, and prime or reprime welds, bolted connections, and abraded surfaces of prime-painted primary and secondary framing, accessories, and bearing plates.

1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 2. Apply compatible primer of same type as shop primer used on adjacent surfaces.
- B. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- C. Roof and Wall Panels: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.
1. Replace panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- D. Doors: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.
1. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 31 12 02

Division 26

Electrical

SECTION 26 00 00

ELECTRICAL GENERAL PROVISIONS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes general provisions relating to the electrical and related work.

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 SCOPE

- A. Contractor shall also refer to the other divisions of the plans and specifications for information which pertains to the electrical section.
- B. The work included in the project shall include the furnishing of all required labor and materials for a complete and operable electrical system as indicated on the accompanying drawings and as required by the project manual inclusive of all appurtenances not specifically shown or covered by the specifications but required for complete operation of the electrical system as defined in the documents. The work shall also include the testing, adjustment, start up and troubleshooting of the electrical equipment and the training of Owner's operating personnel in its operation and maintenance.
- C. It shall be the responsibility of Contractor to furnish a complete and fully operating system. Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation. Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the contract documents.

1.04 VERIFICATION OF DRAWINGS

- A. The contract drawings indicate the required size of conduit and cable for wiring. The locations of equipment shall be verified in the field by Contractor. In the event it should become necessary to change the location of any work due to interference with other work, consult with Engineer before making any changes. Contractor shall determine and be responsible for the proper location and character of all anchor bolts, inserts, hangers, sleeves, etc. for the electrical equipment, unless specifically detailed otherwise.

1.05 ALTERNATES, SUBSTITUTIONS

- A. See General and Supplemental Conditions and Division 1.

1.06 QUALITY

- A. All work shall be installed by skilled mechanics in a neat and workmanlike manner and shall be approved by Engineer before final acceptance by Owner.
- B. If equipment is furnished having power and control requirements other than as specified, Contractor shall make all necessary changes and furnish a complete set of drawings for installing the alternate equipment. The installation shall comply with the requirements of the latest edition of the National Electrical Code, local and state codes and ordinances. Where the contract documents call for workmanship or materials in excess of code requirements, the project manual shall take precedence. Electrical equipment and materials shall be Underwriter's Laboratory approved, where U.L. standards for such products exist.
- C. All equipment to be installed on the project shall be new and unused. Existing equipment, if applicable, shall be reused only after obtaining written permission from Engineer.

1.07 GUARANTEE

- A. See General and Supplemental Conditions and Division 1.

1.08 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 GENERAL

- A. The following items shall be included in the work to be done:
 - 1. All work shall be under the direct supervision of a master electrician.
 - 2. Furnish permits as required for electrical construction. Pay all electrical inspection charges for the construction.
 - 3. Furnish and install all power and control conduit and cable.
 - 4. Furnish and install the ground system and complete all grounding connections.
 - 5. Furnish and install electrical equipment as specified in accordance with the manufacturer's recommendations, instructions and directions. All equipment shall be properly protected during construction.

6. Complete all connections and test-operate the equipment in cooperation with Owner, Engineer and others working on the project.
7. Provide temporary wiring for construction use including ground fault protection in accordance with the latest edition of the National Electrical Code.

3.02 INSPECTION

- A. Contractor shall inspect all the electrical equipment and shall notify Engineer in writing before the equipment is installed if the equipment appears to be deficient in fit, form or function.

3.03 CONSTRUCTION

- A. Contractor, under this portion of the contract, shall be responsible for all cutting, patching, excavation, backfill, sleeves, chases, openings, etc. for equipment specified in this portion of the contract documents or for cable and conduit and associated electrical equipment that is specified in this portion of the contract documents to serve equipment that is provided by a different portion of these documents. If Contractor provides equipment that has power and control requirements that are different from those specified, then that Contractor shall be responsible for any additional costs incurred for engineering, construction, and all wiring changes required to make the alternate equipment perform per the intent of the contract documents.
- B. All patching, cutting, etc. shall have a finish that is compatible with the final finish of the remainder of the surface and shall meet with the approval of Engineer.

END OF SECTION 26 00 00

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment and labor to construct a complete wiring system including conductors, cable, conduit, boxes, fittings, devices and related equipment.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA 250 - Enclosures for Electrical Equipment
 - b. NEMA WD1 - Wiring Devices
2. National Fire Protection Association (NFPA):
 - a. NFPA 70 - National Electrical Code (NEC), latest edition
3. Underwriter's Laboratories (UL)
 - a. UL5 - Surface Metal Raceways and Fittings
 - b. UL50 - Cabinets and Boxes
 - c. UL83 - Thermoplastic Insulated Wire
 - d. UL360 - Liquid-Tight Flexible Steel Conduit
 - e. UL514 - Outlet Boxes and Fittings

1.03 SUBMITTALS

- A. Conductors (all kinds)
- B. Signal cable
- C. Conduit, boxes and fittings (all kinds)

- D. Devices
- E. Wire identification

1.04 QUALITY ASSURANCE

- A. All material shall meet the requirements of the National Electrical Code (N.E.C.), National Electrical Manufacturers Association (NEMA) specifications and local codes and ordinances, and shall be Underwriter's Laboratories listed, where U.L. standards for such products exist.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 CONDUCTORS COPPER - 600V

- A. Conductors shall be of soft drawn, annealed copper, having a conductivity of not less than 98% of pure copper. Conductors shall be NEMA Class B stranded. The conductors shall conform to ICEA and NEMA standards.
- B. The minimum size for power wiring shall be #12 AWG copper, unless shown otherwise. All conductor sizes are based on copper with THWN insulation rated at not less than 75 deg C and suitable for wet and dry locations unless noted otherwise.
- C. All circuits shall be installed using wire with 600V insulation, unless wire with a different voltage rating is indicated. The insulation, as a minimum, shall have a conductor rating of not less than 75 deg C in both wet and dry locations. All cable shall have the same type of insulation by the same manufacturer throughout the project. Insulation shall meet all applicable NEMA and ICEA standards.
- D. All conductors shall be stranded.

2.02 SIGNAL CABLE

- A. Signal cable shall meet the following requirements: The conductors shall be not less than 16 gauge, 7 strand min., Class B, tin coated concentric bare copper wire with a 15 mil (nominal) 90 deg. C PVC primary insulation. The conductors shall be shielded with .35x5 mil (min.) 100% coverage aluminum or copper mylar tape shield, or equal, and an 18 gauge strand copper wire drain wire. The outer jacket shall be 20 mils (nominal) 75 deg. C PVC suitable for wet or dry locations.

2.03 WIRE IDENTIFICATION

- A. Each power, control and signal conductor shall be identified by plastic tags permanently attached to the cable. The tags shall be attached to each cable at each termination and wherever the cable is accessible in junction or pull boxes. Tags shall be marked with printing showing:
 - 1. The circuit number from the cable and conduit schedules and:
 - 2. The terminal number as assigned by the equipment manufacturer.
- B. The cable marking system shall use transparent tape with a white area where the numbering shall be typed using a typewriter, as manufactured by:
 - 1. Raychem
 - 2. Thomas & Betts
 - 3. Brady

2.04 CONDUITS, FITTINGS, BOXES AND DEVICES

- A. Contractor shall supply conduit, couplings, connectors, junction boxes, fittings and all other required items for a complete raceway system. The conduit fills indicated in the contract documents are based on copper conductors with THWN insulation suitable for 75 deg C insulation in both wet and dry locations. Contractor shall resize conduits for other conductor and/or insulation systems, if approved. The conduit shall be reamed and cleaned and made free of burrs. Exposed conduit runs shall be straight and true with the building lines and elbows, bends and offsets shall be uniform and symmetrical. All conduit runs shall be installed with adequate means for drainage provided at the low points.
- B. Rigid Steel Conduit:
 - 1. All conduit shall be galvanized rigid steel unless specifically noted otherwise.
 - 2. The conduit used shall be hot dipped galvanized, including the threads. Unless specified otherwise the conduit shall not be smaller than 3/4". The conduit shall bear the U.L. label.
 - 3. Job site threading need not be galvanized. However, job site threading shall be painted with oil base primer to prevent oxidation of the threads.
 - 4. The use of threadless connectors with rigid steel conduits is not acceptable.
 - 5. Intermediate metal conduit shall not be acceptable.
 - 6. All supporting hardware, clamps, anchors, etc. shall be Type 316 stainless steel.
- C. PVC Conduit:

1. Unless otherwise indicated on the Drawings, Contractor shall furnish and install Schedule 80 PVC conduit underground or embedded in concrete. The conduit shall be supported as recommended by the manufacturer or as required by applicable codes and ordinances, whichever is the more stringent. The conduit shall be composed of high impact PVC and shall be rated for 90 deg C wire. The conduit shall be listed for underground, encased, and exposed applications. The PVC conduit system shall contain fittings for connecting the system to junction boxes and other devices as required.
2. Wherever a PVC conduit system is used Contractor shall furnish and install copper ground conductors. The conductors shall be continuous with no splices or joints unless permitted by the National Electrical Code. The size of the ground conductor shall be as required by the National Electrical Code or as shown on the drawings, whichever is more stringent.
3. The duct shall bear the U.L. label.
4. The conduit shall not be smaller than 3/4".
5. Underground conduit banks shall use Schedule 80 PVC for certain power and control circuits. See Part 3.
6. PVC conduit is permitted only where specifically shown. All other areas must be wired utilizing rigid steel or as required by the contract documents.
7. All supporting hardware, clamps, anchors, etc., shall be PVC or Type 316 stainless steel.

D. Continuous Polyethylene (PE) Duct:

1. Continuous high-density polyethylene (HDPE) duct may be used in place of Schedule 80 PVC underground duct where conduits are to be installed using directional boring method. See Part 3 of this Section.
2. PE duct shall have Schedule 80 (nominal) wall thickness, and shall bear U.L. label for use as underground electrical duct.

E. Electrical Metallic Tubing:

1. Electrical Metallic Tubing (EMT) shall be galvanized and bear the UL label. EMT shall be used only indoors in the electrical building and the storage building, no exceptions.

F. Flexible Sections:

1. Unless equipment is factory wired, the conduit system shall be joined to the equipment with waterproof flexible metallic conduit. The conduit shall be cold rolled steel, galvanized strip shall meet the requirements of a one minute Preece dip test. The galvanized flexible conduit shall be covered with 40 mils \pm 5 PVC coating. The tensile strength of the PVC shall exceed 1600 psi. The flexible conduit shall be connected to the equipment and conduit system with waterproof, oil proof and dustproof connectors which are designed for use with the flexible conduit installed. All flexible conduit and fittings shall be U.L.

approved. The minimum and maximum lengths of flexible connectors shall be sixteen (16) and thirty (30) inches respectively. The flexible conduit shall not be used for grounding equipment. A separate conductor in accordance with N.E.C. Section 250 shall be installed inside the flexible section.

G. Boxes Cast:

1. Outlet and junction boxes shall be of the weatherproof, galvanized cast, ferrous alloy type with threaded hubs for use with rigid steel conduit. The boxes shall bear the U.L. label.
2. In areas where aluminum rigid metal conduit is used, the boxes shall be copper-free aluminum.
3. Manufacturer/Style:
 - a. Crouse-Hinds Type FS
 - b. Appleton Type FS
 - c. Or equal.

H. Wiring Devices Specification Grade:

1. Wiring devices shall be AC quiet, NEMA specification grade, heavy duty unless otherwise specified. All devices shall meet Federal Specification W G 596E and W S 896E NEMA standard WD 1 4, and shall be listed by the Underwriter's Laboratories. The voltage rating shall be as required for the application. The devices shall have an ampacity of not less than 20 amps.
2. Toggle switches shall be 2-pole, to enable interlocking of mechanical equipment as indicated on Drawings.
3. Wall plates shall be Type 316 stainless steel. All switches, other than lighting switches, shall have an engraved label identifying the function of the switch and switch positions.
4. Where applicable, devices located in hazardous areas or areas where adverse conditions exist, shall meet NEMA and National Electrical Code requirements for those areas.

I. Switch Labels

1. All switches, other than lighting switches, shall have an engraved label identifying the function of the switch and switch positions. Labels shall be Type 316 stainless steel, or engraved laminated plastic, attached with screws.

PART 3: EXECUTION

3.01 UNDERGROUND WORK

- A. Contractor shall be responsible for all excavating, concrete work where applicable, and backfilling. The underground conduit shall be at least 30 inches below the finished grade.
- B. Backfill shall be earth or sand tamped into place. The trench shall be filled to the top and the surface restored to a finished condition. All excess earth shall be removed.

3.02 UNDERGROUND CONDUIT BANK

- A. Where shown, Contractor shall furnish and install underground conduit bank. The top of the finished conduit bank shall not be less than thirty (30) inches below the finished grade. The trench shall be dug to the required depth without pockets or dips. All stones shall be removed from the bottom of the trench. Trenching and conduit bank foundation shall be compacted sand per Divisions 31 thru 33 requirements.
- B. The following conduit types shall be used in conduit banks:
 - 1. Galvanized Rigid Steel:
 - a. Shielded signal circuits
 - b. Motor feeders powered by variable frequency drives (VFDs)
 - c. Telephone/LAN circuits
 - 2. Schedule 80 PVC Conduit:
 - a. All other power and control circuits
- C. Furnish and install vinyl cable warning tapes to identify the outer edges of conduit banks as detailed on Drawings. Tape shall be red or yellow, with the words "Caution – Buried Electric Lines Below" or similar language. Tape shall be six inches (6") wide.

3.03 INSTALLATION

- A. Contractor shall furnish, install, wire and start up equipment as required by the contract documents. The manufacturer's installation recommendations shall be observed and the completed assembly shall meet applicable code requirements.

3.04 HAZARDOUS AREAS

- A. Where applicable, devices and conduit installation in hazardous areas or areas where adverse conditions exist, shall meet NEMA and NFPA (including NEC) requirements for those areas. This includes, but is not limited to, the use of seal-off fittings to isolate hazardous areas as required.

3.05 CONDUCTOR INSTALLATION

- A. Conductors shall be installed using industry accepted techniques as defined by Underwriter's Laboratories, National Electrical Code, NEMA, ICEA, and other applicable standards. Contractor shall use approved pulling compound where applicable.
- B. No splices shall be made in power wiring except in junction boxes. Conductors shall be continuous from outlet to outlet.
- C. No splices shall be made in signal or control conductors. The wiring shall be continuous from device to device.
- D. All wire and cable shall be tested for grounds and continuity before the circuit is energized. Contractor shall assume full responsibility for damage done to the equipment due to circuit grounds or open circuits.

3.06 MOTOR CONNECTIONS

- A. Where the wiring system connects to the motor leads in motor junction boxes, the connections shall be insulated with Raychem Type MCK, or equal, motor connection insulation kits.

3.07 CABLE SPLICES

- A. Power cables or control circuit cables that are spliced in locations that are subject to damp or wet locations shall be spliced using 3M cast splice kits, or equal.

END OF SECTION 26 05 00

SECTION 26 20 00

LOW VOLTAGE ELECTRICAL TRANSMISSION

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor for construction of switchgear, panelboards and transformers.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

- B. National Electrical Manufacturer's Association (NEMA)

1. NEMA 250 - Enclosures for Electrical Equipment
2. NEMA PB 1 - Panelboards
3. NEMA ST-20 - Dry-Type Transformers for General Applications

- C. National Fire Protection Associates (NFPA)

1. NFPA 70 - National Electrical Code (NEC), latest edition

- D. Underwriter's Laboratories (UL)

1. UL 67 - Panelboards
2. UL 50 - Cabinets and Boxes
3. UL 1561 - Dry-Type General Purpose and Power Transformers

1.03 MAIN SERVICE

- A. Contractor shall coordinate the installation of the new main service. The system voltage and ampacity shall be as shown. It shall be the responsibility of Contractor to contact the utility serving the project sites and coordinate the details of the service entrances.

- B. Responsibilities of the Utility and Contractor are as follows:

1. Utility will:

- a. Furnish current transformers for revenue metering.
- b. Furnish and install primary conductors and primary terminations.
- 2. Contractor shall:
 - a. Furnish and install conduit, enclosures and provisions for utility metering equipment.
 - b. Construct service, transformer pad and related conduits as indicated on Drawings. Service shall be constructed in accordance with Utility Company requirements and as indicated on Drawings.
 - c. Furnish and install secondary conduits and cables.
- C. The local electrical utility is:

Xcel Energy

1.04 SUBMITTALS

- A. Shop drawings and technical data including:
 - 1. Panelboards (include schedule of circuit breakers).
 - 2. Transformers.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 PANELBOARDS

- A. Unless shown otherwise, the bussing shall be suitable for 200 amps, minimum. The number of circuits shall be not less than indicated on the schedules shown on the drawings. Unless shown otherwise, panelboards shall be NEMA 1. All panelboards on the project shall be by the same manufacturer, shall bear the U.L. label and listed as "suitable for use as service equipment" where applicable.
- B. Cabinet rough in boxes shall be code gauge steel, zinc galvanized, on both inside and outside surfaces, with an in-turned flange on all sides of the front. The front covers shall be sheet steel, with a rust inhibitor primer and a baked enamel finish for surface mounted panels. The front covers shall be fitted with a door with a continuous butt type hinge concealed and welded to

the back of the door. The other three sides shall have door stops. Doors over 48 inches high shall have auxiliary fasteners at the top and bottom. The doors shall have locks with two keys per lock. When the front cover and door assembly is removed, access to the wiring gutters shall be provided. The sub plate shall be fastened to the panel board with screws. The entire panelboard shall be of dead front construction. The trim shall be adjustable.

- C. Where no main overcurrent protective device is scheduled, Contractor shall provide panelboards with main lugs only. Panelboard bussing shall be braced at equal to the interrupting rating of the largest branch overcurrent device in panelboards with main lugs only. The panelboard neutral shall have solderless connectors numbered not less than the number of branch circuits and available spaces in the panelboard. All spaces shall be connected to alternate phases.
- D. Unless otherwise shown, main and branch circuit breakers rated at 208 or 240 volts shall have an interrupting rating of not less than 14,000 amps, r.m.s., sym. Unless otherwise shown, main and branch circuit breakers rated at 480 volts shall have an interrupting rating of not less than 30,000 amps, r.m.s., sym. Where panelboards and breakers are UL labeled for the application, series rated main and branch breakers may be used. Circuit breakers shall indicate open, closed, or trip conditions by handle position. Circuit breakers shall be quick make, quick break with thermal magnetic trips having long time and instantaneous tripping characteristics. Multi pole breakers shall have one handle with internal trip bar with the circuit breaker cases fastened together. Panelboards with breakers with an interrupting rating of 14,000 amps or less, may be plug in. Other panelboards are to be of bolt on circuit breaker construction.
- E. Where required the panelboards shall contain ground fault interrupting circuit breakers. The breakers shall have an interrupting rating of not less than 10,000 amps, r.m.s., sym. The breakers shall have a sensing circuit capable of tripping the breaker in not more than 30 milliseconds at a current imbalance of 5 mA. The breaker shall contain a sensing circuit test feature.
- F. Install closure plates in each space not occupied by a breaker where the knockout has been removed. Accurately list the circuit numbers on the panelboard schedule utilizing a typewriter.

2.02 SURGE PROTECTIVE DEVICE (SPD)

- A. Provide SPD which meets UL 1449, latest edition, utilizing thermally protected metal oxide varistor (MOV) as the core technology. SPD shall provide protection between each of 5 modes (4-wire plus ground) with minimum surge current capacity of 160 kA. Dual color LED indicating lights shall be utilized to indicate protection status.

2.03 DISTRIBUTION TRANSFORMERS

- A. Transformers shall be dry type suitable for indoor or outdoor service as shown on the drawings. Transformers shall have a basic impulse level of not less than 10 kV. Transformers shall have not less than one 2.5% full capacity above normal primary voltage and two 2.5% full capacity below normal primary voltage taps. Sound level may not exceed 45 dB determined in accordance with procedures outlined with NEMA and ANSI standards. The transformers shall have a kVA rating as shown on the drawings. The transformers shall have insulation suitable for NEMA Class H, 150

deg C. The transformer, at full load, shall have a temperature rise not exceeding 115 deg C over a 40 deg C ambient. The transformers shall be U.L labeled for 115 deg C operation.

- B. Transformers shall be constructed in accordance with NEMA and ANSI standards. The transformers shall be finished with one coat of rust inhibiting primer and two finish coats of paint.
- C. Transformers shall comply with U.S. Department of Energy latest efficiency requirements.

2.04 UTILITY METER SOCKET

- A. Provide utility meter socket as approved by the serving utility.

2.05 SAFETY SWITCHES

- A. Safety switches shall be heavy-duty, load break, fusible if so indicated, NEMA 3R for outdoor locations, conforming to UL 98 and NEMA KS1. Fuses shall be UL "Class R" fuses, sized as indicated on the Drawings.
- B. Square D Class 3110 or approved equal.

2.06 GROUNDING MATERIALS

- A. The entire installation shall be grounded in accordance with the National Electrical Code and as otherwise detailed.

PART 3: EXECUTION

3.01 PANELBOARDS

- A. Panelboards shall be mounted with the top of the panelboard at 72 inches above finish floor.

END OF SECTION 26 20 00

SECTION 26 24 19

STATERS AND MOTOR CONTROL

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Motor Starters
 - 2. Field-mounted control devices
 - 3. Disconnect switches

1.02 SCOPE

- A. Contractor shall be responsible for the furnishing and installation of the starters, control switches, limit switches, etc. as required and as indicated on the Drawings. All internal buswork and wiring shall be completed by the manufacturer and where connections must be completed between equipment sections in the field, the wiring or buswork, shall be terminated in each section of equipment in a manner to facilitate field connections. Contractor shall furnish, properly sized and coordinated, connectors for the conductors entering the equipment. All equipment shall meet the requirements of NEMA standards and the latest edition of the National Electrical Code, where applicable.

1.03 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE 519 - IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems, latest edition
 - 2. National Electrical Manufacturer's Association (NEMA)
 - a. NEMA ICS 1 - General Standards for Industrial Control and Systems
 - b. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
 - c. NEMA 250 - Enclosures for Electrical Equipment
 - d. NEMA CP-1 - Capacitors

3. National Fire Protection Association (NFPA)
 - a. NFPA 70 - National Electrical Code (NEC), latest edition
4. Underwriter's Laboratories (UL)
 - a. UL 845 - Electric Motor Control Centers

1.04 SUBMITTALS

- A. Shop drawings and associated operation and maintenance instructions including:
 1. Combination motor starters and all internal and external components including circuit breakers, starters, overloads, control devices, relays, timers and components indicated on the Drawings. Include system schematic drawings, component schematic drawings, dimension drawings, layout drawing and nameplate schedule.
 2. Reference plan sheets for available space for equipment; LIMITED SPACE IS AVAILABLE. Contractor shall be responsible for submitting equipment which fits within the available space.
 3. Field-mounted control devices.
 4. Disconnect switches.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 CONTROL DEVICES

- A. Where required Contractor shall supply all control devices including, but not limited to, selector switches, push button switches, limit switches, and indicating lights. All control devices shall be of the heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. Each control device shall be supplied complete with escutcheon and nameplate. Each control device shall have its function permanently marked on the escutcheon. Raised letters on plastic adhesive tape is not acceptable.
- B. Device enclosures shall be NEMA 4X, minimum. Where explosion-proof zones are indicated on the Drawings, the device enclosures shall comply with the applicable zone.

- C. Furnish and install engraved plastic type label designating equipment served. Embossed raised letter type labels shall not be acceptable. Letters shall be 1" high and white in color on a black background.

2.02 STARTER UNITS

A. General

1. Starter units shall be of the combination type and shall have short circuit protection for not less than 42,000 amperes r.m.s. symmetrical, provided by motor circuit protectors (MCP) unless otherwise required. Each starter shall have a disconnecting device for all powered conductors entering the starter cubicle. In addition, each disconnecting means shall contain provisions so the disconnecting means can be locked in the off position.
2. Starting Contactors
 - a. Starting contactors shall be of the magnetically operated type with three solid-state overload relays for each three pole contactor. Each contactor shall be provided with an external manually operated reset pushbutton for the overload relays mounted in the compartment door. Fused individual control transformers with not less than 50% excess capacity for the control circuit shown shall be furnished for each starter. Starting contactors shall be ambient compensated.
 - b. Solid-state overload relays shall have the following features:
 - 1) Self-powered design.
 - 2) Adjustable current trip range.
 - 3) Internal phase loss protection.
 - 4) Physically-interchangeable with bimetallic overload relays.
 - 5) Selectable trip Class (NEMA Class 10, 20 or 30).
 - 6) Selectable manual or automatic trip.
 - 7) Provide mechanical "reset" mechanism thru front door.
 - c. Contactor contacts and overload heater thermal elements shall be field replaceable on all starters, size 1 thru size 6.
3. Short Circuit Protection
 - a. Short circuit protection shall be provided for each combination starter unit. Protection shall be provided by motor circuit protectors (MCP) unless shown otherwise. Unless otherwise required, the short circuit protective devices shall have not less than 42,000 amperes r.m.s. symmetrical of short circuit interrupting

capacity. The devices shall be capable of interrupting any asymmetrical fault associated with the symmetrical rating.

B. Control Relays

1. Control Relays shall be quiet in operation and shall not have less than four contacts. Relays shall be enclosed in NEMA 1 enclosures and shall be mounted such that they may be removed and installed from the front. Installations where the bus bar compartment must be opened to remove nuts, etc., from mounting screws is not acceptable. Relay operating coils, contacts, etc., shall be designed for continuous operation in atmospheres up to 65 deg. C. Control relay compartments shall be convection cooled. Forced air cooling is not acceptable.
2. General control relays shall be plug in type with sockets. The relays shall have dust covers, suitable for continuous operation, and shall be rated for not less than 10 amps at 120 VAC, 1.0 PF. The contacts shall be 3/16" diameter silver cadmium oxide, gold flashed, min.

C. Elapsed time meters shall have a minimum of 5 digits and shall read in hours and tenths of hours. Meters shall be nominal 3" diameter with 1/8" high numerals.

D. Nameplates shall be supplied to identify each starter and shall be of the laminated black and white composition type with black face and with engraving extending into the white to give white letters on a black background. Nameplates shall be 3 inches long by 1 inch high with 1/8 inch high lettering. Nameplate for switches, relays and other accessories shall have 1/8 inch high lettering and shall be sized as required. Nameplates shall be fastened with screws, adhesives only are not acceptable.

E. All control devices including, but not limited to, selector switches, pushbutton switches, limit switches and indicating lights shall be of the heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. All time clocks, timers, switches, relays, etc., shall be permanently labeled.

F. Control wiring shall be copper, 90°C minimum and shall not be smaller than #14 AWG. All wiring for external connection shall be terminated on fabricated terminal blocks with lettering strips. All termination strips shall correspond with points called out on shop drawings and field connection diagrams.

2.03 MOTOR DISCONNECT

A. Disconnect switches shall be fused or non-fused as required and shall be of the "heavy duty" type. Voltage, horsepower, ampacity and NEMA enclosure rating shall be as indicated.

B. For single phase motors, provide horsepower rated toggle switches, number of poles as required. Include thermal overload relay unit where the motor does not include its own overload protection; Square D Class 2510 or equal.

- C. Furnish and install engraved plastic type label designating equipment served. Embossed raised letter type labels shall not be acceptable. Letters shall be 1/2" high and white in color on a black background.

PART 3: EXECUTION

3.01 SUPPLIES

- A. At Final Completion, Contractor shall furnish the following expendable items:
 - 1. Twenty (20) percent spare fuses and lamps of each type furnished under this Section, but not less than six (6) of each type.

3.02 STARTUP AND TRAINING SERVICES

- A. Provide factory-authorized startup engineering or technician who shall place the equipment in service, enter setpoints and parameters, verify proper operation of features and functions, provide a written startup report, and provide training to Owner's personnel on operation and maintenance of the equipment.
- B. This requirement shall apply to the equipment listed below, and shall include the minimum training hours as listed:
 - 1. Combination starters, including four (4) hours operator training.

END OF SECTION 26 24 19

SECTION 26 50 00

LIGHTING

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes lighting fixtures, lamps and appurtenances.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. Illuminating Engineering Society (IES)
 - a. LM-80 - IES Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules
2. National Fire Protection Association (NFPA)
 - a. NFPA 70 - National Electrical Code (NEC), latest edition
3. Underwriter's Laboratories (UL)
 - a. UL 57 - Electric Lighting Fixtures
 - b. UL 844 - Electrical Lighting Fixtures for Use in Hazardous Locations

1.03 SUBMITTALS

- A. Shop drawings and technical data including:
 1. Fixture specification sheets
 2. Footcandle distribution curves

1.04 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 FIXTURES

- A. All fixtures shall bear the seal of the Underwriter's Laboratories (U.L.). The seal shall be for the type of area the fixture is to be located in.
- B. On all fluorescent, H.I.D., or other fixtures that utilize ballasts, or drivers in the case of solid-state (LED), the entire assembly shall have a power factor of not less than 0.90 at its designated voltage. All ballasts shall be of the type where the starting current does not exceed the operating current. Ballasts/drivers on fixtures that are located outside the building envelope shall be suitable for starting and operating at -20 deg. F. All fluorescent light fixtures shall have "energy saving" ballasts per applicable Code.
- C. All fixtures shall be complete with lamps, starters, diffusers, guards, clips, retainers, etc. in accordance with the drawings, specifications and ordinances governing the installation of the fixtures.
- D. LED fixtures shall have light source mounted to circuit board and designed in such a way to maximize heat transfer away from all LEDs. LED lifetime rating shall be determined in accordance with IES LM-80, and shall have a minimum of 60,000 hour rated life at 70% lumen maintenance.
- E. LED drivers shall include components protecting against overload, short circuit, and voltage surges. They shall have universal 120V through 277V AC input range, with plus or minus 10% above or below the stated voltage range without damage to the driver.
- F. Contractor shall furnish and install fixtures as specified on the drawings.

PART 3: EXECUTION

3.01 GENERAL

- A. Contractor shall verify, prior to ordering the fixtures, that the fixture bears the U.L. label and meets the requirements for the location where the fixtures are to be installed.
- B. Contractor shall install fixtures in accordance with the manufacturer's recommendations and shall be mounted carefully and rigidly. The mounting of the fixtures shall be uniform in height and shall present a neat and aligned appearance.
- C. Contractor shall examine the contract documents for the ceiling system into which the fixtures will be installed. If additional supporting material, wire, channels, or bars are required for the installation, other than the equipment supplied with the ceiling system, Contractor, under this Division, shall furnish and install such devices at no change in the contract price.

- D. The fixtures shall be connected into the power distribution system per the requirements of the National Electrical Code, the manufacturer's requirements, or the contract documents, whichever is more stringent.

END OF SECTION 26 50 00

Division 31

Earthwork

SECTION 31 01 00

SITE PREPARATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to prepare the Site for construction, including, but not limited to:
 - 1. Removal of all trash, debris, rocks, and foreign materials necessary to access the work area and perform the work.
 - 2. Removal, salvage and replacement of any traffic signs within the Work areas.
 - 3. Relocation or protection of all existing utilities and coordination with utility companies relocating any electrical, gas or communications lines.
 - 4. Coordination with utilities companies for all removals, relocations, or replacements of existing utilities.
 - 5. Coordination with other contractors working within or near project areas.
- B. RELATED SECTIONS
 - 1. Section 31 10 00 Clearing and Grubbing

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 SEQUENCING AND SCHEDULING

- A. Protect trees along the site perimeter within the work area as long as practicable to provide a visual barrier for the site. Coordinate tree removal sequencing with Owner and Engineer.
- B. No trees shall be removed without approval of Owner and Engineer.

1.04 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 GENERAL

- A. Take necessary measures to prepare the Site access and Site conditions necessary to perform the Work, all in accordance with the Drawings and these Specifications.
- B. Take necessary measures to secure the Project Site from public access to protect Contractor's materials and equipment, and Project Work areas.
- C. Take necessary measures to protect Work areas from public access that may pose danger or hazard to the public.

3.02 UTILITY LOCATIONS

- A. Locate all utilities and resolve any utility conflicts with utility company prior to any excavation work. Coordination between Contractor and utility companies shall be incidental to the Work.

3.03 CLEARING AND GRUBBING

- A. See Section 31 10 00, Clearing and Grubbing for clearing and grubbing requirements.

END OF SECTION 31 01 00

SECTION 31 05 19.13

GEOTEXTILES FOR EARTHWORK

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to furnish and install geotextiles including, but not limited to:
1. Drainage Collection Geotextile
 2. Leachate Collection Geotextile
 3. Protective Geotextile
 4. Riprap Underlayment
 5. Road Surfacing and Pavement Underlayment

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
1. American Society for Testing Materials (ASTM)
 - a. ASTM D1777: Standard Test Method for Thickness of Textile Materials
 - b. ASTM D3776: Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
 - c. ASTM D4355: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
 - d. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile
 - e. ASTM D4833: Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
 2. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Submit for record manufacturer's quality control certificates indicating conformance test results of furnished material to the Specifications.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Roll Identification:

- 1. Provide geotextile in rolls protected by impermeable and opaque covers and tagged with the following information:
 - a. Manufacturer's name, address, and telephone number.
 - b. Product identification.
 - c. Lot number.
 - d. Roll number.
 - e. Roll dimensions.
- 2. Provide instructions on special handling during hauling and storage.
- 3. Handle and protect product to ensure product is not damaged.

- B. Material will not be accepted on-site without Quality Control Certificates.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Furnish materials whose minimum roll values meet or exceed those specified.
- B. Unless specifically authorized, do not furnish special run or value added products.
- C. Material shall retain a minimum 70 percent strength after 500 hours direct exposure to sunlight (Ultra Violet Resistance ASTM D4355).

2.02 DRAINAGE COLLECTION GEOTEXTILE

- A. Minimum general:
 - 1. Non-woven.
 - 2. Polypropylene.
- B. Minimum dimensional:
 - 1. Roll dimensions: 15 foot roll width, 300 foot roll length.
 - 2. Thickness: 110 mils (ASTM D1777, 2kPa loading).
 - 3. Mass/unit area: 10 ounces per square yard (ASTM D3776).
- C. Minimum permeability/filtration:
 - 1. Apparent opening size: 50-100 U.S. Standard Sieve (ASTM D4751).
 - 2. Permeability: 1×10^2 centimeters per second.
- D. Minimum mechanical:
 - 1. Puncture strength: 125 pounds (ASTM D4833).

2.03 LEACHATE COLLECTION GEOTEXTILE

- A. Equivalent to Drainage Collection Geotextile.

2.04 PROTECTIVE GEOTEXTILE

- A. Equivalent to Drainage Collection Geotextile.

2.05 RIPRAP UNDERLAYMENT

- A. Riprap underlayment to meet the requirements of Mn/DOT Standard Specification 3733 Type 4 geotextile fabric.

2.06 ROAD SURFACING AND PAVEMENT UNDERLAYMENT

- A. Road surfacing and pavement underlayment to meet the requirements of Mn/DOT Standard Specification 3733 Type 5 geotextile fabric.

PART 3: EXECUTION

3.01 EXAMINATION

- A. Examine and verify acceptability of surface to receive installation of geotextile.

3.02 INSTALLATION

A. General

1. Roll out in a manner to keep material in constant tension.
2. Weight material with sandbags or approved equivalent during installation to prevent movement and wind disruption. Keep weight in place until cover material is applied.
3. Prevent damage to underlying material during installation.
4. During installation, do not entrap stones, soil, dust, or moisture which would damage underlying material, hamper seaming, or impede performance of the product.
5. Do not expose material to precipitation prior to installation.
6. Do not expose material to direct sunlight for more than 300 hours prior to installation.

B. Seams

1. Slopes steeper than 10 horizontal to 1 vertical:
 - a. Seam by sewing, fusion, or other approved methods.
 - b. Seam shall be continuous.
 - c. Seam vertical on slope, not across slope.
 - d. Thread shall be polymeric with properties equal to or exceeding the geotextile.
 - e. Sew seams using J-type or double-fold type double-lock stitch, seam stitches $\frac{1}{2}$ to $\frac{3}{4}$ -inch apart and no closer than one inch from edges.
2. Slopes flatter than 10 horizontal to 1 vertical:
 - a. Overlap shall be a minimum of 18 inches.
 - b. Spot seam may be used to prevent wind uplift in-place of sandbags where appropriate.
 - c. Orient overlap in direction of filling (cover material).

- C. Install geotextile around protruding appurtenances as shown on the Drawings (if applicable).

3.03 REPAIR

- A. Remove debris, soil, or other material which may have penetrated the geotextile.
- B. Slope Areas
 - 1. Sew seams using J-type or double-fold type double-lock stitch, seam stitches $\frac{1}{2}$ to $\frac{3}{4}$ -inch apart and no closer than one inch from edges.
 - 2. For tears exceeding 10 percent of roll width, remove roll from slope and replace.
- C. Non Slope Areas
 - 1. Spot seam fabric patch in place with a minimum 24-inch overlap in each direction.

END OF SECTION 31 05 19.13

SECTION 31 05 19.16

GEOMEMBRANES FOR EARTHWORK

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Furnishing and Installing 60-mil High Density Polyethylene (HDPE) geomembrane.
2. Furnishing and Installing 40-mil Linear Low Density Polyethylene (LLDPE) geomembrane.

B. This Section covers the technical requirements for the manufacturing and installation of all geomembrane liners used on the project. All materials must meet or exceed the requirements of this specification, and all work must be performed in accordance with the procedures provided in these Specifications.

1.02 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. American Society for Testing and Materials (ASTM)
 - a. D792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - b. D1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
 - c. D1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
 - d. D1505 Test Method for Density of Plastics by the Density-Gradient Technique
 - e. D1603 Test Method for Carbon Black in Olefin Plastics
 - f. D3895 Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
 - g. D4218 Standard Test Method for Determination of Carbon Black in Polyethylene Compounds
 - h. D4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

- i. D5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
 - j. D5323 Standard Practice for Determination of 2% Secant Modulus for Polyethylene Geomembranes
 - k. D5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
 - l. D5617 Standard Test Method for Multi-Axial Tension Test for Geosynthetics
 - m. D5641 Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
 - n. D5721 Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
 - o. D5820 Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
 - p. D5885 Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
 - q. D5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes
 - r. D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
 - s. D6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
 - t. D7238 Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus
 - u. D7466 Test Method for Measuring the Asperity Height of Textured Geomembranes
2. Geosynthetic Research Institute (GRI)
- a. GRI GM10 Standard Guide for The Stress Crack Resistance of HDPE Geomembrane Sheet
 - b. GRI GM 13 Test Methods, Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.
 - c. GRI GM17 Test Properties, Testing Frequency and Recommended Warranty for LLDPE Smooth and Textured Geomembranes.

- d. GRI GM 19a Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes

1.01 DEFINITIONS

- A. Lot: A quantity of resin (usually the capacity of one rail car) used in the manufacture of geomembranes. Finished rolls shall be identified by a roll number traceable to the resin lot used.
- B. Geomembrane Manufacturer (Manufacturer): The party responsible for manufacturing the geomembrane rolls.
- C. Geosynthetic Quality Assurance Laboratory (Testing Laboratory): Party, independent from the Owner, Owner's On-Site Representative, Manufacturer, and Installer, responsible for conducting laboratory tests on samples of geosynthetics obtained at the Site or during manufacturing, usually under the direction of the Owner's On-Site Representative.
- D. Installer: Party responsible for field handling, transporting, storing, deploying, seaming, and testing of the geomembrane seams.
- E. Panel: Unit area of a geomembrane that will be seamed in the field that is larger than 100 square feet.
- F. Patch: Unit area of a geomembrane that will be seamed in the field that is less than 100 square feet.
- G. Subgrade Surface: Soil layer surface which immediately underlies the geosynthetic material(s).

1.03 SUBMITTALS

- A. Submit for review documentation of qualifications for geomembrane manufacturers and installers per paragraph 1.04.
- B. Submit for documentation the following product data prior to installation of geomembrane material:
 - 1. Resin
 - a. Certification stating that the resin contains no recycled polymer and no more than 10 percent rework of the same type of material is added to the resin (product run may be recycled)).
 - b. Production date(s) of resin.
 - 2. Geomembrane Roll

- a. Certification stating that the material was manufactured and tested in accordance with this specification, together with a report of the test results, shall be furnished at the time of shipment.
 - b. As geomembrane rolls are delivered to the Site, a copy of each roll's label shall be delivered to Owner's On-Site representative and include the minimum information as required in paragraph 1.05.
 3. Proposed panel layout drawings.
 - a. Must show proposed panel layout including field seams and details.
 - b. Must be approved prior to installing the geomembrane.
 - c. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.
- C. Submit for review the following information 14 days prior to Installer's mobilization on Site:
 1. Installer's on-site foreman's resume, crew size, and detailed installation schedule.
 2. Installer's Geosynthetic Field Installation Quality Assurance Plan.
 3. Proposed panel layout drawings.
 - a. Must show proposed panel layout including field seams and details.
 - b. Must be approved prior to installing the geomembrane.
 - c. Approved drawings will be for concept only and actual panel placement will be determined by site conditions.
- D. Submit for record geomembrane subgrade acceptance form(s) prior to geomembrane installation.
- E. Submit for record tensiometer calibration certificate prior to geomembrane installation.
- F. Submit for review the following up-to-date information to Owner's On-Site Representative at the end of each day that geomembrane installation activities occur:
 1. Sketch of work completed.
 2. Panel placement and roll identification.
 3. Trial weld test logs.
 4. Seam locations, lengths and type.
 5. Seam testing and results.

6. Destructive testing and results.
 7. Repair locations and log.
- G. Within 15 working days of Installer's final demobilization from the Site, submit for documentation the following information:
1. All field test results.
 2. Installation certification.
 3. Material and installation warranties.
 4. As-built drawing.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. HDPE geomembrane Manufacturer shall have manufactured a minimum of 20,000,000 square feet of polyethylene geomembrane during the last year and shall have a minimum of ten years of continuous experience in the manufacture of HDPE geomembrane liner.
2. LLDPE geomembrane Manufacturer shall have manufactured a minimum of 20,000,000 square feet of polyethylene geomembrane during the last year and shall have a minimum of ten years of continuous experience in the manufacture of LLDPE geomembrane liner.

B. Installer Qualifications:

1. Contractor shall submit qualifications and experience of proposed Installer. Owner's written approval of Installer is required prior to Installer mobilization to the Site.
2. Installer shall have installed a minimum of 50,000,000 square feet of polyethylene geomembrane for a minimum of 10 completed facilities.
3. Installer shall have worked in a similar capacity on at least 10 projects similar in complexity.
4. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity.
5. The Installer shall provide a minimum of one Master Seamer for work on the project.
 - a. Master Seamer must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for use on this Project.

1.05 DELIVERY, STORAGE, HANDLING

- A. Labeling – Each roll of geomembrane delivered to the Site shall be labeled by the Manufacturer. The label will identify:
1. Manufacturer's name, address, and telephone number
 2. Product identification
 3. Lot number
 4. Roll number
 5. Roll dimensions
 6. Material thickness
- B. Delivery – Rolls of geomembrane shall be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
- C. Storage – The on-site storage location for the geomembrane material, prepared by the Contractor to protect the geomembrane from punctures, abrasions and excessive dirt and moisture, shall have the following characteristics:
1. Level (no wooden pallets), and stacked no more than two high
 2. Smooth
 3. Dry
 4. Protected from theft and vandalism
 5. Adjacent to the area being lined
- D. Handling – Materials are to be handled so as to prevent damage. Instructions for moving geomembrane shall be provided by manufacturer/fabricator.

1.06 WARRANTY

- A. Material shall be warranted against Manufacturer's defects for a period of 5 years from the date of geomembrane installation.
- B. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GEOMEMBRANE LINER MATERIALS

- A. Geomembrane: A 60-mil, dual-sided textured High Density Polyethylene (HDPE) geomembrane that must meet the following:
- B. Resin
 - 1. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
 - 2. Natural resin (without carbon black) shall meet the following requirements:

Table 1: Raw Material Properties

| Property | Test Method | HDPE |
|------------------------------|---------------------------|--------|
| Density (g/cm ³) | ASTM D 1505 | ≥0.932 |
| Melt Flow Index (g/10 min) | ASTM D 1238 (190/2.16) | ≤1.0 |
| OIT (minutes) | ASTM D 3895 (1 atm/200°C) | ≥100 |

- C. Geomembrane Rolls
 - 1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
 - 2. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
 - 3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width and Manufacturer.
 - 4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical properties specified and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

Textured geomembrane shall meet the requirements shown in Table 2:

Table 2: High Density Polyethylene Geomembrane – 60mil

| Tested Property | Test Method | Frequency | Minimum Average TEXTURED Values | Minimum Average SMOOTH Values |
|---|---------------------------------|----------------------------|---------------------------------|-------------------------------|
| Thickness, (minimum average) mil (mm) Lowest individual reading (-10%) | ASTM D 5994 | every roll | Nom. -5% -15 | Nom. (-5%) -10% |
| Density, g/cm ³ | ASTM D 1505/D 792 | 200,000 lb | 0.94 | 0.94 |
| Tensile Properties (each direction) Strength at Break, lb/in-width Strength at Yield, lb/in-width Elongation at Break, % Elongation at Yield, % | ASTM D 6693 Type IV Dumbbell | 20,000 lb | 90 126 100% 12% | 228 126 700 12 |
| Tear Resistance, lb | ASTM D 1004 | 45,000 lb | 42 | 42 |
| Puncture Resistance, lb | ASTM D 4833 | 45,000 lb | 90 | 108 |
| Carbon Black Content, % | ASTM D 4218 | 20,000 lb | 2.0 - 3.0 | 2.0-3.0 |
| Carbon Black Dispersion | ASTM D 5596 | 45,000 lb | Note ⁽¹⁾ | Note ⁽¹⁾ |
| Asperity Height, mil | ASTM D 7466 | Every 2 nd roll | 16 | - |
| Stress Crack Resistance (3) - hr | ASTM D 5397 | Per GRI GM10 | 500 | 500 |
| Oxidative Induction Time (OIT) (min ave.) (6) (a) Standard OIT (min. ave.) -or- High Pressure OIT (min. ave.) | D3895 D5885 | 200,000 lbs | 100 400 | 100 400 |
| Oven Aging at 85°C (5) (a) Standard OIT (min. ave.) - % retained after 90 days -or- High Pressure OIT (min. ave.) - % retained after 90 days | D 5721 D 3895 D5885 | per formulation | 55 80 | 55 80 |
| UV Resistance (6) (a) Standard OIT (min. ave.) - or - High Pressure OIT (min. ave.) - % retained after 1600 hrs (8) | D 7238 D 3895 D 5885 | per formulation | N.R. (9) 50 | N.R. (8) 50 |

⁽¹⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.

2.02 GEOMEMBRANE COVER MATERIALS

A. Raw Materials:

- Geomembrane and extrudate rods used for this project shall be manufactured of new, first quality resins, designed specifically for use in flexible geomembrane installations.

2. Resin used in manufacturing LLDPE geomembranes used for this Project shall meet the specifications set forth in the latest revision of the GRI GM17 for LLDPE.
3. Recycled Polymer shall not be added to the resin. However, the resin may contain polymer reclaimed during the manufacturing process if reclaimed polymer content does not exceed 2 percent by weight.

B. Geomembrane Roll Goods:

1. HDPE geomembrane sheets used for this project shall meet the requirements set forth in the latest revision set forth by the GRI GM13 for HDPE.
2. The HDPE geomembranes shall consist of unreinforced high density polyethylene containing at a maximum 1 percent by weight additives, fillers, or extenders other than carbon black.
3. LLDPE geomembrane sheets used for this project shall meet the requirements set forth in the latest revision set forth by the GRI GM17 for LLDPE.
4. The geomembranes shall consist of unreinforced linear low density polyethylene containing at a maximum 1 percent by weight additives, fillers, or extenders other than carbon black.
5. The geomembranes shall be free of holes, blisters, striations, undispersed raw material, and contamination by foreign matter.
6. The geomembranes shall be supplied in rolls. Each roll shall be identified and labeled with the thickness of the geomembrane, length and width, manufacturer, lot number, and roll identification number. This identification number shall be used to identify roll location on the panel layout record drawing.
7. Geomembrane liners shall be dual-sided textured unless otherwise noted. Smooth geomembrane may be used on slopes of 5 percent or shallower.
8. Geomembrane covers shall be dual-sided textured unless otherwise noted. Smooth geomembrane may be used on slopes of 5 percent or shallower.

C. Extrudate:

1. Resin used in the polyethylene extrudate shall be the same as that used to manufacture the geomembrane sheets. Extrudate rods are to be delivered in original containers with the manufacturer's labeling. Extrudate rods shall be free of dirt, grease, moisture, other contaminants, and shall be free of damage.

D. Neoprene Foam at Clamped Boots (if necessary):

1. Closed cell, weatherproof, black neoprene foam with adhesive backing suitable for long-term sun and liquid exposure. Dimensions shall be as specified on the Drawings or as required to suit application required in the field.
- E. Clamped Boots (if necessary):
1. Boots required to seal the geomembrane to the structures passing through it shall be made of the same materials as the geomembrane. The boots shall be fabricated so that all field assembly, welding, and seam testing can be accomplished using equipment and procedures regularly employed in the field for geomembrane installation. Smooth geomembrane shall be used in all geomembrane boots.
- F. Banding Straps (if necessary):
1. Type 302 stainless steel banding straps or approved equal suitable for use on the pipe diameters shown on the Drawings or encountered in the field. All surfaces of the banding straps shall be machined smooth to prevent tearing or puncturing of the geomembrane pipe boots. A sacrificial layer of geomembrane or geotextile shall separate all banding straps from geomembrane boots. Outer lip of boot shall be sealed with silicone sealant as shown on the Drawings.

2.03 GEOMEMBRANE COVER PROPERTIES

- A. Material shall be dual-sided textured 40mil LLDPE geomembrane. Smooth 40mil LLDPE geomembrane shall be used in all geomembrane boots. Smooth 40mil LLDPE geomembrane may be used on slopes of 5 percent or shallower.
- B. Resin
1. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
 2. Natural resin (without carbon black) shall meet the following requirements:

Table 3: Raw Material Properties

| Property | Test Method | HDPE |
|------------------------------|---------------------------|--------|
| Density (g/cm ³) | ASTM D 1505 | ≥0.915 |
| Melt Flow Index (g/10 min) | ASTM D 1238 (190/2.16) | ≤1.0 |
| OIT (minutes) | ASTM D 3895 (1 atm/200°C) | ≥100 |

- C. Geomembrane Rolls
1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
 2. All geomembrane sheets produced at the factory shall be inspected prior to shipment for compliance with the physical properties specified and be tested by an acceptable method

of inspecting for pinholes. If pinholes are located, identified, and indicated during manufacturing, these pinholes shall be corrected prior to shipping.

3. Geomembrane shall meet the requirements shown in Table 4:

Table 4 – Linear Low Density Polyethylene Geomembrane – 40mil

| Tested Property | Test Method | Frequency | Minimum Average TEXTURED Values | Minimum Average SMOOTH Values |
|---|--------------------------------|-----------------|---------------------------------|-------------------------------|
| Thickness mils (min. ave.) • lowest individual for 8 out of 10 values • lowest individual for any of the 10 values | D 5994/D5199 | every roll | Nom. (-5%) -10% -15% | Nom. (-5%) -10% |
| Density g/ml (max.) | D 1505 D 792 | 200,000 lbs | 0.939 | 0.939 |
| Tensile Properties (7) (min. ave.) • break strength - lb/in. break elongation - % | D 6693 Type IV | 20,000 lbs | 60 250 | 152 800 |
| 2% Modulus - lb/in. (max) | D 5323 | per formulation | 2400 | 2400 |
| Tear Resistance - lb (min. ave.) | D 1004 | 45,000 lbs | 22 | 22 |
| Puncture Resistance - lb (min. ave.) | D 4833 | 45,000 lbs | 44 | 56 |
| Axi-Symmetric Break Resistance Strain - % (min.) | D 5617 | per formulation | 30 | 30 |
| Carbon Black Content - % (Range) | D 4218 (2) | 45,000 lbs | 2.0-3.0 | 2.0-3.0 |
| Carbon Black Dispersion | D 5596 | 45,000 lbs | note (3) | note (3) |
| Oxidative Induction Time (OIT) (4) (b) Standard OIT (min. ave.) -or- High Pressure OIT (min. ave.) | D3895 D5885 | 200,000 lbs | 100 400 | 100 400 |
| Oven Aging at 85°C (5) (b) Standard OIT (min. ave.) - % retained after 90 days -or- High Pressure OIT (min. ave.) - % retained after 90 days | D 5721 D 3895 D5885 | per formulation | 35 60 | 35 60 |
| UV Resistance (6) (b) Standard OIT (min. ave.) - or - High Pressure OIT (min. ave.) - % retained after 1600 hrs (8) | D 7238 D 3895 D 5885 | per formulation | N.R. (7) 35 | N.R. (7) 35 |

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.

- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.

2) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.

3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:

- 9 in Categories 1 or 2 and 1 in Category 3

4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.

6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.

7) Not recommended since the high temperature of the Std-OIT test produces an unrealistic result for some of the antioxidants in the UV exposed samples.

^(b) uv resistance is based on percent retained value regardless of the original hp-oit value.

2.04 GEOMEMBRANE EQUIPMENT

- A. Extruding equipment shall be equipped with a temperature gauge at the barrel and nozzle.
- B. Fusion equipment shall be equipped with a temperature gauge capable of continuous monitoring.
- C. Provide digital or dial continuous temperature recording instruments, in satisfactory working condition, with each welding unit. Welding equipment shall not be operated without functioning temperature recording instruments for measuring geomembrane sheet temperature.
- D. A coupon cutter and a calibrated tensiometer shall be provided for in-field seaming prequalification testing and destructive sample testing.
- E. Store, transport, and operate all equipment to avoid damage to geomembranes.
- F. Glass top of each vacuum box must be clear and free of scratches for easy reading of pressure gauge. The sealing gasket shall be intact and functioning to form close seals during testing.
- G. Owner or Owner's On-Site Representative reserves the right to order the Installer to remove any equipment that in Owner's or Owner's On-Site Representative's opinion is not satisfactory. The Installer will remove the equipment promptly from the construction site and replace the unsatisfactory equipment with suitable equipment within 24 hours.
- H. An adequate number of welding apparatuses shall be available to avoid delaying work.

PART 3: EXECUTION

3.01 EXAMINATION

- A. Installer shall certify in writing that the surface upon which the geomembrane is to be installed is acceptable (use the form attached at the end of this Section).
- B. Submit certification to Owner or Owner's On-Site Representative prior to installing geomembrane.

3.02 EARTHWORK PREPARATION

- A. General:
 - 1. After supporting soil is accepted by Installer, it shall be Installer's responsibility to indicate to Owner or Owner's On-Site Representative and to Contractor changes in supporting soil condition that may require repair Work. The Contractor shall maintain the prepared soil

surface and the soil surface shall be observed daily prior to geomembrane installation. Damage to subgrade caused by installation shall be repaired at Installer's expense.

2. Do not place geomembrane in areas softened by precipitation.
3. Do not place geomembrane until subgrade certification survey is completed and approved by Engineer.

B. Anchoring System:

1. Excavate anchor trench to lines and grades shown on the Drawings prior to geomembrane placement. Protect existing geomembrane and anchor trench.
2. The anchor trench shall be constructed free of sharp edges or corners and maintained in a dry condition. No loose soil shall be permitted beneath the geomembrane within the trench.
3. The anchor trench shall be inspected and approved by Owner's On-Site Representative prior to geomembrane placement, back-filling, and compaction of the anchor trench material.
4. Anchor trench excavated in subgrade is susceptible to desiccation. No more than amount of trench required for geomembrane to be anchored in one day shall be excavated in advance to minimize desiccation potential of anchor trench soils.
5. Include crosswalks/bridges for all geomembrane anchor trenches per requirements on the Drawings. If not specified on the Drawing, then provide a minimum of one crosswalk for every 100 feet of open anchor trench. Contractor to design crosswalks/bridges to minimal width of 4 feet, and to accommodate human and vehicle loads anticipated for the duration of crosswalk/bridge utilization.

C. Backfilling of Anchor Trench:

1. Backfill anchor trench as shown on the Drawings and compact backfill to ≥ 95 percent of Standard Proctor Maximum Dry Density.
2. Prevent damage to geomembrane when backfilling trenches.

3.03 DEPLOYMENT

- A. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval by Owner's On-Site Representative and shall be determined at the job site.
- B. Installer shall visually inspect the geomembrane during the deployment for imperfections and mark faulty or suspect areas.
- C. Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

1. Geomembranes shall be installed according to site-specific specifications.
 2. Equipment used shall not damage geomembrane during handling, trafficking, leakage of hydrocarbons or other means.
 3. Unroll geomembranes using methods that will not damage geomembrane and will protect underlying surface from damage (spreader bar, protected equipment bucket).
 4. To prevent uplift, place ballast (commonly sandbags) on geomembrane which will not damage geomembrane.
 5. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage it. Smoking will not be permitted on the geomembrane.
 6. Do not allow vehicular traffic directly on geomembrane. Rubber-tired ATV may be acceptable if wheel contact is less than 8 pounds per square inch (psi) and pre-approval is obtained from Engineer.
 7. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.
- D. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.
- E. Damage:
1. Panels seriously damaged (torn or twisted permanently) shall be replaced whether or not at the direction of the Owner or Owner's On-Site Representative, and at no cost to Owner. Repair less serious damage.
 2. Remove rejected damaged panels or portions of rejected damaged panels from Work area.

3.04 FIELD SEAMING

- A. Seams shall meet the following requirements:
1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.
 2. Minimize number of field seams in corners, odd-shaped geometric locations and outside corners.
 3. Slope seams (panels) shall extend a minimum of five-feet beyond the grade break into the flat area. To maximum extent possible, minimize panel butt seams on slopes greater than 3 percent. Cut bottom of panel at a 45° angle across the entire roll width where butt seams are required on slopes greater than 3 percent slopes.

4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the Owner's On-Site Representative and Installer.
5. Align seam overlaps consistent with the requirements of the welding equipment being used. A 6-inch overlap is commonly suggested.

B. During Welding Operations

1. Master Seamer shall provide direct supervision over all other welders.
2. At the start of each seam, the seamer shall clearly write the following information on the panel adjacent to each seam:
 1. Seamer ID
 2. Tool No
 3. Time started
 4. Seam No

C. Extrusion Welding

1. Hot-air tack adjacent pieces together using procedures that do not damage the geomembrane.
2. Clean geomembrane surfaces by disc grinder or equivalent.
3. Purge welding apparatus of heat-degraded extrudate before welding.

D. Hot Wedge Welding

1. Welding apparatus shall be a self-propelled device equipped with an electronic controller which displays applicable temperatures.
2. Clean seam area of dust, mud, moisture and debris immediately ahead of hot wedge welder.
3. Protect against moisture build-up between sheets.

E. Trial Welds

1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.
2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.

3. Minimum of two trial welds per day, per welding apparatus; one made prior to the start of work and one completed at mid-shift.
4. Cut a minimum of six, one-inch wide by six-inch long test strips from the trial weld.
5. Quantitatively and qualitatively test specimens for peel adhesion (minimum of 4 tests for both Peel A and Peel B) and for shear strength (minimum of 2 tests).
6. Trial weld specimens shall pass when the results shown in the following tables for HDPE and LLDPE, respectively are achieved with acceptable failure modes in both peel and shear testing.

Table 5 – Minimum Weld Values for HDPE Geomembranes (ref: GRI GM19a Table 1(a))

| Property | Test Method | 60mil |
|-------------------------------------|-------------|-------|
| Peel Strength (fusion), ppi | ASTM D 6392 | 91 |
| Peel Strength (extrusion), ppi | ASTM D 6392 | 78 |
| Shear Strength (fusion & ext.), ppi | ASTM D 6392 | 120 |

⁽¹⁾ The break, when peel testing, shall occur in the geomembrane material itself, not through peel separation (FTB).

⁽²⁾ The break shall be a ductile break

Table 6– Minimum Weld Values for LLDPE Geomembranes (ref: GRI GM19a Table 2(a))

| Property | Test Method | 40mil |
|-------------------------------------|-------------|-------|
| Peel Strength (fusion), ppi | ASTM D 6392 | 50 |
| Peel Strength (extrusion), ppi | ASTM D 6392 | 44 |
| Shear Strength (fusion & ext.), ppi | ASTM D 6392 | 60 |

⁽¹⁾ The break, when peel testing, shall occur in the geomembrane material itself, not through peel separation (FTB).

⁽²⁾ The break shall be a ductile break

7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.
8. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial welds.
9. The following information should be logged for each trial weld.
 1. Date and time of the trial weld completion,
 2. Ambient temperature,
 3. Apparatus identification,
 4. Seaming technician,
 5. Barrel temperature or preheat setting for extrusion welding,

6. Wedge temperature for fusion welding,
 7. Trial weld number, and
 8. Pass or fail of the trial weld.
- F. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. Installer shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.
- G. Defects and Repairs
1. Examine all seams and non-seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.
 2. Repair and non-destructively test each suspect location in both seam and non-seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

3.05 FIELD Quality Assurance

- A. Quality assurance requirements are as specified in this Section.
- B. Field Testing
1. Non-destructive testing shall be carried out as the seaming progresses on all seams.
 - a. Vacuum Testing
 - 1) Shall be performed in accordance with ASTM D5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
 - 2) The vacuum shall be applied for not less than 10 seconds with a minimum of 4 to 8 pounds per square inch (psi) registered on the vacuum gauge.
 - 3) If bubbles appear on the geomembrane seam, the area is considered defective and shall be marked for repair.
 - b. Air Pressure Testing
 - 1) Shall be performed in accordance with ASTM D5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.
 - 2) Pressurize the air channel to 30 psi.
 - 3) Note the time test starts and wait a minimum of 5 minutes to check. If pressure after 5 minutes has dropped less than 2 psi then the test is successful.

- 4) If the recorded pressure drop is above the maximum allowable after the test period, the end seals shall be checked and resealed if a leak is present. The entire test shall then be repeated.
 - 5) If the repeated test fails, then the test shall be performed farther down the seam until a passing test is achieved between two locations. The portion of the seam that failed shall be considered defective and shall be marked for repair.
- c. The following information shall be logged for each seam tested:
- 1) date and time of the completion of the test,
 - 2) seam number,
 - 3) the general seam location,
 - 4) the test crew,
 - 5) the air pressure at the beginning and end of the test for double-track fusion,
 - 6) the length of time that the air pressure was held for double-track fusion welds, and
 - 7) pass or fail result of the test.
2. Destructive Testing
- a. Location and Frequency of Testing
- 1) Collect destructive test samples at a frequency of one per every 500 lineal feet of seam length.
 - 2) Test locations will be determined after seaming by Owner's On-Site Representative.
- b. Sampling Procedures are performed as follows:
- 1) Installer shall cut samples under observation of Owner's On-Site Representative.
 - 2) Installer will number each sample, and the location will be noted on the installation as-built drawing.
 - 3) Samples shall be twelve (12) inches wide by minimal length with the seam centered lengthwise.
 - 4) Cut a 6-inch wide strip from each end of the sample for field testing.

- 5) Cut the remaining sample into two parts for distribution as follows:
 - a) One portion for the Third Party laboratory testing, 12-inches by 18-inches.
 - b) One portion for Owner's On-Site Representative for archive, 12-inches by 12 inches.
 - 6) Destructive testing shall be performed in accordance with ASTM D6392, Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
 - 7) Five weld specimens shall be tested for peel (test both sides for fusion welds) and five shall be tested for shear. The weld shall pass when:
 - a) Four of five specimens (both peel and shear) exceed the values shown in Tables 5 and 6, and the fifth specimen meets or exceeds 80 percent of the value shown in Tables 5 and 6.
 - b) The break, when peel testing, shall occur in the liner material itself (FTB – Film Tear Bond), not through peel separation. Five of five specimens must meet acceptable break codes per GRI GM19a.
 - c) The break shall be a ductile break.
 - 8) Installer shall repair all holes in the geomembrane resulting from destructive sampling.
 - 9) Repair and test the continuity of the repair in accordance with these Specifications.
- c. The following information shall be logged for each seam tested:
- 1) date and time of the completion of the test,
 - 2) seam number,
 - 3) test sample number, and
 - 4) the general seam location
3. Failed Seam Procedures
- a. If the seam fails, Installer shall follow one of two options:
 - 1) Reconstruct the seam between any two passed test locations.

- 2) Trace the weld to intermediate location at least 10 feet minimum or where the seam ends in both directions from the location of the failed test.
 - b. The next seam welded using the same welding device is required to obtain an additional sample, i.e., if one side of the seam is less than 10 feet long.
 - c. If sample passes, then the seam shall be reconstructed or capped between the test sample locations.
 - d. If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.
- C. 3rd Party Independent Laboratory Destructive Seam Testing
1. Destructive seam samples for the geomembrane shall be sent to the 3rd party independent laboratory for quality assurance testing.
 2. Samples shall be sent to the independent laboratory periodically throughout geomembrane installation so not to delay placement of overlying materials.
 3. Test results from the independent laboratory shall be provided to Owner's On-Site Representative within 72 hours from when the destructive sample was retrieved from the in-place geomembrane liner.
 4. Owner's On-Site Representative shall be responsible for coordinating and performing the 3rd party independent laboratory testing.

3.06 REPAIR PROCEDURES

- A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non-destructive test.
- C. Installer shall be responsible for repair of defective areas.
- D. Agreement upon the appropriate repair method shall be decided between Owner's On-Site Representative and Installer by using one of the following repair methods:
 1. Patching- Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.
 2. Abrading and Re-welding- Used to repair short section of a seam.
 3. Spot Welding- Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

4. Capping- Used to repair long lengths of failed seams.
5. Flap Welding- Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.
6. Remove the unacceptable seam and replace with new material.

E. The following procedures shall be observed when a repair method is used:

1. All geomembrane surfaces shall be clean and dry at the time of repair.
2. Surfaces of the polyethylene which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.
3. Extend patches or caps at least 6 inches for extrusion welds and 4 inches for wedge welds beyond the edge of the defect, and around all corners of patch material.

F. Repair Verification

1. Number and log each patch repair (performed by Installer).
2. Non-destructively test each repair using methods specified in this Section.

3.07 GEOMEMBRANE ACCEPTANCE

A. Retain ownership and responsibility for geomembrane until acceptance by Owner. Geomembrane liner accepted by Owner when:

1. Installation complete.
2. Verification of adequacy of field seams and repairs, including associated testing, is complete.
3. Copy of all field testing results received.
4. Installation certificate received stating the geomembrane has been installed in accordance with the Contract Documents.
5. Manufacturer and installation warranties received.
6. As-built drawing received showing the following minimum information:
 - a. Actual geomembrane placement, dimensions and seams labeled with panel and roll numbers.

END OF SECTION 31 05 19.16

**CERTIFICATE OF ACCEPTANCE OF
GEOMEMBRANE SUBGRADE SURFACE BY INSTALLER**

DESCRIPTION OF AREA TO BE CERTIFIED _____

INSTALLER

PROJECT

NAME: _____ LOCATION: _____

ADDRESS: _____ PROJECT: _____

AUTHORIZED REPRESENTATIVE: _____ OWNER: _____

The undersigned, _____ certifies that he is a representative of _____ (company), duly authorized to execute this certificate, that he visually inspected the subgrade surface described above on _____ (date) and found the surface to be acceptable for installation of the geomembrane. This certification is based on observations of the surface of the subgrade only. No subterrain inspections or tests have been performed and _____ (company) makes no representations or warranties regarding conditions which may exist below the surface of the subgrade.

DATE: _____ SIGNATURE: _____

NAME: _____

TITLE: _____

CERTIFICATE RECEIVED BY CONTRACTOR:

CERTIFICATE RECEIVED BY OWNER'S ON-SITE REPRESENTATIVE:

DATE: _____ DATE: _____

COMPANY: _____ COMPANY: _____

SIGNATURE: _____ SIGNATURE: _____

NAME: _____ NAME: _____

TITLE: _____ TITLE: _____

SECTION 31 05 19.23

GEOSYNTHETIC CLAY LINERS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes the geosynthetic clay liner (GCL) for composite liner.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. American Society for Testing and Materials (ASTM)
 - a. D4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - b. D4643 Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Method
 - c. D5084 Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
 - d. D5261 Standard Test Method for Measuring Mass Per Unit Area of Geotextiles
 - e. D5321 Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
 - f. D5887 Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
 - g. D5888 Standard Guide for Storage and Handling of Geosynthetic Clay Liners
 - h. D5889 Standard Practice for Quality Control of Geosynthetic Clay Liners
 - i. D5890 Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
 - j. D5891 Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
2. Geosynthetic Research Institute (GRI)

- a. GCL 3 Test Methods, Required Properties, and Testing Frequencies of Geosynthetic Clay Liners (GCLs)

1.03 DEFINITIONS

- A. *Geosynthetic Clay Liner (GCL)* – A factory manufactured hydraulic barrier consisting of granular sodium bentonite clay, sandwiched between, supported and encapsulated by two geotextiles, held together by needlepunching.
- B. *Geotextile* – A semi-permeable woven or nonwoven fabric used to contain the bentonite used in a GCL.
- C. *Minimum Average Roll Value (MARV)* – The minimum average value of the material in a particular lot calculated as the mean of the tested values minus two standard deviations providing a 95% confidence level.
- D. *Needlepunching* – A GCL manufacturing process whereby boards of barbed needles incorporate the staple fibers from a nonwoven geotextile, through a sodium bentonite clay layer, into the matrix of a second geotextile layer.
- E. *Sodium Bentonite* – The high swelling clay component of GCLs consisting primarily of the mineral Montmorillonite.
- F. *Thermal Locking* – A needlepunching enhancement process utilizing heat to bond the needlepunched fibers and more permanently lock them into the second geotextile to increase the internal shear strength characteristics.

1.04 SUBMITTALS

- A. Information with Bid:
 1. The following shall be submitted with the bid:
 - a. Statement of experience from the proposed GCL supplier.
 - b. Statement of experience from the proposed GCL Installer.
- B. Prior to Installation:
 1. Submit for record within 10 business days of the Contract Award to ensure that the materials and parties selected for use on the project meet the requirements of this Specification:
 - a. Reference list supplied by GCL Manufacturer indicating the appropriate experience level as required by the Specification.

- b. Reference list supplied by the GCL Installer indicating the appropriate experience level as required by the Specification.
- C. Prior to Deployment:
 - 1. Submit for review the following information prior to the deployment of any GCL material to ensure that the materials and subgrade preparation meet the requirements of this Specification:
 - a. GCL Manufacturer's Quality Control Certifications.
 - b. Certifications of subgrade acceptance for each area covered by GCL, signed by the Contractor and Owner's On-Site Representative.
- D. Submit for record all manufacturer and installation warranties.

1.05 QUALIFICATIONS

- A. The GCL Manufacturer, Installer and Construction Quality Assurance (CQA) inspector shall all be skilled in accordance with the following experience requirements. Any exceptions must be approved by Owner prior to the project bid.
- B. GCL Manufacturer - The GCL manufacturer selected for use on this project shall have successfully produced at least 10,000,000 square feet of needlepunched GCL product.
 - 1. The following GCL manufacturers are approved for this project (other manufacturers may be acceptable, provided Engineer approval is obtained):
 - a. CETCO Lining Technologies (224) 365-9207 or (248) 318-1102
2870 Forbes Avenue
Hoffman Estates, IL 60004
 - b. Solmax Solmax.com
- C. Contractor request for approval of alternate supplier (if any) must be submitted to Owner. Contractor must obtain Owner's written approval of alternate supplier in order to include alternate in Bid.
- D. GCL Installer - The installer shall provide to the Owner sufficient evidence of installation experience and competence with the specified geosynthetic materials.
 - 1. GCL Only Installation - The GCL installer shall demonstrate a minimum of 1,000,000 square feet of GCL installation experience, shall provide sufficient evidence of installation experience and competence with other geosynthetics or shall demonstrate an acceptable level of training and supervision will be utilized in order to ensure the quality of the installation.

2. Multi-Component Composite Liner System - The GCL shall be installed by the lining contractor responsible for the installation of the overlying geomembrane liner. The GCL/geomembrane lining contractor shall demonstrate a minimum of 1,000,000 square feet of successfully completed multi-component composite liner installation experience or shall provide sufficient evidence of the appropriate level of installation experience and competence with other geosynthetics.

1.06 WARRANTY

- A. GCL material as well as installation warranties provided by the manufacturer and installer shall be made a part of the final submittal documents.
- B. The installer of the GCL material shall provide a one year installation workmanship warranty, repairing and or replacing any material not installed in full compliance with the requirements of the specification.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GCL MATERIALS

- A. The GCL product supplied to the project shall be in full accordance with the requirements of this specification. The GCL shall be manufactured by mechanically bonding the geotextiles using a needlepunching process to enhance frictional and internal shear strength characteristics.
- B. In order to maintain these characteristics, no glues, adhesives or other non-mechanical bonding processes shall be used in lieu of the needlepunch process. Their use to enhance the physical properties of the GCL is not permitted.
- C. Description – GCL shall meet the requirements of GRI – GCL3 for Reinforced GCL. Acceptable GCL for this project include Bentomat ST manufactured by CETCO Lining Technologies and BentoLiner manufactured by Solmax, provided these products conform to all other specification requirements herein, or other Engineer and Owner-approved needlepunched GCL which meets the requirements of this specification.

2.02 GCL MANUFACTURING

- A. The GCL supplied in accordance with this project shall be manufactured by needlepunching as described in Section 1.03 - Definitions.

1. The needlepunched GCL shall be thermally locked. The thermal lock process must heat set the nonwoven fibers where they protrude from the second geotextile (woven or nonwoven depending upon product) to more permanently secure the reinforcement in place. Other means may be used to lock the fibers in place if the process demonstrates similar performance to the thermal lock process.
2. To demonstrate the uniformity of the manufacturing process, no delamination of the geotextile components from the bentonite core shall occur when the GCL is exposed to 80 degree tap water for one hour.

2.03 ALTERNATIVE MATERIALS

- A. Prior to considering an alternative GCL material, the Contractor shall submit certified test results and statements of quality from the proposed GCL supplier to the Engineer indicating without exception that the proposed GCL meets the requirements of this specification. Submittals shall be delivered to the Engineer a minimum of five business days in advance of the bid.
- B. No other manufacturing techniques shall be approved unless it can be suitably demonstrated that the GCL exhibits uniform shear strength characteristics across the entire width of the panel. Isolated sewn or stitched rows do not constitute uniform reinforcement for the purposes of this specification.

2.04 DIMENSIONS

- A. The minimum acceptable dimensions for the GCL panels shall be 15 feet wide and 125 feet long. Short rolls (rolls less than 125 feet long) may be supplied, but at a rate not to exceed 5-percent of the total square footage produced for this project.
- B. A minimum overlap guide-line and a construction match-line delineating the overlap zone shall be imprinted with non-toxic ink on both edges of the GCL panel to ensure the accuracy of the seam. The minimum overlap guideline shall indicate where the edge of the panel must be placed in order to achieve a full 6-inches of bentonite overlap for each panel.

2.05 MANUFACTURING QUALITY CONTROL

- A. The GCL shall be tested for compliance with this specification by the test methods and frequencies indicated on the material specification. GCL materials may be tested pre-approved at the manufacturing location.
 1. Manufacturer Quality Control Certification - Quality Control certificates shall be issued by the GCL manufacturer to the Owner or Owner's Representative for each delivery of material. The certifications shall be signed by the quality control manager of the GCL manufacturer or other responsible party and shall include the following information:
 - a. Shipment Packing List - A list indicating the rolls shipped on a particular truckload.

- b. Bill of Lading - The shipping documents for the truck used for the shipment.
 - c. Letter of Certification - The letter indicating the material is in conformance with the physical properties specified.
 - d. Physical Properties Sheet - The material specification for the GCL supplied in accordance with this specification.
2. Manufacturer Quality Control Submittal - Quality Control submittals shall be issued by the GCL manufacturer to the Owner or Owner's Representative. The submittals shall include the following information:
- a. Bentonite Manufacturer Certification - Bentonite manufacturer quality documentation for the particular lot of clay used in the production of the rolls delivered.
 - b. Geotextile Manufacturer Certification - Geotextile manufacturer quality control documentation for the particular lots of geotextiles used in the production of the rolls delivered.
 - c. GCL Manufacturer Tracking List - Cross referencing list delineating the corresponding geotextile and bentonite lots for the materials used in the production of the rolls delivered.
 - d. Manufacturing Quality Control Data - The manufacturing quality control test data indicating the actual test values obtained when tested at the appropriate frequencies for the properties specified.

2.06 PACKAGING

- A. All GCL rolls shall be packaged in moisture resistant plastic sleeves. The cardboard cores shall be sufficiently strong to resist collapse during transit and handling.
- B. Prior to shipment, the manufacturer shall label each roll, both on the GCL roll and on the surface of the plastic protective sleeve. Labels shall be resistant to fading and moisture degradation to ensure legibility at the time of the installation. At a minimum the roll labels shall identify the following:
 - 1. Length and width of roll
 - 2. Total weight of roll
 - 3. Type of GCL material
 - 4. Production Lot number and Individual Roll number

2.07 ACCESSORY BENTONITE

- A. Any accessory bentonite used for sealing seams, penetrations, or repairs, shall be the same granular bentonite as used in the production of the GCL itself.

PART 3: EXECUTION

3.01 GENERAL

- A. The following installation procedures are as specific as possible while recognizing that the specific requirements of the Project may necessitate minor modifications. Significant deviations from these procedures shall be pre-approved by the engineer.
- B. Do not install GCL until subgrade certification survey is completed and approved by Engineer.

3.02 SHIPPING AND HANDLING EQUIPMENT

- A. The party responsible for unloading the GCL shall contact the manufacturer prior to shipment to determine the correct unloading methods and equipment if different from the pre-approved and specified methods.
- B. GCL must be supported during handling to ensure worker safety and prevent damage to the liner. Under approved circumstances only, shall the rolls be dragged, lifted from one end, lifted with only the forks of a lift truck or pushed to the ground from the delivery vehicle.
- C. Owner or Owner's Representative shall verify that Contractor's proper handling equipment exists which does not pose any danger to installation personnel or risk of damage or deformation to the liner material itself. Suitable handling equipment is described below:
 - 1. Spreader Bar Assembly - A spreader bar assembly shall include both a core pipe or bar and a spreader bar beam. The core pipe shall be used to uniformly support the roll when inserted through the GCL core while the spreader bar beam will prevent chains or straps from chafing the roll edges. The cardboard roll supplied with the GCL shall not be used in place of a steel core pipe.
 - 2. Stinger - A stinger is a rigid pipe or rod with one end directly connected to a forklift or other handling equipment. If a stinger is used, it should be fully inserted to its full length into the roll to prevent excessive bending of the roll when lifted.
 - 3. Roller Cradles - Roller cradles consist of two large diameter rollers spaced approximately 3-inches apart, which both support the GCL roll and allow it to freely unroll. The use of roller cradles shall be permitted if the rollers support the entire width of the GCL roll.
 - 4. Straps - Straps may be used to support the ends of spreader bars but are not recommended as the primary support mechanism. As straps may damage the GCL where

wrapped around the roll, and generally do not provide sufficient uniform support to prevent roll bending or deformation, great care must be exercised when this option is used.

- D. GCL Inspection Upon Delivery - Each roll shall be visually inspected when unloaded to determine if any packaging or material has been damaged during transit. Repairs to damaged GCL shall be performed in accordance with this specification.
1. Rolls exhibiting damage shall be marked and set aside for closer examination during deployment.
 2. Minor rips or tears in the plastic packaging shall be repaired with moisture resistant tape prior to the GCL being placed in storage to prevent moisture damage.
 3. GCL rolls delivered to the project site shall be only those indicated on GCL manufacturing quality control certificates.
- E. Storage / Stockpiling / Staging
1. Storage of the GCL rolls shall be the responsibility of the installer or other designated party under Contractor's control. All GCL rolls shall be stock-piled and maintained dry in a flat location area away from high-traffic areas but sufficiently close to the active work area to minimize handling.
 2. For needlepunched GCLs, the presence of free-flowing water within the packaging shall require that roll to be set aside for further examination to ascertain the extent of damage, if any. Free-flowing water within the packaging of unreinforced GCLs shall be cause for rejection of that roll.
 3. GCL should be stored no higher than three to four rolls high or limited to the height at which the handling apparatus may be safely handled by installation personnel. Stacks or tiers of rolls should be situated in a manner that prevents sliding or rolling by "choking" the bottom layer of rolls.
 4. Rolls shall not be stacked on uneven or discontinuous surfaces in order to prevent bending, deformation, damage to the GCL or cause difficulty inserting the core pipe.
 5. An additional tarpaulin or plastic sheet shall be used over the stacked rolls to provide extra protection for GCL material stored outdoors.
 6. Bagged bentonite material shall be stored and tarped next to GCL rolls unless other more protective measures are available. Bags shall be stored on pallets or other suitably dry surface which will prevent undue prehydration.

3.03 EXAMINATION

- A. The earthen subgrade shall be continuously inspected, approved and certified in writing prior to GCL placement.

- B. Submit certification to Owner or Owner's Representative prior to installing GCL.

3.04 SUBGRADE PREPARATION

- A. Earthen Subgrade – The surface upon which the GCL will be installed shall be inspected by the installer and certified by the Contractor to be in accordance with the following:
 - 1. Finished surface of Earthen Subgrade shall be free of all angular stones, and free of all stones greater than 3/8-inch protruding from the finished surface.
 - 2. Subgrade surface shall be smooth rolled to achieve a finished surface suitable for placement of GCL.
 - 3. The surfaces to be lined shall be smooth and free of any debris, vegetation, roots, sticks, sharp rocks, or other deleterious materials as well as free of any voids, large cracks or standing water or ice.
 - 4. Directly prior to deployment of the GCL, the subgrade shall be final-graded to fill remaining voids or desiccation cracks, and proof-rolled to eliminate sharp irregularities or abrupt elevation changes. All rocks greater than 3/8-inch protruding from the finished surface shall be hand-picked and removed. The surfaces to be lined shall be maintained in this smooth condition.
- B. Anchor Trench (if necessary) - An anchor trench shall be excavated by the earthwork contractor or liner installer to the lines and grades shown on the project Drawings.
 - 1. The anchor trench shall be constructed free of sharp edges or corners and maintained in a dry condition. No loose soil shall be permitted beneath the GCL within the trench.
 - 2. The anchor trench shall be inspected as well as approved by Owner or Owner's Representative prior to GCL placement, back-filling and compaction of the anchor key material.

3.05 GCL Placement

- A. GCL material shall be placed in general accordance with the procedures specified below, or modified to account for site specific conditions.
- B. GCL Orientation - In the absence of specific guidelines, GCL panels shall be placed per manufacturer recommendation on slopes to maximize the shear strength characteristics.
- C. In base or flat areas, the GCL shall be placed by placing the woven geotextile face of the GCL against the overlying geomembrane.
- D. GCL Panel Position - Where possible, all slope panels should be installed parallel to the maximum slope while panels installed in flat areas require no particular orientation.

- E. Panel Deployment - GCL materials shall be installed in general accordance with the procedures set forth in this specification, subject to site specific conditions which would necessitate modifications.
- F. Reinforced GCL shall be used on both slopes as well as the flat areas to ensure the GCL withstands the rigors of the installation and subsequent low load hydration.
- G. Deployment should proceed from the highest elevation to the lowest to facilitate drainage in the event of precipitation.
- H. The GCL may be deployed on slopes by pulling the material from a suspended roll, or securing a roll end into an anchor trench and unrolling each panel as the handling equipment slowly moves backwards.
- I. Deployment on flat areas shall be conducted in the same manner as that for the slopes, however, care should be taken to minimize "dragging" the GCL. Slip-sheet may be used to facilitate positioning of the GCL while ensuring the GCL is not damaged from underlying sources.
- J. Overlaps shall be a minimum of 6-inches and in no case less than specified on the Drawings, and be free of wrinkles, folds or "fish-mouths". Any overlaps occurring above a break in slope angle shall be a minimum of 12-inches.
- K. The Installer shall only install as much GCL as can be covered at the end of each day. No GCL shall be left exposed overnight. The exposed edge of the GCL shall be covered by a temporary tarpaulin or other such water resistant sheeting until the next working day.
- L. Anchoring- All GCL material installed on slopes shall be anchored to prevent potential GCL panel movement.
 - 1. Standard Anchor - The GCL shall be placed into and across the base of the excavated trench, stopping at the back wall of the excavation.
 - 2. "Run-Out" Anchor - On gentle slopes or locations where it is difficult to create an anchor trench, the GCL may alternatively be anchored by a material run-out past the crest of the slope. The length of the run-out shall be pre-approved by the Engineer prior to the use of this method.
- M. Seaming - A 6-inch lap line and a 9-inch match line shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink.
 - 1. Overlap seams shall be a minimum of 6-inches on panel edges and 12-inches on panel ends.
- N. Detailing - Detail work, defined as the sealing of the GCL to pipe penetrations, foundation walls, drainage structures, spillways, and other appurtenances, shall be performed as recommended by the GCL Manufacturer.

- O. Damage Repair - Prior to cover material placement, damage to the GCL shall be identified and repaired by the Installer. Damage is defined as any rips or tears in the geotextiles, delamination of geotextiles or a displaced panel.
1. Rip and Tear Repair (Flat Surfaces) - Rips or tears may be repaired by completely exposing the affected area, removing all foreign objects or soil, and by then placing a patch cut from unused GCL over the damage (damaged material may be left in place), with a minimum overlap of 12-inches on all edges.
 - i. Accessory bentonite should be placed between the patch edges and the repaired material at a rate of a quarter pound per lineal foot of edge spread in a continuous 6-inch fillet.
 2. Rip and Tear Repair (Slopes) - Damaged GCL material on slopes shall be repaired by the same procedures above; however, the edges of the patch should also be adhered to the repaired liner with an adhesive to keep the patch in position during backfill or cover operations.
 3. Displaced Panels - Displaced panels shall be adjusted to the correct position and orientation. The adjusted panel shall then be inspected for any geotextile damage or bentonite loss. Damage shall be repaired by the above procedure.
 4. Premature Hydration - If the GCL is prematurely hydrated, Installer shall notify the QA/QC technician and Owner or Owner's Representative for a site specific determination as to whether the material is acceptable or if alternative measures must be taken to ensure the quality of the design - dependent upon the degree of damage.

3.06 COVER MATERIAL

- A. The cover materials shall be compatible as well as suitable for use over the GCL, and placed in a manner appropriate to the particular subgrade. Regardless of the cover material, the uncovered edge of GCL panels shall be protected at the end of the working day with a waterproof sheet which is secured adequately with ballast.
- B. Earthen Cover Soil - If the cover material is soil or gravel, a minimum thickness of 12-inches shall be placed over the GCL. The soil cover shall be free of sharp-edged stones greater than 1-inch in size.
1. Equipment - Soil cover shall be placed with low ground pressure equipment. Care should be taken to avoid damaging the GCL by making sharp turns or pivots with equipment as well as sudden starts or stops.
 2. Placement - Soils may be placed on the GCL by pushing with a track dozer or by carefully placing it with a loader or a back-hoe. The use of scrapers or pans directly over the GCL is strictly prohibited.

3. Thickness - A minimum thickness of 36-inches of cover shall be kept between heavy equipment and the GCL at all times, except when final-grading. No heavy vehicles should be driven directly on the GCL or overlying geomembrane until the proper thickness of cover has been placed.
 4. Slope Placement - When covering GCL on sloped areas steeper than 4 horizontal to 1 vertical, cover should be pushed up-slope to minimize tension on the GCL.
- C. Geosynthetic Cover - Precautions shall be taken to prevent damage to the GCL by restricting the use of heavy equipment over the liner system.
1. Equipment - Installation of the overlying geosynthetic component can be accomplished through the use of lightweight, rubber-tired equipment such as a 4-wheel all-terrain vehicle (ATV). This vehicle can be driven directly on the GCL, provided the ATV makes no sudden stops, starts, or turns.
 2. Placement – Smooth geomembrane may be dragged across the GCL surface with equipment or by hand labor during positioning. Similarly, the geomembrane may be unrolled with the use of low ground pressure equipment.
 3. Use of Textured Liners - If a textured geomembrane is placed over the GCL, a slip sheet (such as 20-mil smooth HDPE) shall first be placed over the GCL in order to allow the geomembrane to slide into its proper position. Once the overlying geomembrane is properly positioned, the slip-sheet shall be carefully removed paying close attention to avoiding any movement to the geomembrane.

END OF SECTION 31 05 19.23

SECTION 31 05 19.26

GEOCOMPOSITE DRAINAGE FOR EARTHWORK

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes the technical requirements for the manufacturing and installation of the geocomposite drainage layer (geocomposite). All materials shall meet or exceed the requirements of this Section, and all Work included in this Section shall be performed in accordance with the following paragraphs, the General Requirements set forth in these Specifications, and the provisions of the other Contract Documents.
- B. Related Sections
 - 1. Section 31 05 19.13 Geotextiles for Earthwork

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM): the most recent version of the standards listed below shall be referenced.
 - 1. ASTM D792: Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - 2. ASTM D1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
 - 3. ASTM D1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique
 - 4. ASTM D4218: Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
 - 5. ASTM D4355: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus
 - 6. ASTM D4491: Standard Test Method for Water Permeability of Geotextiles by Permittivity
 - 7. ASTM D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
 - 8. ASTM D4716: Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

9. ASTM D4751: Standard Test Method for Determining Apparent Opening Size of a Geotextile
10. ASTM D5035: Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
11. ASTM D5199: Standard Test Method for Measuring Nominal Thickness of Geosynthetics
12. ASTM D5261: Standard Test Method for Measuring the Mass per Unit Area of Geotextiles
13. ASTM D6241: Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe
14. ASTM D6364: Standard Test Method for Determining Short-Term Compression Behavior of Geosynthetics
15. ASTM D7005: Determining the Bond Strength (Ply-Adhesion) of Geocomposites
16. ASTM D7179: Standard Test Method for Determining Geocomposite Breaking Force

B. Geosynthetic Research Institute (GRI)

1. GRI-GC8: Standard Guide for Determination of the Allowable Flow Rate of a Drainage Geocomposite
2. GRI-GN2* and GRI-GC13*: Standard Guide for Joining and Attaching Geonets and Drainage Composites

1.03 DEFINITIONS

- A. Geocomposite Manufacturer (Manufacturer) – The party responsible for manufacturing the geocomposite rolls.
- B. Geosynthetic Quality Assurance Laboratory (Testing Laboratory) – Party, independent from the manufacturer, Installer, Owner, and Owner’s On-Site Representative, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing.
- C. Installer – Party responsible for field handling, transporting, storing, and deploying the geocomposite.
- D. Lot – A quantity of resin (usually the capacity of one rail car) used to manufacture polyethylene geocomposite rolls. The finished rolls will be identified by a roll number traceable to the resin lot.

1.04 SUBMITTALS

- A. Prior to Installation – The following information shall be supplied to Owner or Owner’s On-Site Representative for review to ensure that the materials and parties selected for use on the project meet the requirements of this specification:
1. Statement of experience from the proposed geocomposite supplier.
 2. Statement of experience from the proposed geocomposite Installer.
 3. Samples of geocomposite proposed for use on the project.
 4. Product literature.
 5. Installation Quality Assurance Manual.
 6. Reference list supplied by geocomposite Manufacturer indicating the appropriate experience level as required by the specification.
 7. Reference list supplied by the geocomposite Installer indicating the appropriate experience level as required by this specification.
- B. Prior to Deployment – The following information shall be submitted by the Installer to Owner or Owner’s On-Site Representative prior to the deployment of any geocomposite material to ensure that the materials and subgrade preparation meet the requirements of this specification:
1. Copies of quality control certificates issued by the raw material supplier including the production dates of the raw material and the origin of the raw materials used to manufacture geocomposite for the project.
 2. Results of tests conducted by the Manufacturer to verify the resin quality used to manufacture the geocomposite rolls assigned to the project and the resin origin, along with quality control certificates issued by the resin supplier.
 3. Certification that no post-consumer reclaimed polymer is added to the resin during the manufacture of the geocomposite to be used in this project. Rework of identical manufactured product is allowable up to a limit of 7-percent by weight.
 4. Results of the product’s hydraulic Transmissivity measured in accordance with ASTM D4716.
 5. Test results of the product’s Compressive Strength measured in accordance with ASTM D6364.
 6. Manufacturing quality control certificates for each shift’s production signed by responsible parties employed by the Manufacturer (such as the Production Manager).
 7. The quality control certificate shall include:

- a. Roll numbers and identification.
 - b. Quality control test results, including descriptions of test methods used.
8. The Manufacturer quality control tests to be performed are outlined in Section 2.01 of this specification.
 9. Certification or affidavit signed by a legally authorized official of the Manufacturer attesting that the geocomposite meets the physical, manufacturing, and performance requirements stated in these specifications.
 10. Submit Manufacturer installation instructions and general recommendations.
 11. Certifications of subgrade acceptance for each area covered by geocomposite, signed by Contractor and Owner's On-Site Representative.

1.05 QUALIFICATIONS

A. Manufacturer

1. Manufacturer shall have manufactured a minimum of 10,000,000 square feet of polyethylene geocomposite during the last year.

B. Installer

1. Installer shall have installed a minimum of 2,000,000 square feet of geocomposite in the last 4 years.
2. Installer shall have worked in a similar capacity on at least 2 projects similar in complexity to the Project described in Contract Documents, and with at least 400,000 square feet of geocomposite installation on each project.
3. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

1.06 DELIVERY, STORAGE AND HANDLING

A. Labeling – each roll of geocomposite delivered to the site shall be wrapped and labeled by the Manufacturer. The label will identify:

1. Manufacturer's Name
2. Product Identification
3. Length
4. Width

5. Roll Number
 - B. Delivery – Rolls of geocomposite will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off-loading.
 - C. Storage – The on-site storage location for the geocomposite, provided by Contractor to protect the geocomposite from abrasions, excessive dirt, and moisture shall have the following characteristics:
 1. Level (no wooden pallets)
 2. Smooth
 3. Dry
 4. Protected from theft and vandalism
 5. Adjacent to the area lined
 - D. Handling
 1. The Installer shall note any visible damage to roll materials on the Bill of Lading prior to unloading roll materials. Should any visible damage be noted, Installer or Owner's On-Site Representative shall notify the Manufacturer in writing immediately.
 2. Contractor and Installer shall handle all rolls in such a manner to ensure they are not damaged in any way.
 3. The Installer shall take any necessary precautions to prevent damage to underlying layers during placement of the geocomposite.
- 1.07 WARRANTY
- A. Material shall be warranted, on a pro-rata basis against defects for a period of 20 years from the date of the geocomposite installation.
 - B. Installation shall be warranted against defects in workmanship for a period of 5 years from the date of geocomposite completion.
- 1.08 BASIS FOR COMPENSATION
- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GEOCOMPOSITE MATERIALS

A. Resin

1. Resin shall be new prime quality virgin, compounded polyethylene resin.
2. Natural resin (without carbon black) shall meet the following additional minimum requirements:

Table 1: Raw Material Properties

| Property | Test Method ⁽¹⁾ | Value |
|------------------------------|----------------------------|-------|
| Density (g/cm ³) | ASTM D792 | >0.94 |
| Melt Flow Index (g/10 min) | ASTM D1238 | ≤ 1.0 |

(1) Test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

B. Geotextile

1. The geotextile forming the friction surface shall be a 6 oz./yd² nonwoven needle-punched geotextile. The non-woven needle-punched geotextile specified herein shall be made from staple fiber.
2. The geotextile shall be made from prime quality virgin polymer.
3. The geotextile shall be able to withstand direct exposure to ultraviolet radiation from the sun for up to 15 days without any noticeable effect on index or performance properties.
4. Along the edges, about 6 to 12-inches of the geotextile shall not be heat bonded to allow adjacent geocomposite panel connection in the field.

C. Geocomposite Properties

1. The geocomposite shall be manufactured by extruding two round polyethylene strands to form a bi-planar drainage net structure. A non-woven geotextile shall be bonded to the bottom and the top sides.
2. The geocomposite shall be chemically inert when immersed in a leachate representative of that from a typical landfill. The geocomposite shall contain a maximum of one percent by weight of additives, fillers, or extenders (not including carbon black) and shall not contain foaming agents or voids within the ribs of the geocomposite.

3. The geocomposite shall be PermaNet 270 Geocomposite as manufactured by GSE Environmental, LLC, SKAPS TRANSTNETTM 330-2-6 Geocomposite as manufactured by SKAPS Industries, or a pre-approved equal having properties that meet or exceed the values listed in the following table.

Table 2 Geocomposite Properties

| Property | Test Method | Frequency | Minimum Average Roll Value ⁽¹⁾ |
|--|---------------------------------|---------------------------|---|
| Geocomposite | | | |
| Index Transmissivity ⁽²⁾ at 15,000 psf, m ² /sec | ASTM D4716 | 1/540,000 ft ² | 9 x 10 ⁻⁴ |
| Ply Adhesion Strength, lb/in | ASTM D7005 | 1/50,000 ft ² | 1.0 |
| Geonet Core⁽³⁾ | | | |
| Index Transmissivity ⁽²⁾ , m ² /sec | ASTM D4716 | 1/540,000 ft ² | 4 x 10 ⁻³ |
| Thickness, mil | ASTM D5199 | 1/50,000 ft ² | 270 mil |
| Density, g/cm ³ | ASTM D1505 | 1/50,000 ft ² | 0.94 |
| Compression Strength, psf | ASTM D6364 | 1/540,000 ft ² | 40,000 |
| Tensile Strength (MD), lb/in | ASTM D5035/D7179 | 1/50,000 ft ² | 75 |
| Carbon Black Content, % | ASTM D4218 | 1/100,000 ft ² | 2.0-3.0 |
| Geotextile | | | |
| Mass per Unit Area, oz/yd ² | ASTM D5261 | 1/90,000 ft ² | 6 |
| Grab Tensile, lb | ASTM D4632 | 1/90,000 ft ² | 160 |
| CBR Puncture Strength, lb | ASTM D6241 | 1/90,000 ft ² | 435 |
| Trapezoidal Tear Strength, lb | ASTM D4533 | 1/90,000 ft ² | 65 |
| AOS, US Sieve (mm) | ASTM D4751 | 1/540,000 ft ² | 70 (0.212) |
| Permittivity, (sec ⁻¹) | ASTM D4491 | 1/540,000 ft ² | 1.5 |
| Flow Rate, gpm/ ft ² | ASTM D4491 | 1/540,000 ft ² | 110 |
| UV Resistance, % retained | ASTM D4355 (After 500-hours) | Per formulation | 70 |
| Typical Roll Dimensions | | | |
| Roll Length ⁽⁴⁾ , ft | | | 210 |
| Roll Width ⁽⁴⁾ , ft | | | 15 |
| Roll Area, ft ² | | | 3,150 |

(1) All values are minimum average roll values (MARV) except thickness which is a typical value.

(2) Transmissivity at gradient of 0.1, water at 20°C or 70°F between plates for 15-minutes.

(3) Component properties prior to lamination.

(4) Roll widths, lengths and areas have a tolerance of ±1%.

2.02 MANUFACTURING QUALITY CONTROL

- A. The geocomposite shall be manufactured in accordance with the Manufacturer's Quality Control Plan submitted to and approved by Engineer.
- B. The geocomposite shall be tested according to the test methods and frequencies listed in Table 2.
- C. Geocomposite material in non-conformance with these specifications shall be subject to rejection.

PART 3: EXECUTION

3.01 INSPECTION

- A. Prior to implementing any of the work in the section to be lined, the Installer shall carefully inspect the installed work of all other sections and verify that all work is complete to the point where installation of the section may properly commence without adverse impact.
- B. If the Installer has any concerns regarding the installed work of other sections, Installer shall notify Engineer.

3.02 MATERIAL PLACEMENT

- A. The geocomposite roll should be installed in the direction of the slope and in the intended direction of flow unless otherwise specified by Engineer.
- B. To maximum extent possible, minimize panel butt seams on slopes greater than 2-percent.
- C. In the presence of wind, all geocomposites shall be weighted down with sandbags or the equivalent. Such sandbags shall be used during placement and remain until replaced with cover material.
- D. The geocomposite shall be properly anchored to resist sliding. Anchor trench compacting equipment shall not come into direct contact with the geocomposite.
- E. Motorized vehicles are not allowed to travel directly on the geocomposite during installation.
- F. In applying fill material, no equipment can drive directly across the geocomposite. The specified fill material shall be placed and spread utilizing vehicles with a low ground pressure.
- G. The cover soil shall be placed on the geocomposite in a manner that prevents damage to the geocomposite. Placement of the cover soil shall proceed immediately following the placement and inspection of the geocomposite.

- H. See Section 31 05 19.13, Geotextiles for Earthwork for additional geotextile installation requirements.

3.03 SEAMS AND OVERLAPS

- A. Each component of the geocomposite will be secured to the like component at overlaps.
- B. Geocomposite Components
 1. Adjacent edges along the length of the geocomposite roll shall be overlapped a minimum of 6-inches or as recommended by Engineer.
 2. The overlapped edges shall be joined by tying to geonet structure with cable ties. These ties shall be spaced every 5 feet along the roll length.
 3. Adjoining rolls across the roll width should be shingled down in the direction of the slope, and joined together with cable ties spaced every foot along the roll width. The top geocomposite will overlap the bottom geocomposite a minimum of 12-inches across the roll width. Geocomposite rolls shall be terminated in sumps, swales, or anchor trenches as detailed on the Drawings.

3.04 REPAIR

- A. Prior to covering the deployed geocomposite, each roll shall be inspected for damage resulting from construction.
- B. Any rips, tears or damaged areas on the deployed geocomposite shall be removed and patched. The patch shall be secured to the original geocomposite by tying every 6-inches with the approved tying devices. If the area to be repaired is more than 50 percent of the width of the panel, the damaged area shall be cut out and the two portions of the geocomposite shall be joined in accordance with paragraph 3.03.
- C. See Section 31 05 19.13 Geotextiles for additional geotextile repair requirements.

END OF SECTION 31 05 19.26

SECTION 31 10 00
CLEARING AND GRUBBING

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete site clearing and grubbing, including, but not limited to:
 - 1. Clearing and grubbing that includes: cutting and/or removing all trees, shrubs, and herbaceous plants (including stumps) as shown on Drawings.
 - 2. Protecting all remaining trees and vegetative materials located within and adjacent to the construction limits and as directed by Engineer.
 - 3. Proper composting and/or disposal of vegetative materials cleared and grubbed from the site in accordance with Laws and Regulations.
 - 4. Topsoil stripping.

1.02 SUBMITTALS

- A. No submittals are required from this Section.

1.03 SEQUENCING AND SCHEDULING

- A. Coordinate sequencing and scheduling of Work on the site with Owner and Engineer.

1.04 BASIS FOR COMPENSATION

Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS (NOT USED)

PART 3: EXECUTION

3.01 CLEARING AND GRUBBING

- A. Clear and grub areas indicated on Drawings or as directed by Owner.

- B. Remove stumps, roots, and buried logs.
- C. Protect trees not marked to be removed.
- D. Composting and/or chipping of cleared vegetation are incidental to the Work.

3.02 TOPSOIL

- A. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other objectionable material; remove heavy growths of grass from areas before stripping.
- B. Stockpile topsoil in storage piles for use during site restoration in areas shown on the Drawings or approved by Owner and Engineer. Construct storage piles to provide free drainage of surface water and provide and maintain erosion control.

3.03 DISPOSITION OF MATERIALS

- A. Dispose of demolished materials at a suitable location for off-site disposal in accordance with Laws and Regulations. Transport all debris, rubbish, and other materials, including all vegetation removed during clearing and grubbing activities, from the site weekly (at a minimum).
- B. Burning of materials will not be permitted on the site.

END OF SECTION 31 10 00

SECTION 31 23 00

MASS EXCAVATION, EMBANKMENT, AND STOCKPILES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete all general or miscellaneous excavation and fill operations at the site including, but not limited to:
 - 1. General stripping, excavation, and stockpiling of soil materials. Specific requirements for trenching are described in Section 33 05 28, Trenching and Backfilling for Utilities.
 - 2. Hauling, placing, and compacting soils.
 - 3. General site grading.
 - 4. Elevation, grade, and material thickness requirements.
- B. Related Sections
 - 1. Section 31 23 16 Waste Excavation and Consolidation
 - 2. Section 31 23 23 Liner and Cover Soil Materials
 - 3. Section 32 92 00 Turfs and Grasses
 - 4. Section 33 05 28 Trenching and Backfilling for Utilities

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 2. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.
 - 3. Minnesota Pollution Control Agency Best Management Practices for the Off-Site Reuse of Unregulated Fill

4. Occupational Safety and Health Standards-Excavations (OSHA)
 - a. OSHA set forth in 29 CFR 1926, Subpart P.

1.03 SUBMITTALS

- A. Submit for approval a Materials Handling Plan prior to excavation and transport of any materials. Materials Handling Plan shall include:
 1. Section A: Project Coordination
 - a. Resume of Project superintendent(s)
 - b. Identification of key personnel
 - c. Detailed Project staffing plan showing staffing levels and numbers for each task and phase of the Work, along with any plans for shift work
 - d. List of major equipment, systems, and material
 - e. List of permits and approvals obtained by Contractor, including contact names, titles, and phone numbers for the permitting agency representative
 2. Section B: Work Schedule
 - a. Contractor's initial Work schedule
 3. Section C: Construction Facilities and Temporary Controls
 - a. Plan for how utilities will be managed during the Work
 - b. Plan for temporary utility services
 - c. A Site layout drawing showing the following information:
 - 1) Location of Contractor's office trailer, if used
 - 2) Location of laydown areas
 - d. Contingency plan that outlines steps that will be taken in response to failures of proposed sediment control structures or exceedances of water quality requirements
 4. Section D: Excavation and Fill Plan
 - a. Contractor shall provide design for excavation deeper than 20'.

- b. Vehicle and equipment requirements and descriptions, driver instructions, decontamination procedures, and emergency procedures.
 - c. Method of elevation control during excavation and filling
 - d. Number and types of ancillary equipment
 - e. Proposed sequence of material excavation, transport, and placement
 - f. Description of how survey verification will be coordinated with excavation and filling activities
 - g. Description of areas requiring long term and intermediate cover
 - h. Methods and procedures to ensure that waste-contact surface runoff does not leave the existing waste limits
- B. Submit for information a list of sources of imported materials specified in this Section to Owner or Owner's On-Site Representative at least two weeks prior to delivery of materials to the Site.
 - C. Testing shall be conducted according to appropriate ASTM standards to conform required material properties or classifications specified in this Section.
 - D. Submit for approval a Proposed Stockpiling Plan which includes locations and types of proposed stockpiles prior to excavation and transport of any materials. Plan shall include access routes, flood protection, stockpile dimensions, restoration plan, sequencing and phasing, and erosion control measures.
 - E. Submit for review all other soil testing and survey data as specified in Section 01 45 00, Quality Control.
 - 1. Owner or Owner's On-Site Representative may take samples of the material during the progression of the Work to verify compliance with the Specifications. Materials not meeting the Specifications shall be removed and replaced at Contractor's expense, including the cost for testing.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Upon delivery of materials to the Site, provide access for sampling or observation of loads by Owner or Owner's On-Site Representative prior to unloading.
- B. Store materials where designated or as directed by Owner or Owner's On-Site Representative. Prevent segregation of graded materials and mixing of dissimilar materials during unloading, stockpiling, or removal from stockpile.

1.05 SEQUENCING AND SCHEDULING

- A. Owner's On-Site Representative will be evaluating results of Contractor's independent registered land surveyor's grade, slope, and material thickness verifications. Owner's On-Site Representative will be evaluating results of Contractor's independent soil laboratory field and laboratory soil test results, as described in Section 01 45 00, Quality Control. Do not proceed with subsequent operations until Owner and Owner's On-Site Representative have been notified and have been given opportunity to verify that Work meets the requirements of these Specifications.

1.06 JOB CONDITIONS

- A. It shall be Contractor's sole responsibility to review available tests and reports, conduct additional tests, and otherwise determine to its own satisfaction the location and nature of all surface and subsurface features and the soil and water conditions that may be encountered.
- B. Use of explosives will not be permitted.
- C. Contractor shall be solely responsible for determining the means and methods for meeting the compaction requirements unless otherwise specified herein, except that compaction by flooding, puddling, or other means that involve saturation or over-wetting the soil will not be permitted.
- D. Provide shoring, bracing, sheet piling, trench boxes, tie backs, and other measures required to perform all the Work in accordance with Laws and Regulations. Specifically, all excavations shall conform to the requirements of OSHA set forth in 29 CFR 1926, Subpart P.

1.07 ENVIRONMENTAL COMPLIANCE – IMPORT SOILS AND AGGREGATES

- A. All sources of import soils and aggregates specified herein shall meet the MPCA definition of Unregulated Fill. Import soils and aggregates shall be free of contamination, invasive species, debris, roots, organic material, frozen materials, and recycled materials.
- B. Contractor shall provide access to proposed source(s) for inspection by Engineer and Owner, and Owner reserves the right to reject a source if contamination is suspected.

1.08 QUALITY CONTROL

- A. Source quality control:
 - 1. The entire quantity required for imported products shall be obtained from a single source for each product, if possible. Contractor must obtain approval from Owner for all sources used through the procedures described in Section 01 45 00, Quality Control if it is necessary to use multiple sources for any material.
 - 2. Contractor shall perform source quality control testing as described in Section 01 45 00, Quality Control.

3. Owner or Owner's On-Site Representative may take samples of the material during the progression of the Work to verify compliance with the Specifications. Materials not meeting the Specifications shall be removed and replaced at Contractor's expense, including the cost for testing.

B. Field quality control:

1. Perform field quality control as specified in Section 01 45 00, Quality Control.

1.09 TEMPORARY ENVIRONMENTAL CONTROLS

- A. See Section 01 57 19, Temporary Environmental Controls, for Noise Control, Dust Control, Water Management and Control, and Cleaning requirements.

1.10 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Radon-free material free of wood, organic soils, peat, topsoil, debris, roots, sticks, brush, non-soil materials, and other unsuitable materials which in the opinion of Engineer will have a deleterious effect on the Work.
- B. Boulders larger than 6 inches in diameter shall not be allowed.
- C. Contractor shall furnish all materials designated "IMPORTED".

2.02 COMMON FILL

- A. Common fill (salvaged)
1. All soil materials except organic soils and shall be free of vegetation, peat, debris, roots, sticks, brush, non-soil materials, and other materials which in the opinion of Engineer will have a deleterious effect on the Work.
 2. Excavated onsite soils, free of organic matter or debris and rocks greater than 6 inches in diameter may be used as common fill.
 3. Do not use high plasticity silt or clay (MH, CH) soils as common fill.
- B. Common fill (imported)

1. All soil materials except organic soils and shall be free of vegetation, peat, debris, roots, sticks, brush, non-soil materials, and other materials which in the opinion of Engineer will have a deleterious effect on the Work.
2. Soil, free of organic matter or debris and rocks greater than 6 inches in diameter may be used as common fill.
3. Do not use high plasticity silt or clay (MH, CH) soils as common fill.

2.03 PIPE BEDDING (IMPORTED)

- A. See Section 31 23 23, Liner and Cover Soil Materials for pipe bedding material requirements.

2.04 COVER SOIL

- A. See Section 31 23 23 Liner and Cover Soil Materials for cover soil requirements.

2.05 TOPSOIL

- A. See Section 31 23 23 Liner and Cover Soil Materials for topsoil requirements.

PART 3: EXECUTION

3.01 GENERAL

- A. Maintain all waste-contact surface water runoff within the existing waste limits; carry-over of this runoff outside the existing waste limits is strictly prohibited.
- B. Locate and protect overhead and underground utilities.
- C. Construct excavations in accordance with applicable Laws and Regulations.
- D. Remove and replace material not meeting these Specifications and native soils or compacted fill softened by frost, flooding or weather.
- E. Provide temporary controls such as diversions and dewatering equipment to prevent surface runoff from entering excavations and to remove ponded water from excavations. Maintain excavations in a dry and stable condition at all times.
- F. Extend excavations a sufficient distance to allow placement and compaction of bedding, encasement, and other required backfill materials, to prevent sloughing of materials into the excavation, and to permit observation of the Work by Owner or Owner's On-Site Representative. Excavate to sufficient depth to remove loose or disturbed soil. Avoid over-excavating sound, clean native soil.
- G. Subsurface dewatering outside construction limits not permitted without Owner's permission.

- H. See Sections 33 05 28, Trenching and Backfilling for Utilities and 31 23 23, Liner and Cover Materials for additional specifications related to trenching and backfilling for utilities.

3.02 EXCAVATION

A. Soil Stripping

1. Strip and segregate Cover Soil and Topsoil. Cover soil and Topsoil to be stockpiled for use in restoration activities and landfill cover.
2. See Section 31 23 23, Liner and Cover Soil Materials for additional detail on Cover Soil and Topsoil.
3. Excavate to locations shown on the drawings. Material to be stockpiled as described in Section 3.03.

B. Waste Excavation

1. See Section 31 23 16, Waste Excavation and Consolidation for excavation requirements.

C. Common fill

1. On-site soil material not classified as cover soil or topsoil that meets the conditions in Section 2.02.
2. Excavate to locations shown on the drawings. Material to be stockpiled as described in Section 3.03.

D. Bedrock Excavation

1. Excavate bedrock as necessary to support liner subgrade and water and sanitary utilities.
2. Bedrock materials to be buried in low lying restoration areas agreeable to Owner. No bedrock materials may be placed under landfill liner, ramps, roads, embankment, or berm construction.

E. Peat Excavation

1. Excavate peat as necessary to support subgrade for landfill liner, ramps, roads, embankment, or berm construction.
2. Owner's Onsite Representative will determine if Peat materials are considered Waste, See Waste Excavation, or clean materials. Peat materials, determined to not be waste, to be buried in low lying restoration areas agreeable to Owner. No peat materials may be placed under landfill liner, ramps, roads, embankment, or berm construction.

F. Excavation Adjacent to Existing Features

1. Contractor shall excavate adjacent structures or piping so as not to damage existing features that are specified to remain in place.
2. Necessary repairs to existing site improvements damaged by Contractor will be at Contractor's expense.

G. Maintenance of excavations and slopes:

1. Excavate and remove material outside the limits of the excavation that is unstable and constitutes potential slides, and material which falls or rolls into excavations for any reason.
2. Maintain slopes until substantial completion and acceptance of the work. Promptly repair slides, slip-outs, washouts, settlements, and subsidences that occur for any reason, and refinish the slope to the lines and grades indicated on the Drawings.

3.03 STOCKPILES

- A. Maintain stockpile slopes to meet applicable Laws and Regulations.
- B. Do not place any temporary stockpiles within drainage ways or wetlands. Stockpile locations shall be protected from flooding. All stockpile locations must be coordinated and approved by Owner or Owner's On-Site Representative.
- C. Grade stockpiles to be free-draining and to present a uniform appearance.
- D. Install erosion control devices around the stockpile as necessary to minimize erosion.
- E. Maintain stockpiles in accordance with requirements of the SWPPP.
- F. Furnish equipment suitable for soil conditions and compactive effort required to meet compaction criteria specified herein.

3.04 BACKFILL, FILL, AND COMPACTION

- A. Place backfill and fill materials in layers not more than 12 inches in loose depth, except as noted. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Scarify, remoisten, and recompact surfaces that have been dried, weathered, or loosened between lifts.
- B. Do not place fill on soil layers requiring certification surveys until finished elevation documentation is approved by Engineer.

- C. Place backfill materials at the locations and to the dimensions and thicknesses shown on the Drawings. Furnish equipment suitable for soil conditions and compactive effort required to meet compaction criteria specified herein.
 - 1. Granular soils shall be compacted using vibratory mechanical compaction equipment.
 - 2. Fine-grained soils shall be compacted using sheepsfoot mechanical compaction equipment.
 - 3. Fill material consisting of cohesive, clayey soils shall be compacted with a sheepsfoot roller in lifts not exceeding the requirements herein.
- D. Backfill and compact only with pre-approved materials and those called out on the Drawings.
- E. Do not place frozen material or place fill on frozen or unsuitable subgrade.
- F. Contractor shall remove and replace fill that is too wet to permit compaction as specified.
- G. Uniformly compact each lift by operating equipment over the entire area prior to placing the subsequent lift.
- H. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift. Protect insulation by hand placement if necessary. Notify Engineer of any damage and repair as approved before proceeding.
- I. Moisture content and density control:
 - 1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil to prevent free water appearing on surface during or subsequent to compaction operations. Disc or otherwise thoroughly mix to distribute added water.
 - 2. Remove and replace soil material that is too wet to permit compaction as specified.
 - 3. Compaction by flooding or other means that involve saturation or over-wetting the soil will not be permitted.
- J. General:
 - 1. Place and compact any material within 3 feet of finished ground surface under pavements to minimum 100% of standard Proctor maximum dry density (ASTM D698) and within +/- 2% of optimum moisture content.
- K. Common Fill
 - 1. Place Common Fill for ramps, roads, embankment, berm construction, and restoration area as shown on the Drawings.

2. Place and compact Common Fill to minimum 95% of standard Proctor maximum dry density (ASTM D698) and at a water content matching the range of water content at which the standard proctor curve indicates a dry density of 95% or greater.
3. Proof roll and examine common fill subgrade to determine existence of soft areas, areas loosened by frost action or softened by flooding, weather, or unsuitable materials. Do not place common fill on existing waste or other unsuitable subgrade materials.

L. Pipe Bedding/Utility backfill:

1. See Section 31 23 23, Liner and Cover Soil Materials for Pipe Bedding requirements.

M. Topsoil:

1. See Section 31 23 23, Liner and Cover Soil Materials for Topsoil requirements.

3.05 GRADING

- A. Grade intermediate slopes to minimize erosion potential. Maintain temporary erosion controls as necessary to minimize erosion.
- B. Smooth-grade finished ground on exterior slopes of berms, along access roads, and other areas disturbed by Contractor's activities, to uniform levels or slopes between points where elevations are shown, or between such points and existing ground.
- C. Construct ditches and/or drainage swales to control run-on onto and run-off from topsoil and within the Construction Limits as directed by Owner's On-site Representative.

3.06 RESTORATION OF DISTURBED AREAS

- A. See Section 31 23 23, Liner and Cover Soil Materials for restoration requirements.

3.07 TOLERANCES

- A. Construct the excavation and backfill Work within the dimensional tolerances given below. Alignment, elevation, thickness, and grade tolerances are acceptable deviations from the dimensions shown on the Drawings.
- B. Alignment Tolerances (subgrade and embankment)
 1. Road Centerlines: +/- 0.2 foot.
- C. Elevation Tolerances:
 1. Compacted Clay Liner subgrade: +0.0 foot, - 0.5 foot.
 2. Landfill Embankment Road and other Road Surfaces: +/- 0.2 foot.

3. Pipe Grade: +/- 0.1 foot.

D. Grade Tolerances:

1. Landfill Embankment Road: 1.5 to 2.5 percent.

2. Access Ramp Cross-Slopes: 1.5 to 2.5 percent.

3. Restoration area: +0.2 percent to -0.0 percent (must maintain 0.5 percent minimum slope everywhere).

3.08 MAINTENANCE

A. Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Maintain erosion control.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.09 DISPOSITION OF MATERIALS

A. Manage debris resulting from the Work or encountered on Site in accordance with applicable Laws and Regulations. Debris may include abandoned electrical cable, abandoned well materials, or other man-made objects.

B. Debris may be placed within newly constructed lined facility or transported to an approved landfill in accordance with Section 31 23 16, Waste Excavation and Consolidation.

C. Burning of materials will not be permitted on the Site.

END OF SECTION 31 23 00

SECTION 31 23 16

WASTE EXCAVATION AND CONSOLIDATION

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete all waste excavation operations at the site including, but not limited to:
 - 1. Waste excavation, screening, relocating, and consolidation.
 - 2. Hauling and off-site disposal of Unacceptable Waste.
 - 3. Monitoring of environmental conditions, including trash, odors, organic vapors, and vectors.
 - 4. Implementation of environmental controls.
- B. Related Sections
 - 1. Section 31 23 00 Mass Excavation Embankment and Stockpiles
 - 2. Section 31 23 19 Dewatering

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. Focused Remedial Investigation Report, Freeway Landfill and Freeway Dump. Prepared for Minnesota Pollution Control Agency. Barr Engineering Company. October 2009.
 - 2. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 DEFINITIONS

- A. Waste: existing buried waste that is present at the Site and will be removed in accordance with these Specifications
 - 1. Acceptable Waste: represents a significant majority of the waste present at the site, including mixed municipal waste and ash, and may be placed in the newly constructed, on-site lined facility.

2. Unacceptable Waste: represents a small fraction of the waste that may not be placed in the newly constructed, on-site lined facility. Unacceptable Waste includes homogenous pockets of waste that does not fall into one of the Acceptable Waste categories. If the Unacceptable Waste accounts for 5% or less (by volume) of the waste that would fit in a haul truck, then that load will be considered Acceptable Waste. If more than 5% of Unacceptable Waste is encountered in an area, Contractor shall segregate the waste and implement the procedure detailed in Section 3.03, part G. Examples of Unacceptable Wastes might include vehicle batteries, tires, etc.

1.04 SUBMITTALS

- A. Submit for approval a Waste Excavation and Relocation Plan prior to excavation of any materials. Plan shall include the following components:
 1. Methods and sequencing of excavation and relocation of waste
 2. Waste classification and screening procedures as required by this Section
 3. Location and management of waste stockpiles
 4. Approach for limiting and controlling water in excavations (may reference Dewatering Plan, see Section 31 23 19, Dewatering)
 5. Contingency Plan to be implemented if Minnesota River elevation rises to levels specified in Section 3.03.
 6. Approach and products to be used to comply with Odor Control and Vector Control requirements of this Section
- B. Submit for approval a Sampling and Analysis Plan to be implemented if, based on Contractor's Waste Screening procedures, excavated material is determined to be Unacceptable Waste. Sampling and Analysis Plan shall describe Contractor's sampling methodology, approach, and subcontracted analytical laboratory.
 1. Samples shall be collected by appropriately trained personnel
 2. Laboratory shall be accredited by Minnesota Department of Health
 3. Sample methodology and analytical methods shall meet the requirements of the licensed disposal facilities that the waste may need to be taken to.
- C. Submit for approval a list of Licensed Disposal Facilities that would accept the Unacceptable Wastes identified in paragraph 1.03.
- D. Submit for approval an Excavation Environmental Controls Plan, including the following:
 1. Approach to minimize generation of odors and discourage vector intrusion

2. Quantitative and/or qualitative descriptions of limits that will be in place to monitor air quality, odors, and presence of vectors. Limits shall be no less restrictive than the following:
 - a. Organic Vapors – sustained vapor readings over a 30 minute period shall not exceed background readings taken at upwind construction limits.
 - b. Odors – sustained qualitative assessment of construction-related odors over a 30 minute period shall not exceed assessment taken at upwind construction limits.
3. Monitoring locations (within Site limits), methods and frequencies
4. Product specifications
5. Approach to implement control measures when necessary

1.05 SEQUENCING AND SCHEDULING

- A. Flood protection berm must be constructed prior to excavation within the Flood Protection Boundary.

1.06 TEMPORARY ENVIRONMENTAL CONTROLS

- A. See Section 01 57 19, Temporary Environmental Controls, for Noise Control, Dust Control, Water Management and Control, and Cleaning requirements.

1.07 EXCAVATION ENVIRONMENTAL CONTROLS

- A. Provide methods, means, and facilities to minimize odors, litter control/prevent blowing trash, control vectors, and control volatile organics that are produced by waste excavation activities.
- B. Identify areas that may require long term or intermediate cover to control odors, minimize vectors, and control blowing trash.
- C. Monitor for presence of odors, vectors, and volatile organics at the frequencies and locations identified in Excavation Environmental Controls Plan. If monitoring identifies the presence of odors, vectors, or air quality in excess of the criteria listed in Excavation Environmental Controls Plan, implement control measures. If control measures are ineffective at rectifying the situation, then cease the work that is generating the exceedance of criteria until a plan can be established and implemented to bring the situation back in compliance with the criteria identified in Excavation Environmental Controls Plan.
- D. Recover trash that blows away from exposed working faces or stockpiles.
- E. In addition to Contractor's monitoring, Owner or Owner's On-Site Representative may perform independent monitoring. If Owner or Owner's On-Site Representative's monitoring indicates the

presence of odors, vectors, or organic vapors in excess of the criteria listed in Excavation Environmental Controls Plan, then Contractor shall implement control measures.

1.08 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 POLYETHYLENE SHEETING

- A. Minimum thickness of 10-mil

2.02 SPRAY APPLIED CONTROL MATERIALS

- A. Posi-shell Cover System, or equivalent

2.03 COMMON FILL

- A. See Specification Section 31 23 00, Excavation and Fill for Common Fill requirements

PART 3: EXECUTION

3.01 GENERAL

- A. See Section 31 23 00, Excavation and Fill for additional excavation requirements.

3.02 EXCAVATION

- A. Waste Excavation
 1. Contractor shall excavate waste as shown on the Drawings.
 2. Contractor shall prevent waste from contact with areas outside of the existing waste limits and shall prevent transport of waste by tracking, erosion, wind erosion, or other transport mechanisms.
 3. Any waste spills located outside of existing waste limits shall be removed and cleaned up immediately.
 4. Excavation will be guided by visual field characterization with Owner or Owner's On-Site Representative conducting a review for acceptance of the extent of excavation. Verification of waste material excavation extent shall include:

a. Horizontal Limits

- 1) The horizontal limits of the waste as indicated on the Drawings, are approximations based on analysis and evaluation of soil borings and other geotechnical information.
- 2) Contractor will extend excavation limits horizontally until the limits of the waste material has been reached (with exception listed below), as directed and verified by the Owner or Owner's On-Site Representative.
 - a) In several locations, waste will be left behind, as shown on the Drawings. In those locations, excavate to the limits that will prevent damage to the adjacent facilities (e.g., paved surfaces and buildings).
- 3) Excavation beyond the limits identified on the Drawings should only occur after Contractor receives direction from Owner or Owner's On-Site Representative.

b. Vertical Limits

- 1) The vertical limits of waste has been approximated based on analysis and evaluation of soil borings and other geotechnical information.
 - 2) If clean soils are encountered prior to bedrock, then test pits to a depth of at least three feet below apparent waste bottom or to bedrock, whichever is shallower, will be conducted at a rate of three per acre to visually confirm no underlying waste materials are present in the sector. Excavation in that sector will be deemed complete if visual inspection finds primarily "clean" or "native" soils in the test pits.
5. Do not place fill over excavated areas until excavated area is documented (including photo), surveyed, and approved by Owner or Owner's On-Site Representative.
 6. If significant areas of apparently clean soil are encountered within an area targeted for waste excavation, the potentially clean will be segregated and temporarily stockpiled for screening by Owner for acceptance prior to use.
 7. If soil conditions are encountered that cannot be adequately dewatered prior to excavation, the target elevation of waste shall be 1 foot below the (construction drawing's) excavation surface (or bedrock if encountered sooner). Excavated material shall be inspected, and excavation shall continue if waste is present.
 8. If needed, dewater or stabilize free liquids for any excavated Waste within the excavation area prior to loading for offsite transport and disposal. Any dewatering must meet Section 31 23 19, Dewatering.
 9. Amount of exposed waste material shall be minimized in an effort to reduce generation of odors and blowing trash, and to discourage vector intrusion.

10. Intermediate and long-term cover may be required over waste stockpiles or open excavation faces to manage blowing and loose waste, to discourage water intrusion, to control odor, and to comply with Stormwater Pollution Prevention Plan (SWPPP) requirements.
 - a. Intermediate cover will be required when conditions require to control blowing of materials or excessive odor, in accordance with Contractor's Excavation Environmental Controls Plan or as directed by the Owner's On-Site Representative.
 - b. Long-term cover will be required for compliance with the Stormwater Pollution Prevention Plan (SWPPP) requirements.
 - c. Intermediate cover will consist of a spray-applied product (such as Posi-shell or approved equivalent) or a thin layer of Common Fill.
 - d. Long-term cover will consist of a minimum of 6-inches of Common Fill seeded per Stormwater Pollution Prevention Plan (SWPPP) requirements.

3.03 WASTE RELOCATION

- A. Relocated waste shall be placed and compacted in layers by spreading and leveling material during placement. Spread individual layers to a uniform thickness throughout in horizontal lifts.
- B. Place waste materials uniformly in maximum 18-inch loose lifts.
- C. Place soil-like waste materials, e.g. contaminated native subgrade soils or existing cover soils interfacing the existing waste, to a minimum thickness of three feet above the sand layer overlying the landfill liner.
- D. Compact relocated waste materials utilizing a 35-ton sheepsfoot compactor. After 20 feet of waste is in place, a compactor heavier than 35 tons may be used. A minimum of three passes shall be made over placed and graded waste, before placing next lift. Areas showing inconsistent degrees of yielding or rutting shall be recompact as necessary. Proof-rolling will be observed and compaction approved by the Engineer or Owner's On-Site Representative.
- E. Place soil-like waste materials, e.g. contaminated native subgrade soils or existing cover soils interfacing the existing waste, within 2 feet of the finished final cover subgrade surface. Smooth-roll the finished ground subgrade surface to remove surface irregularities.
- F. FLOOD PROTECTION
 1. During Waste excavation, Contractor shall be responsible maintaining flood projections as shown on the Drawings. All active waste excavation, stockpiling, loading, and placement areas shall be protected from Minnesota River flooding throughout the work.
 2. Flood protection will be accomplished by a combination of relying on existing waste embankments yet to be excavated, construction of temporary soil embankments, and

construction of the final landfill flood protection embankments. Flood protection in specific areas may transition across those approaches, with transition work occurring during wintertime when flood risk is lowest, and river and weather forecast are favorable for maintaining non-flood conditions. Transition work will include removing existing waste to allow construction of temporary or final embankments. or removing temporary embankments to allow construction of final embankments.

3. Contractor shall monitor Minnesota River forecasts at all times during construction. If, at any time, work is performed outside of the flood protection berm and the river is forecasted to rise within two vertical feet of the active work area, Contractor shall implement Contingency Measures, as detailed in Waste Excavation and Relocation Plan submittal.

G. WASTE CLASSIFICATION AND SCREENING

1. Contractor shall be responsible for on-going screening of excavated material and classifying it as Acceptable Waste or Unacceptable Waste. Owner may also screen excavated material and will promptly inform Contractor of Owner's findings.
2. If areas of potential Unacceptable Waste, Contractor shall notify Owner's On-Site Representative and implement the following procedures:
 - a. If possible, discontinue excavation in area of concern until further characterization has been made.
 - b. If necessary, remove material in question and place either over existing waste or on top of 10-mil (min) polyethylene sheeting. Cover with 10-mil (min) polyethylene sheeting when inactive. Clearly delineate and identify material so that other material does not become co-mingled with material in question.
 - c. Collect and analyze representative characterization samples, per requirements of Licensed Disposal Facility, and in accordance with approved Sampling and Analysis Plan.
 - d. Inform Owner's On-Site Representative of disposal plan and disposal cost.
 - e. Dispose of material after acceptance by disposal facility and upon approval by Owner's On-Site Representative
3. If waste is suspected to contain hazardous material, Contractor shall notify Owner or Owner's On-Site Representative and proceed with handling, storing, testing, and disposing in accordance with procedure outlined above and waste regulations
4. The cost to address Unacceptable Waste will be developed as follows:

- a. The cost to load, haul, and dispose of Unacceptable Waste will be agreed upon prior to disposal once a suitable disposal facility can be determined.
- b. The cost to segregate, stockpile, and evaluate Unacceptable Waste is considered incidental.
- c. The cost to excavate Unacceptable Waste, even though it may not be placed in the on-site facility would already be included in the measurement of excavated waste, which is based on pre- and post-excavation surveys.

3.04 EQUIPMENT DECONTAMINATION

- A. Construct decontamination pads at exit of each removal area and at exit from project area.
- B. After completion of project or excavation in a particular area, remove decontamination pad and dispose.
- C. Decontaminate all equipment prior to demobilizing from site.
- D. Prior to haul truck leaving site, truck shall pass through the decontamination area. If necessary, brush any spilled or loose waste or impacted soil from haul trucks. If dry brushing and driving over rattle plate is insufficient to remove material from outside of trucks and prevent tracking, then spray with water to remove material. Allow water to drain back into removal area and infiltrate into soil.

3.05 HAULING

- A. Trucks transporting material within the site shall take care to not cross-contaminate waste materials into clean areas.
- B. Any trucks leaving the site shall be decontaminated, covered, and in compliance with applicable laws and regulations.
- C. Any trucks leaving the site shall be watertight such that liquids do not drip or drain from the truck during transport.
- D. Waste shall be in a condition to meet requirements of landfill, including passing paint filter test.

END OF SECTION 31 23 16

SECTION 31 23 19

DEWATERING

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete excavation dewatering at the site including, but not limited to:
 - 1. Collection and treatment of water from excavation areas for solids removal.
 - 2. Discharge of treated water from the excavation area.
 - 3. Management of solids generated during water treatment.
- B. Surface water runoff volumes and groundwater levels vary from area to area and season to season, and dewatering may be required at times for construction of this Project. Furthermore, depending on groundwater table elevation, some excavated materials may require dewatering prior to transport. The need for dewatering shall be determined by the Contractor, and dewatering shall be the responsibility of the Contractor.
- C. Dewatering activities shall be coordinated with Owner.
- D. Related Sections
 - 1. Section 01 57 19 Temporary Environmental Controls
 - 2. Section 31 23 16 Waste Excavation and Consolidation
 - 3. Section 31 25 00 Erosion and Sediment Control

1.02 DEFINITIONS

- A. Non-Contact Water: water (stormwater, groundwater, or surface water) that does not come into contact with waste material.
- B. Contact Water: water (stormwater, groundwater, or surface water) that comes into contact with waste material.

1.03 PERFORMANCE REQUIREMENTS

- A. Minimize contact water generation to the extent practical.

- B. Maintain all contact surface water runoff within the existing waste limits; carry-over of this runoff outside the existing waste limits is strictly prohibited.
- C. Water that accumulates within an excavation is allowed to infiltrate.
- D. Water that is removed from an excavation will require management in accordance with this specification.

1.04 SUBMITTALS

- A. Work plan for approval including:
 - 1. Dewatering plan describing the means and methods that will be used to successfully accomplish water collection, treatment, and discharge of dewatering water during the Work. Information in the dewatering plan shall include, but not be limited to, the following:
 - a. Description of key equipment components (i.e., tanks, pumps, filters, flow meters, etc.) including supplier and model name, operational characteristics and expected performance for solids removal.
 - b. Plans showing the layout of the water collection, treatment, and conveyance system.
 - c. Description of operation of the collection, treatment, and conveyance equipment (estimated flow-rates and standard operating procedures [SOPs]).
 - d. Description of discharge and energy dissipation system.
 - e. The method and location of dewatering and means of disposal of waste-contact dewatering water.
 - f. Anticipated start and end dates of dewatering.
 - 2. Submit plan a minimum of two weeks prior to the initiation of dewatering activities.
 - 3. Approval of dewatering plan does not relieve Contractor from complete responsibility for water management at the site.
- B. Test results and certificates including:
 - 1. Records of the discharge rate and total volume and duration of treated water discharge.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Contractor shall carry out the control of water in compliance with all federal, State and local applicable stream discharge and pollution prevention requirements.

- B. Contractor shall monitor volume of water pumped through use of an hour meter on the pump(s) with pump chart or flowmeter(s) and shall maintain pumps and discharge lines in good working condition.
- C. All discharge shall be in accordance with applicable permits (SWPPP, MCES, or other).
- D. Contractor shall minimize sediment transport during dewatering through use of constructed sumps, filter socks, or other measures. Contractor shall not discharge brown water to the river.
- E. See Section 01 57 19, Temporary Environmental Controls for additional requirements.

1.06 SEQUENCING AND SCHEDULING

- A. Dewatering system(s) shall be mobilized and ready for utilization prior to commencing excavation operations.
- B. Work that may be impacted by groundwater, such as the waste excavation, should be sequenced when possible to be completed during time of year when groundwater levels are low to reduce dewatering quantities.
- C. Reduce contact water by preventing stormwater from running into open excavations where possible.

1.07 PERMITS

- A. Obtain a Minnesota DNR Water Appropriation Permit for use with groundwater dewatering activities.
- B. SWPPP: see Section 01 57 13, Temporary Erosion and Sediment Control for SWPPP requirements.
- C. MCES Discharge Permit: see section 01 57 19, Temporary Environmental Controls for MCES Discharge Permit requirements.
- D. Obtain other permits Contractor may need for discharging water (e.g., MPCA Contaminated Groundwater Pump-Out General Permit)

1.08 QUALITY ASSURANCE

- A. Contractor shall be responsible for evaluating the need to dewater as well as the design and adequacy of the dewatering system(s). Contractor shall provide dewatering system(s) sufficient to maintain the Work areas in a dewatered condition, as necessary and as specified. Contractor shall implement dewatering systems to perform as follows:
 1. Effectively reduce the hydrostatic pressure if necessary and lower the groundwater levels below the excavation.

2. Develop a substantially dry and stable subgrade for execution of construction operations.
 3. Prevent damage to adjacent properties, buildings, structures, utilities, and other work as a result of settlement or other groundwater-related effects; and dewatering.
 4. Spoils (excavated material) dewatering shall be performed in a designated areas (within existing waste footprint) to promote infiltration.
 5. Provide sediment removal/filtering methods to meet NPDES discharge requirements to receiving water bodies.
 6. The dewatering system(s) shall be operated and maintained by Contractor.
 7. Contractor shall immediately furnish backup dewatering systems if other dewatering systems fail unexpectedly (including potentially off-site or sanitary sewer discharge/disposal if permitted).
- B. Seepage and overland runoff flow into the Work area shall be intercepted, collected, and removed as needed to minimize Contact Water generation and for proper performance of the Work
- C. Modify dewatering procedures that cause, or threaten to cause, excessive ground movement or damage to new or existing facilities, so as to prevent further ground movement damage.
- 1.09 BASIS FOR COMPENSATION
- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 EQUIPMENT

- A. Contractor shall be responsible to have pumps, hoses, and other equipment necessary for dewatering.
- B. Provide back-up equipment as necessary for replacement and for unanticipated emergencies.

PART 3: EXECUTION

3.01 GENERAL

- A. Contractor shall be aware that flows will vary in proportion to recent rainfall events, and with rapid and heavy rains, ponded water may accumulate. Contractor shall be responsible for and

take measures to protect his personnel, equipment, and supplies from such an event should conditions render.

- B. Coordinate all dewatering activities with Owner and Owner's On-Site Representative.
- C. Perform dewatering in accordance with approved Dewatering Work Plan. Keep Engineer advised of any changes made to accommodate field conditions and, on completion of the dewatering system implementation, revise and resubmit Dewatering Plan as necessary to indicate the installed configuration.
- D. Do not dewater wetlands.
- E. Areas shall be dewatered as necessary so construction of berms, roads, subgrade, cover soils, ditches, and other structures are completed under dry conditions.
- F. Waste excavation should either be conducted in the dry or with provisions to allow wet waste to drain free liquids within existing waste areas.
- G. All dewatering activities must comply with Section 01 57 13, Temporary Erosion and Sediment Control. Non-Contact Water shall be routed to drain towards existing surface waters as determined per approved Dewatering Plan in accordance with applicable permits. Water shall be discharged in such a manner as not to cause erosion or damage to adjacent property.
- H. Contractor shall minimize cross contamination of Non-Contact water with Contact water to minimize volumes necessitating treatment.
- I. Contact Water runoff shall be directed away from clean materials and areas and contained within the existing waste boundary.
- J. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- K. Contractor shall be solely responsible for managing and coordinating related work that affects the quality and quantity of the water that is discharged from the excavation area. Continuously restrict stormwater runoff from entering the excavation area to minimize the volume of water to be managed.
- L. Sequence and coordinate work so that the dewatering system is operational prior to beginning operations that will generate water including but not limited to: dewatering of excavation areas, precipitation into earthwork areas, and decontamination activities.
- M. Operate dewatering system so that effects of dewatering do not adversely affect structures and facilities.

3.02 DEWATERING SYSTEM EQUIPMENT OPERATION

- A. Operate the collection and treatment equipment in conformance to the approved Water Collection, Treatment, Discharge, and Monitoring Plan. It is anticipated that treatment may involve the following processes:
 - 1. Water can be allowed to infiltrate. Contact water shall be infiltrated within existing waste limits. When conditions require that additional dewatering is necessary, water can be directed away from active work areas to infiltrate.
 - 2. When conditions require active pumping and removal of water, then Contractor shall pump water from their work areas for treatment and discharge in compliance with permits.
 - 3. Contact water may require treatment for contaminants before discharge as required by permits. All water will require control and removal of sediment before discharge. Contact water sediment can be dewatered of free liquids and managed with the Waste.
 - 4. Solids removal will be accomplished either by pump intake screening, silt fencing, temporary settling basins/tanks, or other suitable means to remove suspended solids.
- B. At a minimum, treat the water to remove solids to below 50 mg/L total suspended solids (TSS) prior to discharging.

3.03 IN PLACE MANAGEMENT APPROACHES

- A. Excavated saturated material shall be placed in an area targeted for further excavation. If the saturated material is placed in an area that is not targeted for further excavation, materials will need to be placed on plastic sheeting and runoff will need to be controlled to prevent impacting the underlying soils.

3.04 MONITORING OF WATER TREATMENT AND DISCHARGE

- A. Monitor water discharges from the dewatering system in accordance with the monitoring plan submitted.
- B. Discharge should include energy dissipation at outlet.

3.05 MANAGEMENT OF WATER TREATMENT SOLIDS

- A. Recover, dewater, and manage any solids that are removed by or accumulated in water treatment equipment as described for the water collection, treatment, discharge, and monitoring plan prepared by Contractor. Solids may be placed within newly constructed lined facility or transported to an approved landfill in accordance with Section 31 23 16, Waste Excavation and Consolidation.

END OF SECTION 31 23 19

SECTION 31 23 23

LINER AND COVER SOIL MATERIALS

PART 1: GENERAL

1.01 SUMMARY

A. Section includes providing all materials, equipment, and labor to perform the required fill operations at the site including, but not limited to:

1. Constructing Compacted Clay Liner.
2. Placing Sand Drainage Layer.
3. Excavating for anchor trenches.
4. Placing Drainage Aggregate for Drainage Collection Pipes.
5. Constructing Buffer Layer, Cover Soil, and Topsoil.
6. Placing Structural Fill.
7. Placing Pipe Bedding.
8. Placing Coarse Aggregate for Gas Extraction Wells and pipe trenches.
9. Elevation, grade, and material thickness requirements.

B. Related Sections

1. Section 31 05 19.13 Geotextiles for Earthwork
2. Section 31 05 19.16 Geomembranes for Earthwork
3. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
4. Section 31 23 16 Waste Excavation and Consolidation
5. Section 32 92 00 Turf and Grasses
6. Section 33 05 28 Trenching and Backfilling for Utilities

1.02 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. American Society for Testing and Materials (ASTM)
 - a. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - b. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedures).
2. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.
3. Minnesota Pollution Control Agency Best Management Practices for the Off-Site Reuse of Unregulated Fill

1.03 SUBMITTALS

- A. Submit for approval a Materials Handling Plan prior to excavation and transport of any materials. See Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for additional information.
- B. Submit for information a list of sources of imported materials specified in this Section to Owner or Owner's On-Site Representative at least two weeks prior to delivery of materials to the Site.
- C. Testing shall be conducted according to appropriate ASTM standards to conform required material properties or classifications specified in this Section.
- D. Submit for review all other soil testing and survey data as specified in Section 01 45 00, Quality Control.
 1. Owner or Owner's On-Site Representative may take samples of the material during the progression of the Work to verify compliance with the Specifications. Materials not meeting the Specifications shall be removed and replaced at Contractor's expense, including the cost for testing.

1.04 DELIVERY, STORAGE, HANDLING

- A. Upon delivery of materials to the Site, provide access for sampling or observation of loads by Owner or Owner's On-Site Representative prior to unloading.
- B. Store materials where designated or as directed by Owner or Owner's On-Site Representative. Prevent segregation of graded materials and mixing of dissimilar materials during unloading, stockpiling, or removal from stockpile.

1.05 SEQUENCING AND SCHEDULING

- A. Owner's On-Site Representative will be evaluating results of Contractor's independent registered land surveyor's grade, slope, and material thickness verifications. Owner's On-Site

Representative will be evaluating results of Contractor's independent soil laboratory field and laboratory soil test results, as described in Section 01 45 00, Quality Control. Do not proceed with subsequent operations until Owner and Owner's On-Site Representative have been notified and have been given opportunity to verify that Work meets the requirements of these Specifications.

- B. Sequence liner and cover soil placement in accordance with Drawings and Materials Handling Plan.

1.06 JOB CONDITIONS

- A. It shall be Contractor's sole responsibility to review available tests and reports, conduct additional tests, and otherwise determine to its own satisfaction the location and nature of all surface and subsurface features and the soil and water conditions that may be encountered.
- B. Use of explosives will not be permitted.
- C. Contractor shall be solely responsible for determining the means and methods for meeting the compaction requirements unless otherwise specified herein, except that compaction by flooding, puddling, or other means that involve saturation or over-wetting the soil will not be permitted.
- D. Provide shoring, bracing, sheet piling, trench boxes, tie backs, and other measures required to perform all the Work in accordance with Laws and Regulations. Specifically, all excavations shall conform to the requirements of Occupational Safety and Health Administration (OSHA) set forth in 29 CFR 1926, Subpart P.

1.07 ENVIRONMENTAL COMPLIANCE – IMPORT SOILS AND AGGREGATES

- A. All sources of import soils and aggregates specified herein shall meet the MPCA definition of Unregulated Fill. Import soils and aggregates shall be free of contamination, invasive species, debris, roots, organic material, frozen materials, and recycled materials.
- B. Contractor shall provide access to proposed source(s) for inspection by Engineer and Owner, and Owner reserves the right to reject a source if contamination is suspected.

1.08 QUALITY ASSURANCE

- A. Source quality control:
 - 1. The entire quantity required for imported products shall be obtained from a single source for each product, if possible. Contractor must obtain approval from Owner for all sources used through the procedures described in Section 01 45 00, Quality Control if it is necessary to use multiple sources for any material.
 - 2. Contractor shall perform source quality control testing as described in Section 01 45 00, Quality Control.

3. Owner or Owner's On-Site Representative may take samples of the material during the progression of the Work to verify compliance with the Specifications. Materials not meeting the Specifications shall be removed and replaced at Contractor's expense, including the cost for testing.

B. Field quality control:

1. Perform field quality control as specified in Section 01 45 00, Quality Control.

1.09 TEMPORARY ENVIRONMENTAL CONTROLS

- A. See Section 01 57 19, Temporary Environmental Controls, for Noise Control, Dust Control, Water Management and Control, and Cleaning requirements.

1.10 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Radon-free material free of wood, organic soils, peat, topsoil, debris, roots, sticks, brush, non-soil materials, and other unsuitable materials which in the opinion of Engineer will have a deleterious effect on the Work.
- B. Boulders larger than 6 inches in diameter shall not be allowed.
- C. Contractor shall furnish all materials designated "IMPORTED".

2.02 BUFFER LAYER

- A. Inorganic soil free from roots, debris, and other deleterious materials.
- B. Gradation: 100 percent passing 3/8-inch sieve.
- C. Containing no material that may pose a physical risk of puncturing the cover geomembrane.
- D. Unsuitable material will include any material that does not provide a firm, stable base, when compacted.

2.03 COARSE AGGREGATE (IMPORTED)

- A. Coarse Aggregate: A mineral product consisting of sound, rounded or sub-rounded durable particles, excluding sandstone, crushed rock, crushed concrete, salvaged bituminous mixture, and free of all organic material, and which is in conformance with the following gradation requirements:
 - 1. 3-inch (maximum) to 1-inch (minimum)
 - 2. 2 percent (maximum) passing 1/2-inch sieve.
- B. Coarse aggregate shall be non-calcareous gravel.
 - 1. Calcium carbonate content 5 percent (maximum) by weight.
- C. Coarse aggregate shall contain no angular particles and not more than 30 percent subangular particles as defined by ASTM D2488. Crushing or other processing methods which results in sharp edges shall not be used.

2.04 COMMON FILL

- A. See Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for common fill requirements.

2.05 DRAINAGE AGGREGATE (IMPORTED)

- A. Drainage Aggregate: A mineral product consisting of sound, rounded or sub-rounded durable particles, excluding sandstone, crushed rock, crushed concrete, salvaged bituminous mixture, and free of all organic material, and which is in conformance with the following gradation requirements:

| Sieve | % Passing |
|--------|-----------|
| 1-1/2" | 100 |
| 3/4" | 35-80 |
| 3/8" | 15-40 |
| #4 | 5-25 |
| #10 | 0-10 |
| #100 | 0-5 |

- B. Drainage aggregate shall be non-calcareous gravel.
 - 1. Calcium carbonate content 15 percent (maximum) by weight.
- C. Drainage aggregate shall contain no angular particles and not more than 30 percent subangular particles as defined by ASTM D2488. Crushing or other processing methods which results in sharp edges shall not be used.

2.06 COMPACTED CLAY LINER (IMPORTED)

- A. Compacted Clay Liner shall be inorganic soil meeting the following requirements:
 - 1. Classified as CL, CH, or CL/CH by the Unified Soil Classification System. Some SC/CL soils may be acceptable if hydraulic conductivity criterion is met.
 - 2. Hydraulic Conductivity: Maximum of 1×10^{-7} cm/s, when compacted to 95% standard Proctor maximum dry density at a moisture content 0 to 5 percentage points wet of optimum.
 - 3. Maximum particle size: 3/4 inch (gravel); soil clods shall be pulverized prior to placement and compaction.
- B. Compacted Clay Liner may require pulverizing, screening, moisture conditioning, and reworking in order to meet the requirements of the Specifications. Such operations shall be conducted as part of the performance of the Work and the cost of such operations shall be included in the Bid.

2.07 COVER SOIL

- A. Engineer approved salvaged or imported natural soil material consisting of sand, silt, clay, and gravel or mixtures thereof, free of rubbish, demolition debris, and other foreign materials and containing no particles larger than 3 inches in the largest dimension. Soil screening activities may be required for on-site cover soil material.
- B. Cover soil may contain organic material.

2.08 PEA STONE (IMPORTED)

- A. Pea Stone shall be rounded to sub-rounded, free-draining aggregate material free of organics, debris, and other foreign material and in conformance with the following requirements; 'squeegee' aggregate may be suitable for Pea Stone; verify with Engineer and Owner:
 - 1. Gradation: 100 percent passing 1/2-inch sieve, 0 to 5 percent passing #8 sieve

2.09 PIPE BEDDING (IMPORTED)

- A. Pipe bedding material shall be in conformance with Mn/DOT Standard Specification 3149.2.F for Granular Bedding.

2.10 SAND DRAINAGE LAYER (IMPORTED)

- A. Durable washed sand meeting the following requirements:
 - 1. Gradation:

- a. 100 percent passing 3/8-inch sieve.
 - b. 5 percent (maximum) passing #200 sieve.
2. Hydraulic Conductivity: Minimum of 1×10^{-3} cm/s, when compacted to 90% standard Proctor maximum dry density.

2.11 STRUCTURAL FILL (IMPORTED)

- A. Soil materials specified, except organic soils, and free of vegetation, debris, roots, sticks, brush, non-soil materials, and other materials which in the opinion of Engineer will have a deleterious effect on the Work. Certain excavation material may be acceptable for structural fill provided it meets the Specifications.
- B. Structural Backfill to meet the requirements of Mn/DOT Standard Specification 3149.2 D2.

2.12 TOPSOIL

- A. Topsoil (salvaged)
 1. Topsoil (salvaged) or subsoils capable of sustaining vegetation, meeting the following requirements:
 1. Natural soil material consisting of sand, silt, clay, and gravel or mixtures thereof, free of rubbish, waste, demolition debris, and other foreign/deleterious materials and containing no particles larger than 3 inches in the largest dimension.
 2. No more than 5 percent by weight may be retained on a 3/4-inch sieve.
 3. Organic Content between 3% and 50%.
- B. Topsoil (imported)
 1. Topsoil (imported) shall be as specified in MnDOT Standard Specification 3877.2.A.

PART 3: EXECUTION

3.01 GENERAL

- A. Maintain all waste-contact surface water runoff within the existing waste limits; carry-over of this runoff outside the existing waste limits is strictly prohibited.
- B. Locate and protect overhead and underground utilities.
- C. Construct excavations in accordance with applicable Laws and Regulations.

- D. Remove and replace material not meeting these Specifications and native soils or compacted fill softened by frost, flooding or weather.
- E. Provide temporary controls such as diversions and dewatering equipment to prevent surface runoff from entering excavations and to remove ponded water from excavations. Maintain excavations in a dry and stable condition at all times.
- F. Extend excavations a sufficient distance to allow placement and compaction of bedding, encasement, and other required backfill materials, to prevent sloughing of materials into the excavation, and to permit observation of the Work by Owner or Owner's On-Site Representative. Excavate to sufficient depth to remove loose or disturbed soil. Avoid over-excavating sound, clean native soil.
- G. Subsurface dewatering outside construction limits not permitted without Owner's permission.
- H. See Section 33 05 28, Trenching and Backfilling for Utilities for additional specifications related to trenching and backfilling for utilities.

3.02 EXCAVATION

- A. Anchor Trenches
 - 1. Anchor trenches for geosynthetic materials shall be excavated at the minimum depths and widths shown on the Drawings.
 - 2. Do not advance excavation of trenches beyond the anchor trench anticipated to be installed each day.
 - 3. For trenches that will remain open for greater than one day and are greater than 100 feet in length, provide temporary cross-walks capable of supporting personnel and hand-carried equipment at a minimum of a 100-foot spacing.
- B. See Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for additional excavation requirements.

3.03 STOCKPILES

- A. See Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for stockpile requirements.

3.04 BACKFILL, FILL, AND COMPACTION

- A. Place backfill and fill materials in layers not more than 12 inches in loose depth, except as noted. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content. Compact each layer to required percentage of maximum density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Scarify, remoisten, and recompact surfaces that have been dried, weathered, or loosened between lifts.

- B. Do not place fill on soil layers requiring certification surveys until finished elevation documentation is approved by Engineer.
- C. Place backfill materials at the locations and to the dimensions and thicknesses shown on the Drawings. Furnish equipment suitable for soil conditions and compactive effort required to meet compaction criteria specified herein.
 - 1. Granular soils shall be compacted using vibratory mechanical compaction equipment.
 - 2. Fine-grained soils shall be compacted using sheepsfoot mechanical compaction equipment.
 - 3. Fill material consisting of cohesive, clayey soils shall be compacted with a sheepsfoot roller in lifts not exceeding the requirements herein.
- D. Backfill and compact only with pre-approved materials and those called out on the Drawings.
- E. Do not place frozen material or place fill on frozen or unsuitable subgrade.
- F. Contractor shall remove and replace fill that is too wet to permit compaction as specified.
- G. Uniformly compact each lift by operating equipment over the entire area prior to placing the subsequent lift.
- H. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around structure to approximately same elevation in each lift. Protect insulation by hand placement if necessary. Notify Engineer of any damage and repair as approved before proceeding.
- I. Moisture content and density control:
 - 1. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil to prevent free water appearing on surface during or subsequent to compaction operations. Disc or otherwise thoroughly mix to distribute added water.
 - 2. Remove and replace soil material that is too wet to permit compaction as specified.
 - 3. Compaction by flooding or other means that involve saturation or over-wetting the soil will not be permitted.
- J. General:
 - 1. Place and compact any material within 3 feet of finished ground surface under pavements to minimum 100% of standard Proctor maximum dry density (ASTM D698) and within +/- 2% of optimum moisture content.
- K. Buffer Layer:

1. Place Buffer Layer material over unsuitable geomembrane cover subgrade as directed by Engineer.
 2. Place in one uniform lift and smooth-roll the finished surface.
- L. Common Fill:
1. See Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for common fill requirements.
- M. Compacted Clay Liner:
1. Compacted Clay Liner Subgrade:
 - a. Scarify, disc, and compact the upper 6-inches of Compacted Clay Liner Subgrade materials to minimum 95% of standard Proctor maximum dry density (ASTM D698) before placing the initial lift of the Compacted Clay Liner.
 2. Compacted Clay Liner material shall be placed for composite liner construction as long as the daily average temperature is above 40 degrees Fahrenheit and the Contractor can demonstrate that compacted clay liner construction meets construction specifications detailed in this section. Contractor must obtain approval from Owner or Owner's On-Site Representative prior to placement of compacted clay liner material.
 3. Compacted Clay Liner material shall have a water content of 0 to 5 percentage points over optimum moisture content at the time of placement and compaction. If moisture conditioning of the Compacted Clay Liner is necessary prior to compaction, such conditioning shall be performed so that the soil is mixed with uniform moisture content.
 4. Over-wetted Select Clay shall not be used for construction of the compacted clay liner. Compacted Clay Liner shall be determined to be over-wetted if displacement occurs under the weight of vehicle traffic or if the required compaction cannot be achieved with a reasonable number of passes with compaction equipment.
 5. Place Compacted Clay Liner in maximum 8-inch loose lifts, or thinner, so that each compacted lift is not greater than 6-inches thick. Compact each lift to at least 95 percent standard Proctor maximum dry density (ASTM D698). The water content specified above shall be maintained throughout compaction work. Compaction shall be performed with sheepsfoot compactors.
 6. Compacted Clay Liner lifts shall be constructed in an approximately horizontal orientation.
 7. Stagger edge joints in overlying lifts. Joints shall be offset at least 15 feet.
 8. The surface of each Compacted Clay Liner lift shall be kept moist until the next lift is placed. If the Compacted Clay Liner surface becomes dry, apply water and rework the surface with a sheepsfoot compactor, disc, scarifier, or other suitable equipment to

thoroughly remoisten the material. The Compacted Clay Liner surface from the previous day's construction shall be scarified and wetted prior to beginning compacted clay liner construction every day.

9. Roll the finished Compacted Clay Liner surface with a smooth drum roller.
10. Remove all particles larger than 1/2 inch in the largest dimension exposed above the subgrade surface.
11. The finished clay liner surface shall be maintained in a moist condition until covered by the geomembrane to prevent desiccation and deep cracking.
12. Construction stakes, hubs, or lath shall not be left in place in the clay liner after construction.

N. Cover Soil:

1. Cover Soil shall not be placed over the geocomposite drainage layer until the geocomposite has been inspected. Inspection of the geocomposite and required documentation may be submitted in phases to facilitate timely placement of Cover Soil material.
2. Place Cover Soil material over the geocomposite up the slope in a single lift and minimize compaction during placement. Placement of the Cover Soil material over the geocomposite shall be performed under the supervision of Owner's On-Site Representative.
3. Spreading shall occur by pushing the material from discrete dumping points, and pushing the newly dumped materials outward over that material already placed. The Cover Soil shall be "rolled" over the edge of the material already placed, rather than pushed or slid across the surface of the geocomposite. Compaction shall be limited to that provided by construction vehicle traffic.
4. In no case shall any construction equipment be allowed to operate on the geocomposite when less than 12-inches of Cover Soil material is covering the geocomposite. To support truck traffic, a temporary 3-foot lift of Cover Soil material shall be placed over the geocomposite in traffic areas.
5. Place Cover Soil in a single lift to the thicknesses indicated and in the locations indicated on the Drawings, and in other locations disturbed by Contractor's activities as required. Minimize compaction of Cover Soil during placement.

O. Drainage Aggregate:

1. Place Drainage Aggregate over the geotextile fabric and around the leachate collection pipes to the dimensions shown on the Drawings. Place Drainage Aggregate carefully by dropping from backhoe or loader bucket from a height of less than 2 feet. Spread by hand with rakes or other suitable tools. Do not spread with mechanical equipment.

2. See Section 31 05 19.13, Geotextiles for Earthwork for geotextile requirements.

P. Pipe Bedding/Utility backfill:

1. This section applies to underground piping and utility structure installations that lie outside the lined portion of the landfill.
2. Pipe Bedding for piping:
 - a. Place a minimum of 6-inches of Pipe Bedding material in bottom of trench before laying pipe. Place bedding in maximum 6-inch lifts. Pipe Bedding materials shall extend across full width of the trench. Compact each lift to minimum 100% of standard Proctor maximum dry density (ASTM D698).
 - b. Place Pipe Bedding material in maximum 4-inch loose lifts under pipe haunches and compact each lift to minimum 100% of standard Proctor maximum dry density (ASTM D698) until firmly compacted to the pipe spring line.
 - c. Place Pipe Bedding material in maximum 6-inch lifts, compacting to minimum 100% of standard Proctor maximum dry density (ASTM D698) to an elevation at least 6-inches over the top of the pipe.
2. Pipe Bedding for utility structures:
 - a. Place a minimum of 6-inches of Pipe Bedding materials under utility structures. Place bedding in maximum 6-inch lifts. Pipe Bedding materials shall extend a minimum of 1 foot horizontally beyond utility structure footprint. Compact Pipe Bedding materials to minimum 95% of standard Proctor maximum dry density (ASTM D698). Finished surface of bedding shall be uniform and level.
 - b. After placing utility structures, backfill remainder of excavation with Common Fill.
3. Place and compact common fill to minimum 95% of standard Proctor maximum dry density (ASTM D698) taking care not to damage or misalign any pipe or utility structure. See Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for additional common fill requirements.

Q. Sand Drainage Layer:

1. Sand Drainage Layer material shall not be placed over geomembrane until the geomembrane has been inspected, tested, and all test results and required documentation is submitted to Engineer. Inspection of the geomembrane and required documentation may be submitted in phases to facilitate timely placement of Sand Drainage Layer material.
2. Place Sand Drainage Layer material over the geomembrane up the slope in a single lift. Placement of the Sand Drainage Layer material over the geomembrane shall be

performed in accordance with the geomembrane manufacturer's recommendations, and under the supervision of Owner's On-Site Representative.

3. Spreading shall occur by pushing the material from discrete dumping points, and pushing the newly dumped materials outward over that material already placed. The Drainage Layer material shall be "rolled" over the edge of the material already placed, rather than pushed or slid across the surface of the geomembrane. Compaction shall be limited to that provided by construction vehicle traffic.
4. In no case shall any construction equipment be allowed to operate on the geomembrane when less than 12-inches of Sand Drainage Layer material is covering the geomembrane. To support truck traffic, a temporary 3-foot (minimum) lift of Sand Drainage Layer material shall be placed over the geomembrane in traffic areas.
5. Sand Drainage Layer materials are susceptible to sliding during and shortly after rainfall events. Contractor shall take precautions necessary to limit this potential and shall repair all damage from sliding at no additional compensation.
6. Placement of Sand Drainage Layer materials on geomembrane shall not proceed at ambient temperatures below 40°F.

R. Structural Fill:

1. Place and compact Structural Fill to minimum 100% of standard Proctor maximum dry density (ASTM D698) and within +/- 2% of optimum moisture content for structure subgrades of footings, slabs on grade, and pads.

S. Topsoil:

1. Place after completion of the Cover Soil or Common Fill layer installation.
2. Do not place topsoil layer until Cover Soil or Common Fill certification survey is completed and approved by Engineer.
3. Place topsoil in single uniform loose lift and minimize compaction during placement over entire area to be planted to a minimum depth of 6 inches. In the event that topsoil has been disturbed or is not of acceptable depth prior to application of sod, planting, or seed, add supplement topsoil in area to bring it up to the required depth. Work all areas receiving seed until the soil is completely fined and in a mellow condition, and to a smooth, even finish grade. Fill all holes, depressions and rivulets to ensure no disruption of established drainage patterns. Remove all rubble, sticks, branches, or stones and extraneous material over 3/4-inch diameter on the surface, which will interfere with the seeding.
4. Immediately prior to sodding, seeding, or planting, loosen topsoil to a depth of 3-inches on all areas using discs, harrows, tiller rakes, or hand tools as needed to produce fine grade and incorporate the compost into the soil.

5. Prepare ground so top of newly sodded, seeded, or planted areas will be flush with adjacent soil, adjacent walks, and permanent surfacing.

T. Waste Relocation:

1. See Section 31 23 16, Waste Excavation and Consolidation for waste relocation requirements.

3.05 ACCESS ROADS AND RAMP CONSTRUCTION

- A. Contractor shall determine location of temporary access roads and ramps into the landfill area.
- B. Permanent access roads and ramps shall be constructed at the locations shown on the Drawings or as directed by Owner or Owner's On-Site Representative.
- C. Access roads and ramps shall be crowned or sloped to promote surface water runoff.

3.06 GRADING

- A. Grade intermediate slopes to minimize erosion potential. Maintain temporary erosion controls as necessary to minimize erosion.
- B. Smooth-grade finished ground on exterior slopes of berms, along access roads, and other areas disturbed by Contractor's activities, to uniform levels or slopes between points where elevations are shown, or between such points and existing ground.
- C. Construct ditches and/or drainage swales to control run-on onto and run-off from topsoil and within the Construction Limits as directed by Owner's On-site Representative.

3.07 SUBGRADE PREPARATION FOR GEOMEMBRANES

- A. Proof roll and examine geomembrane subgrade to determine existence of soft areas, areas loosened by frost action or softened by flooding, weather, or unsuitable materials. Determination of soft areas will be based on Engineer's judgment, but generally detected by soil deflection of greater than 2-inches and accompanied with stress cracks in soil when rolled over by Engineer approved heavy construction equipment.
- B. The surface upon which the geomembrane will be installed shall be inspected by Engineer and the Geomembrane Installer. Geomembrane Installer shall certify in writing that the surface upon which the geomembrane is to be installed is acceptable.
- C. Smooth-roll the subgrade to remove surface irregularities. The finished surface shall be smooth and free from lumps, ruts, depressions, protruding rocks, and rocks larger than 1-inch in surface dimension whether protruding or flush with the finished surface. All particles that are protruding from the surface and are larger than 3/8-inch diameter shall be removed prior to placement of geomembrane.

- D. Contractor shall maintain subgrade in a smooth and compacted condition and in good repair up to the time of geomembrane cover installation.
- E. Contractor shall make any improvements to the surface condition requested by the Geomembrane Installer at no additional cost to Owner.
- F. See Section 31 05 19.16, Geomembranes for Earthwork for additional requirements.

3.08 RESTORATION OF DISTURBED AREAS

- A. Disturbed areas shall be restored by Contractor to conditions equal to or better than that present before areas were disturbed.
- B. Disturbed areas shall be smooth graded with perimeter slopes 3 horizontal to 1 vertical or shallower.
- C. Topsoil shall be placed on disturbed areas to a depth of not less than 6-inches in locations directed by Owner.
- D. Turf will be established on disturbed areas as directed by Owner or Owner's On-Site Representative in accordance with Section 32 92 00, Turf and Grasses.

3.09 TOLERANCES

- A. Construct the excavation and backfill Work within the dimensional tolerances given below. Alignment, elevation, thickness, and grade tolerances are acceptable deviations from the dimensions shown on the Drawings.
- B. Alignment Tolerances (subgrade and embankment)
 - 1. Road Centerlines: +/- 0.2 foot.
- C. Elevation Tolerances:
 - 1. Compacted Clay Liner subgrade: +0.0 foot, - 0.5 foot.
 - 2. Landfill Embankment Road and other Road Surfaces: +/- 0.2 foot.
 - 3. Pipe Grade: +/- 0.1 foot.
 - 4. Structural Fill: +/- 0.1 foot.
- D. Thickness Tolerances:
 - 1. Buffer Layer: -0.0 foot, +0.2 foot
 - 2. Compacted Clay Liner Layer: -0.0 foot, + 0.7 foot.

3. Cover Soil: -0.0 foot, +0.2 foot
4. Drainage Aggregate: +/- 0.2 foot.
5. Sand Drainage Layer: -0.0 foot, + 0.2 foot.
6. Structural Fill: -0.0 foot, + 0.5 foot.
7. Topsoil: -0.0 foot, +0.2 foot

E. Grade Tolerances:

1. Landfill Embankment Road: 1.5 to 2.5 percent.
2. Access Ramp Cross-Slopes: 1.5 to 2.5 percent.
3. Landfill Liner Floor: 2 percent or greater.
4. Landfill Leachate Collection Trench Slopes: 0.5 percent or greater.
5. Landfill Cover: 3 percent or greater.
6. Restoration area: +0.2 percent to -0.0 percent (must maintain 0.5 percent minimum slope everywhere).

3.10 MAINTENANCE

- A. Protect newly graded areas from traffic and erosion, and keep free of trash and debris. Maintain erosion control.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.11 DEBRIS MANAGEMENT

- A. Manage debris resulting from the Work or encountered on Site in accordance with applicable Laws and Regulations. Debris may include abandoned electrical cable, abandoned well materials, or other man-made objects.
- B. Debris may be placed within newly constructed lined facility or transported to an approved landfill in accordance with Section 31 23 16, Waste Excavation and Consolidation.
- C. Burning of materials will not be permitted on the Site.

END OF SECTION 31 23 23

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROL

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete erosion and sediment control at the site including, but not limited to:
 - 1. Provide temporary erosion control to meet the requirements of all federal, state and local agencies.
 - a. Contractor shall implement all requirements of the project-specific Stormwater Pollution Prevention Plan (SWPPP).
 - 2. Prevent transport of soil and removed sediment materials from the sites of the Work in compliance with this Section of the Specifications.
- B. Where conflicts exist between this Specification and the project-specific SWPPP, requirements of the project-specific SWPPP shall take precedence.
- C. Related Sections
 - 1. Section 01 57 13 Temporary Erosion and Sediment Control
 - 2. Section 02 41 00 Demolition
 - 3. Section 31 01 00 Site Preparation
 - 4. Section 31 10 00 Clearing and Grubbing
 - 5. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
 - 6. Section 31 23 19 Dewatering
 - 7. Section 32 92 00 Turfs and Grasses
 - 8. Section 33 05 28 Trenching and Backfilling for Utilities

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:

1. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.
2. Minnesota Pollution Control Agency (MPCA)
 - a. General Permit No. MN R100000.
3. Authorization to Discharge Stormwater Associated with Construction Activity Under the National Pollutant Discharge Elimination System/State Disposal System (NPDES) Permit Program.
4. Stormwater Pollution Prevention Plan (SWPPP) for the work

1.03 SUBMITTALS

- A. Weekly/storm event inspection forms to ensure permit compliance.
- B. Submit all inspection records completed as a part of the NPDES Permit to Owner at the end of the project.
- C. Submit manufacturer and product information for erosion control measure products.

1.04 QUALITY ASSURANCE

- A. Owner may stop work on the project if Contractor is operating in violation of the erosion control permit or these Specifications. Commence to diligently restore the project to conform to the conditions of the permit, the SWPPP, and these Specifications within 24 hours. If, in Owner's opinion, Contractor has not, within 24 hours after work stoppage, commenced to diligently restore the project to conform to the conditions of the permit, then Owner may, without further notice to Contractor, take actions to immediately restore the project to the conditions of the permit and these Specifications. The cost of actions by Owner required to restore the project to conditions of the permit and these Specifications will be paid by Contractor.
- B. All inspection records completed by the Contractor as a part of the Permit compliance shall be submitted to the Owner at the end of the Project.
- C. The Contract Documents, compliance documentation, and permits shall be available at the construction site in the field office for inspection by federal, state, and local officials as required by the permit for the duration of the Work.
- D. Owner and Contractor shall maintain a record of all inspections of the Site as required by the permits, and shall include at a minimum:
 1. Date and time of inspections
 2. Name of inspector

3. Findings of inspections
4. Corrective actions taken (including date and time)
5. Documentation of changes to the Temporary Erosion and Sediment Control Plan made during construction.
6. Date of all rainfall events (including total precipitation)
7. Documentation of any active runoff discharges and their color/clarity based on visual inspection.

1.05 SEQUENCING AND SCHEDULING

- A. Transfer of responsibility for the NPDES Application for General Stormwater Permit for Construction Activity (MNR100001) and the associated Storm Water Pollution Prevention Plan (SWPPP) including all compliance measures and procedures to Contractor upon award of Contract. The representative permit and SWPPP will be prepared by Owner and presented to Contractor at the pre-construction meeting for review, finalizing and signatures. The permit fee and submittal will be administered by Owner.
- B. Install BMP's and erosion and sediment control measures specified in this Section and in accordance with the Drawings, the SWPPP, or as directed by Owner or Owner's On-Site Representative prior to any disturbance to existing site features conditions.
- C. Maintain and replace the erosion and sediment controls for the duration of the Project as necessary in accordance with the Drawings, the SWPPP, this Section of the Specifications, and as directed by Owner or Owner's On-Site Representative.
- D. Coordinate the Work so as to reduce to a minimum the lag time between the initial and final phases of the combined work and establish erosion and sediment control as soon as possible after the graded areas have had topsoil placed or finish graded.
- E. For areas where vegetation is required, maintain erosion and sediment controls until an effective vegetative cover has been established.

1.06 TEMPORARY ENVIRONMENTAL CONTROLS

- A. See Section 01 57 19, Temporary Environmental Controls, for Noise Control, Dust Control, Water Management and Control, and Cleaning requirements.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 CONCRETE WASHOUT MANAGEMENT AREA

- A. Concrete washout management area shall be as specified on the Drawings. An impermeable liner is required where sandy soils exist to prevent infiltration of washout.

2.02 CONSTRUCTION ENTRANCE

- A. Construction entrance shall be as specified on the Drawings.

2.03 CULVERT/INLET PROTECTION

- A. Contractor shall provide culvert/inlet protection as shown on the Drawings, SWPPP, or as approved by Engineer. The protection measures shall be approved devices and methods to prevent the transportation of sediments into the storm sewer system.
- B. Contractor responsible for cleaning out sediment from culverts/inlets within work area.

2.04 EROSION CONTROL BLANKET

- A. Erosion control blanket shall be as specified in Mn/DOT Standard Specification 3885.2, Category 30, or approved equal.

2.05 FLOTATION SILT CURTAIN

- A. Flotation silt curtain shall be as specified in Mn/DOT Standard Specification 3887, type Heavy Duty, or approved equal.

2.06 HYDROMULCH - BONDED FIBER MATRIX

- A. Hydromulch shall be as specified in Mn/DOT Standard Specification 3884.2.B.4 (Bonded Fiber Matrix). Product shall be installed per manufacturer's specification. Mulch product must be appropriate for slope steepness and time needed to establish vegetation.
- B. Owner or Engineer may request submittal for types of mulch material proposed for use.
- C. Other hydromulch products may be considered by Owner or Owner's On-Site Representative, based on the application area. Contractor to submit alternative products and receive written approval prior to substitution.

2.07 SEDIMENT CONTROL LOG

- A. Sediment control log shall be as specified in Mn/DOT Standard Specification 3897 and as specified on the Drawings.

- B. Sediment control log shall be a minimum of 9 inch diameter.
- C. Straw-filled sediment control log shall be staked at a minimum of every 4 feet. Straw sediment control log utilized as a ditch check shall be staked every 2 feet.

2.08 SILT FENCE

- A. Silt fence shall be Machine Sliced as specified in Mn/DOT Standard Specification 3886, except that support posts shall be no further than 4 feet apart.

2.09 SPRAY TACKIFIER

- A. Spray tackifier shall conform to Mn/DOT Standard Specification 3884. Contractor shall use Ramy Turf Hyper-Tack (at an application rate of 5 lbs/acre) or approved equal.

2.10 TEMPORARY SEDIMENTATION BASIN AND OUTLET STRUCTURE

- A. Temporary Sedimentation Basins shall be excavated below existing grade to contain a runoff volume as indicated on the Drawings or a volume otherwise determined by the Contractor for proper implementation of the Stormwater Pollution Prevention Plan and NPDES permit's minimum basin volume per acre of disturbed area.
- B. Contractor shall size, install and maintain berms and ditches for the redirection of all runoff in accordance with the Stormwater Pollution Prevention Plan. As drainage conditions change during construction, Contractor shall be responsible for coordinating and establishing the appropriate berms and ditches to direct runoff to temporary sedimentation locations.

2.11 TEMPORARY SEEDING & MULCHING

- A. Temporary seeding or mulching of disturbed areas as Specified in Section 32 92 00, Turf and Grasses.

PART 3: EXECUTION

3.01 TEMPORARY EROSION AND SEDIMENT CONTROL

- A. Temporary erosion and sediment control activities will be required through the duration of the project as set forth in the SWPPP.
- B. Maintain the appearance and functionality of the temporary sediment and erosion control measures throughout the duration of the Work.
- C. Temporary sediment and erosion control measures shall be installed, maintained and removed in accordance with the requirements of the SWPPP.

- D. Sweep roads free of all sediment which is transported onto them as a result of construction. Sweep weekly if sediment is on the streets or more frequently if requested by Owner. The cost for sweeping shall be at Contractor's expense.
- E. Conduct all erosion prevention and sediment control work in accordance with these Specifications, the SWPPP, and as shown in the Drawings.
- F. Temporarily protect or permanently cover all exposed soil areas within 7 days.
- G. Construct temporary erosion controls where there is evidence that sediment is being transported from the work area, where drainageways flow from the work area, and elsewhere as required to control erosion.
- H. Schedule operations to minimize the amount of area disturbed and thus susceptible to erosion at any given time.
- I. Design, construct, and maintain diversion berms and ditches to control the 25-year, 24-hour storm events (or larger).
- J. Remove and dispose of all temporary erosion controls when turf has been fully established or when earthwork has eliminated the possibility of sediment transport from the work area and in accordance with the SWPPP.
- K. See Section 01 57 13, Temporary Erosion and Sediment Control for additional requirements.

3.02 CONCRETE WASHOUT MANAGEMENT AREA

- A. Contractor shall furnish the appropriate measures for proper concrete washout. Concrete washout shall not be discharged at grade or otherwise allowed to flow into existing waterways, groundwater or storm sewers.
- B. Washout must be disposed of in accordance with the Stormwater Pollution Prevention Plan (SWPPP) for the work.
- C. Concrete washout at the batch plant is an acceptable alternative.

3.03 CONSTRUCTION ENTRANCE

- A. Construct construction entrance to the dimensions and material thicknesses shown on the Drawings and the SWPPP.
- B. Clean and maintain at the end of each work day.
- C. Contractor shall be responsible for removal and disposal of construction entrances.

3.04 CULVERT/INLET PROTECTION

- A. Provide culvert/inlet protection in accordance with the SWPPP.

3.05 EROSION CONTROL BLANKET

- A. Install in accordance with Mn/DOT Standard Specification 2573, manufacturer's recommendations, the SWPPP, and as shown on the Drawings.
- B. Install erosion control blanket on slopes 4 horizontal to 1 vertical or steeper.
- C. Unless otherwise indicated by the manufacturer, install the erosion control blanket as follows:
 - 1. Prepare the soil before installing the blankets, including smoothing all ruts and gullies, removing exposed rocks/protrusions, seeding and soil amendments if applicable.
 - 2. Erosion blankets with natural netting must be handled with care. Stretching of the net during installation may cause the straw to fall out. Contractor is responsible for maintaining an effective BMP.
 - 3. Roll the blankets down the slope. If blankets must be spliced down the slope, place blankets end over end (shingle style – upstream blanket overlapping downstream blanket) with approximately 12-inch overlap. Staple through the overlapped area, per manufacturer's recommendations.
 - 4. Overlap adjacent blankets at least 6 inches and staple through overlapped area.
 - 5. Erosion control blankets shall not be stretched during placement. Unnecessary tension may cause premature erosion blanket failure.
 - 6. Use metal staples. Staples are to be inserted a maximum spacing of every 2 feet in all directions in order to avoid tenting up of the erosion mat. Erosion blankets that tent up indicates a defective installation and must be reinstalled at the direction of the SWPPP inspector. Contractor to bear this cost.
 - 7. NOTE: Spacing requirement will be strictly enforced. Failure to adhere to the staple spacing requirements will result in withholding of payment to Contractor for the entire amount of erosion control blanket placement until such time as the staple spacing requirements are met.
- D. Maintenance:
 - 1. Repair soil, re-seed, fertilize and re-install erosion control blanket on any areas on which the original blanket has eroded, washed away, or blown off, as directed by Owner or Owner's On-Site Representative.

3.06 FLOTATION SILT CURTAIN

- A. Flotation silt curtain shall be installed and maintained in accordance with Mn/DOT Standard Specification 2573, manufacturer's recommendations, the SWPPP, and as shown on the Drawings.
- B. Remove and properly dispose of flotation silt curtain at completion of Project and the establishment of vegetation. Removal of flotation silt curtain shall not cause unnecessary ground disturbance.

3.07 HYDROMULCH - BONDED FIBER MATRIX

- A. Bonded fiber matrix shall be installed and maintained in accordance with Mn/DOT Standard Specification 3884 and as detailed in the SWPPP.

3.08 SEDIMENT CONTROL LOG

- A. Install, anchor, and maintain in accordance with Mn/DOT Standard Specification 2573, manufacturer's recommendations, the SWPPP, and as shown on the Drawings.

3.09 SILT FENCE

- A. Install in accordance with Mn/DOT Standard Specification 2573, manufacturer's recommendations, the SWPPP, and as shown on the Drawings. Four-foot maximum post spacing. 24 inches minimum post embedment below grade.
- B. Remove and properly dispose of silt fence at completion of Project and the establishment of vegetation. Removal of silt fence shall not cause unnecessary ground disturbance. Posts must be removed and silt fence fabric shall not be cut off at grade during silt fence removal.

3.10 SPRAY TACKIFIER

- A. Spray tackifier shall be installed and maintained in accordance with Mn/DOT Standard Specification 3884 and as described in the SWPPP.

3.11 TEMPORARY SEDIMENTATION BASIN AND OUTLET STRUCTURE

- A. Temporary sedimentation basins shall be installed in accordance with the SWPPP. Basin locations and sizes shown on the Drawings are for the temporary drainage areas shown on the Drawings. Contractor shall be responsible for establishing temporary drainage areas, verifying required storage volume and providing the appropriate size and location of basins for the work.
- B. Temporary sedimentation basins shall be installed in accordance with Mn/DOT Standard Specification 2573.3.A

- C. Temporary sedimentation basins shall be maintained in accordance with Mn/DOT Standard Specification 2573. Contractor shall drain and remove sediment when collected sediment comprises 50% or more of the storage volume.

3.12 TEMPORARY SEEDING & MULCHING

- A. Contractor shall furnish and install temporary seeding and mulching on disturbed areas as required by the SWPPP.
- B. Temporary seeding and mulching shall be performed in accordance with Section 32 92 00, Turf and Grasses.

END OF SECTION 31 25 00

SECTION 31 37 00

RIPRAP

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to furnish and install riprap including, but not limited to:
 - 1. Granular Filter
 - 2. Riprap
- B. Related Sections
 - 1. Section 31 05 19.13 Geotextiles for Earthwork

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Submit for information a list of sources of imported materials specified in this Section to Owner or Owner's On-Site Representative at least two weeks prior to delivery of materials to the Site.
- B. Submit for review all other soil testing and survey data as specified in Section 01 45 00, Quality Control.
 - 1. Granular Filter
 - 2. Riprap

1.04 QUALITY CONTROL

- A. Perform source quality control and field quality control as specified in Section 01 45 00, Quality Control.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Materials used for riprap shall be durable washed angular (crushed) igneous rock (no limestone or sandstone), of approved quality, sound, hard, and free of seams, cracks, and other structural defects. The stone shall be free of contamination by soil and other debris prior to incorporation in the Work.

2.02 GRANULAR FILTER

- A. Granular filter to meet the requirements of Mn/DOT Standard Specification 3601, Table 3601.2-2 Granular Filter Material.

2.03 RIPRAP

- A. Riprap shall be field-stone riprap meeting the requirements of Mn/DOT Standard Specification 3601, Table 3601.2-1 for the Class indicated on the Drawings.

2.04 RIPRAP UNDERLAYMENT (GEOTEXTILE)

- A. Riprap underlayment (geotextile) shall be as specified in Section 31 05 19.13, Geotextiles for Earthwork.

PART 3: EXECUTION

3.01 INSTALLATION

- A. Place riprap and granular filter in the locations and depths shown on the Drawings.
- B. Areas on which riprap are to be placed shall be graded and dressed to lines and grades shown on Drawings or as directed by Owner's On-Site Representative.
- C. Contractor shall place geotextile under riprap and granular filter and cover completely. No geotextile shall be exposed along edges or under riprap. Contractor shall place granular filter and riprap so geotextile is not damaged.
- D. Place riprap, granular filter, and riprap underlayment (geotextile) in accordance with Mn/DOT Standard Specifications 2511 and 3601.

E. See Section 31 05 19.13, Geotextiles for Earthwork for additional geotextile requirements.

END OF SECTION 31 37 00

Division 32

Exterior Improvements

SECTION 32 10 00

BASES AND PAVEMENTS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete pavement at the site including, but not limited to:
 - 1. Gravel pavement
 - 2. Bituminous pavement
- B. Related Sections
 - 1. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise.
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM D698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 2. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Test results and certificates including:
 - 1. Prior to placement, submit signed certification that materials furnished and mixture designs to be used for this Work have been tested and conform to the applicable requirements of these Specifications.
 - a. Indicate source of materials, mixture designations and proportions, name and address of testing laboratory, and dates of tests.

1.04 QUALITY CONTROL

- A. Perform source quality control and field quality control as specified in Section 01 45 00, Quality Control.

1.05 SEQUENCING AND SCHEDULING

- A. Do not proceed with paving activities until testing of subgrade materials and/or observation of subgrade preparation has been completed by Engineer or Owner.
- B. Do not proceed with paving activities until grading of subgrade material has been completed in accordance with Section 31 23 00, Mass Excavation, Embankment, and Stockpiles. Touch up or regrade as necessary to provide surface free of ruts, rills, depressions, and other undesirable features.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Only materials meeting requirements of Specifications at time of placement (temperature, etc.) will be accepted.
- B. Immediately remove from Site all materials not meeting requirements.
- C. Store materials and stage equipment within construction limits and staging.
- D. Do not block access to buildings with delivery of materials and equipment staging.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 AGGREGATE BASE (GRAVEL)

- A. 100% crushed quarry rock (limestone or dolostone) Class 5 as specified in Mn/DOT Standard Specifications 3138.

2.02 GRAVEL (SURFACING)

- A. Gravel (Surfacing) material shall be equivalent to Aggregate Base (Gravel) material.

2.03 BITUMINOUS PAVEMENT

- A. Bituminous Base Course:

1. Transfer Station Access Road
 - a. Shall conform to the requirements of Mn/DOT Standard Specification 2360 for Plant Mixed Asphalt Pavement, Type SPNWB440B, or an owner-approved equal.
 2. Site Access Road
 - a. Shall conform to the requirements of Mn/DOT Standard Specification 2360 for Plant Mixed Asphalt Pavement, Type SPNWA240B, or an owner-approved equal.
- B. Bituminous Tack Coat:
1. Shall conform to the requirements of Mn/DOT Standard Specification 2357 for Bituminous Tack Coat, Type MC250-800 and 3151 for Bituminous Material.
- C. Bituminous Wear Course:
1. The use of recycled materials in bituminous mixtures for wear course will not be allowed.
 2. Transfer Station Access Road
 - a. Shall conform to the requirements of Mn/DOT Standard Specification 2360 for Plant Mixed Asphalt Pavement, Type SPWEB440C, or an owner-approved equal.
 3. Site Access Road
 - a. Shall conform to the requirements of Mn/DOT Standard Specification 2360 for Plant Mixed Asphalt Pavement, Type SPWEA240B, or an owner-approved equal.
- D. Asphalt Binder Material:
1. Shall conform to the requirements of Mn/DOT Standard Specification 3151 for Performance Grade Asphalt Binder.
- E. All bituminous mixtures shall incorporate an approved coating and anti-stripping additive.

PART 3: EXECUTION

3.01 SUBGRADE COMPACTION

- A. See Specification 31 23 00, Mass Excavation, Embankment, and Stockpiles..

3.02 PROOF ROLLING

- A. Perform proof rolling with a fully loaded tandem axle dump truck having a minimum gross weight of 25 tons. Proof rolling should be performed in the presence of Engineer or Owner. If

any soft or weak zones are identified during the proof roll, the material should be subcut a minimum of 3 feet and replaced with suitably compacted fill material.

3.03 AGGREGATE BASE

- A. Place and compact Aggregate Base material to the compacted thicknesses required as on the Drawings. Compact to minimum 100% of standard Proctor maximum dry density (ASTM D698) and within +/- 2% of optimum moisture content.

3.04 GRAVEL SURFACING

- A. Place and compact Gravel Surfacing material to the compacted thicknesses required as on the Drawings. Compact to minimum 100% of standard Proctor maximum dry density (ASTM D698) and within +/- 2% of optimum moisture content.

3.05 BITUMINOUS PAVEMENT

- A. Install bituminous pavement in accordance with MN/DOT Standard Specification 2360 and to the compacted thickness in lifts as shown on the Drawings.
- B. Non-wearing course:
 - 1. Place within 72 hours of completion of Aggregate Base course.
 - 2. Prior to base course paving, tack material shall be applied to existing construction joints adjoining to new base course mat. Tack coat shall be applied at an application rate of 0.05 gallons per square yard.
 - 3. Verify that all structures are properly plated with a metal plate prior to paving.
 - 4. Prior to paving areas with previously installed utilities, verify that those utilities were not damaged during construction.
- C. Wearing course:
 - 1. Prior to paving, base surface must be cleaned and tack material applied.
 - 2. Prior to paving, adjust castings and remove a diamond cut with a minimum of 2 feet (0.6m) of bituminous base course around any structure to allow approved mechanical recompaction of aggregate base. Recompaction of aggregate base shall be accomplished with a Wacker J-Tamper or approved equal (vibratory pads are not allowed). Refill and compact resulting gap with bituminous to level of surrounding course prior to paving the next course. Tack or reheat all edges prior to patching.
 - 3. Paving wear course before June 1 or after October 15 requires (written) permission from the Engineer. Confirmation shall be in written form.

4. Tack Coat: Excess fuel oil or similar substances should be removed from any surface after the tack coat has been applied. Tack coat shall be applied as close as possible to paving time. Tack coat shall be reapplied at the discretion of the Engineer. Tack coat shall be applied at an application rate of 0.05 gallons per square yard.
5. Pneumatic roller for finishing wear course is required except as may be prohibited by Engineer adjacent underground structures.
6. Construction joints: the contact surface of all fixed structures shall be tacked prior to paving. The edge of any cold in-place pavement shall also be tacked prior to paving.

3.06 TOLERANCES

- A. Line and grade (+/- 0.2 foot horizontally, +/- 0.05 feet vertically)

END OF SECTION 32 10 00

SECTION 32 31 00

FENCES AND GATES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor for:
 - 1. Chain link fencing,
 - 2. Swing gate for walk-through access,
 - 3. Double swing gate for vehicle access,
 - 4. Swing arm gate for vehicle access,
 - 5. Split rail fence, and
 - 6. Temporary chain link fencing.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section:
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. AASHTO M232: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM F900: Standard Specification for Industrial and Commercial Steel Swing Gates
 - 3. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Submit temporary fencing plan for approval. Plan shall include proposed temporary fencing, proposed location of temporary fencing, and proposed schedule of temporary and final fencing.
- B. Manufacturer's Information: Submit manufacturer's data and installation instructions for all pre-fabricated products.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance, for a minimum of 10 projects within the last 2 years.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Care shall be utilized throughout the delivery, storage and handling to not scratch, bend, warp or otherwise damage the components.
- B. All components shall be stored above ground on level timbers or other material that will not stain, corrode, scratch or otherwise damage the components.

1.06 SEQUENCING AND SCHEDULING

- A. Maintain security around Transfer Station, provide temporary fencing until final fencing is installed.

1.07 PERFORMANCE REQUIREMENTS

- A. Vehicle Access Gate Structural Performance: Provide gate systems to withstand gate dead loads and wind live loads to a minimum of 75 mph.

1.08 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 CHAIN LINK FENCE

- A. Fabric: 9-gage galvanized steel wire, 2-inch mesh, knuckle selvage top and bottom, conforming to Mn/DOT 3376.2
- B. Top Rail: 1 5/8" O.D.
- C. Line Posts: 1 7/8" O.D.
- D. Terminal, Corner or Gate Posts: 2 3/8" O.D.
- E. Post Caps: Dome Style, AASHTO M232.

- F. Truss Rods: 3/8" galvanized steel.
- G. Tension Wire: 7-gage galvanized.
- H. Ties: 9-gage aluminum.

2.02 SWING GATES (WALK-THROUGH OR VEHICLE ACCESS)

- A. Fabricate in accordance with ASTM F900.
- B. Size and location as shown on Drawings.
- C. Fabric: same as Paragraph 2.01.
- D. Hinges: galvanized steel, non-lift type to allow gate swing 180-degrees.
- E. Latch: galvanized steel, forked type to allow operation from either side of gate, and provision for padlock.
- F. Drop rod (for double gates): galvanized drop rod with center gate stop pipe or receiver.

2.03 TEMPORARY CHAIN LINK FENCE

- A. Height: 6' minimum
- B. Fabric: 9-gage galvanized steel wire, 2-inch mesh,
- C. Rails: 1 1/4" O.D. with horizontal and vertical braces

2.04 SPLIT RAIL FENCE

- A. Split rail fence materials shall be Western Red Cedar, or an owner-approved equal.

2.05 CONCRETE

- A. Portland cement, 28-day compressive strength of 3,000 psi.

PART 3: EXECUTION

3.01 ERECTION

- A. General: All metal components shall be erected in a neat workmanship-like manner. All components shall be plumb, horizontal at the designated slope, and square, as appropriate. All components shall be installed in full conformance with manufacturer's written instructions.

- B. Fence posts shall be spaced according to manufacturer's recommendation, plus or minus ½-inch. For installation that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade.
- C. Fence panels shall be attached to posts with brackets supplied by the manufacturer.
- D. Gate posts shall be spaced according to the manufacturer' recommendation and Drawings. Gate hardware shall be provided by the manufacture of the gate and shall be installed per manufacturer's recommendations.
- E. Posts shall be set in concrete footers and shall comply with the Drawings.
- F. When cutting/drilling rails, posts, or panels adhere to the following steps to seal exposed steel surfaces:
 - 1. Remove all metal shavings from cut area.
 - 2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole, let dry.
 - 3. Failure to seal exposed surfaces per step 1-2 above may result in negation of fence warranties.

3.02 FIELD CONTROL QUALITY

- A. Establish and maintain quality control for work under this section to assure compliance with contract requirements and maintain records of his quality control for all construction operations. In addition, coordinate, verify, and check the operations which directly affect placement of the fence and gates.

END OF SECTION 32 31 00

SECTION 32 92 00
TURFS AND GRASSES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes restoring all disturbed areas, and includes soil preparation, seeding, erosion control blanket and all other work as may be necessary including, but not limited to:
 - 1. Placing topsoil for seeding.
 - 2. Restoring all areas disturbed.
 - 3. Furnishing and Installing wetland seed mix, upland buffer seed mix, general seed mix, and cover crop seed mix.
 - 4. Mulching and fertilizing.
 - 5. Placing erosion control blankets.
 - 6. Establishing and maintaining seeding.
- B. Related Sections
 - 1. Section 01 45 00 Quality Control
 - 2. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
 - 3. Section 31 23 23 Liner and Cover Soil Materials
 - 4. Section 31 25 00 Erosion and Sedimentation Control

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. Minnesota Board of Water and Soil Resources (BWSR) Native Vegetation Establishment and Enhancement Guidelines (October 2014).
 - 2. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Submit for information all requested submittals a minimum of two weeks prior to the Work, except as noted.
- B. Installation Supervisor resume of qualifications.
- C. Seeding Plan/Schedule
 - 1. Contractor shall submit a seeding plan/schedule for approval by the Owner and/or Engineer. This plan shall include proposed methods of seeding and proposed surface preparation and equipment.
- D. Submit for review soil testing analyses per Section 01 45 00, Quality Control.
- E. Test results and certificates:
 - 1. Seed mixture guarantee that the mixture and ratios meets the specified percentage or weight in the Seed and Plant Lists.
 - 2. Seed testing indicating an 80% or higher viability prior to final payout.

1.04 QUALIFICATIONS

- A. Foreman qualifications:
 - 1. Minimum of five years of experience in landscape installation and restoration.
 - 2. Horticultural or ecological restoration training.
 - 3. Able to take direction from and communicate with Engineer in spoken English.
- B. Crew qualifications:
 - 1. Familiar with planting procedures.
 - 2. Under the supervision of a qualified foreman.

1.05 QUALITY ASSURANCE

- A. Inspection: The Owner reserves the right to inspect all seeds at their place of growth and upon delivery for conformity to specification requirements. Approval of material at those times does not preclude the right of inspection and rejection during progress of the planting work.
- B. Seed analysis shall be attached to the seed bags showing species, germination, purity, name of certified testing agency, and date of test. No seed will be accepted unless test date is within 12 months of planting date.

- C. Communication between Contractor and Owner:
 - 1. Notify Engineer or Owner at least (3) three days in advance of any Work to be performed at Site, or of any inspections necessary to conform to Specifications.

1.06 DELIVERY, STORAGE, HANDLING

- A. Furnish standard products in unopened manufacturer's containers.
- B. Ship and store seed and mulch with protection from weather or other conditions that would damage the product or impair its effectiveness. Contractor shall inspect materials and items that have become wet, moldy, or otherwise damaged in transit or in storage shall be rejected.
- C. The Engineer or Owner will inspect all seeds. Items which have become wet, moldy, or are otherwise damaged will be rejected.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate the planting work with cover placement, site grading work, and any other restoration work, with the goal of minimizing lag time between completion of grading and restoration work.
- B. Contact the local utility companies for verification of the location of all underground utility lines in the area of work.
- C. Turf establishment shall conform to the planting Season of Planting requirements of Mn/DOT Standard Specification 2575.3 A.
- D. Contractor shall plant seed during non-frozen dormant seasons or growing seasons.
 - 1. Dormant seeding shall conform to MN/DOT Standard Specifications 2575.3 B.7 as approved by Engineer. Snow seeding is not allowed.
- E. Notify Owner and/or Engineer when planting operations and site monitoring visits will occur, a minimum of three (3) days in advance.

1.08 SUBSTITUTIONS

- A. Species to be planted shall be as specified. For any proposed substitutions Contractor shall submit written application and comply with requirements of the Agreement.
- B. If acceptable proof is submitted to the Engineer and Owner, that any seed or plant specified is not obtainable, due to conditions beyond the control of Contractor and for reasons other than cost changes since submittal of Contractor's Bid, a proposal will be considered for use of the nearest equivalent species with an appropriate adjustment of the unit price.

1.09 EROSION CONTROL

- A. Contractor is required to continue erosion control methods and maintain previously installed materials, and to install, where necessary, additional protection to control erosion and sedimentation during their work on the site.
- B. Verify that conditions on the Site are suitable to receive work prior to commencing.
- C. Contractor will be responsible to repair all subsequent soil erosion after site condition verification extending for a period of three months after receipt of preliminary acceptance.
- D. Repair all erosion rills greater than one inch deep. Repair all eroded areas within 48 hours of receipt of notification from Engineer or Owner. Additional erosion control repairs and/or measures shall be considered incidental to the plant installation.

1.10 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 SOIL

- A. Common Fill
 - 1. See Section 32 23 00, Mass Excavation, Embankment, and Stockpiles for Common Fill requirements.
- B. Topsoil
 - 1. See Section 31 23 23, Liner and Cover Soil Materials for Topsoil requirements.

2.02 FERTILIZER:

- 1. Fertilizer shall be as specified in Mn/DOT Standard Specification 3881.
- 2. Contain minimum percentage by weight of: 10-10-10: Nitrogen, Phosphorus, Potash.
 - a. Adjust, if necessary, per the outcome of topsoil analysis.

2.03 AGRICULTURAL LIME

- A. Provide Agricultural Lime if required for pH adjustment per outcome of topsoil analysis

- B. Agricultural Lime (if required for pH adjustment per outcome of topsoil analysis) shall be as specified in Mn/DOT Standard Specification 3879.

2.04 SEED MIXES

- A. General Seed Mix

- 1. General Seed Mix shall be State Seed Mix 35-241 as specified in Mn/DOT Standard Specification 3876.

- B. Native General Seed Mix

- 1. Native General Seed Mix shall meet the following requirements:

| Common Name | Scientific Name | Rate (lb/ac) | Rate (Seeds/square foot) | Mix (% by weight) | Mix (% by seeds) |
|----------------------------|--------------------------------|--------------|--------------------------|-------------------|------------------|
| Side-oats grama | <i>Bouteloua curtipendula</i> | 2.88 | 6.35 | 7.90 | 4.78 |
| Blue grama | <i>Bouteloua gracilis</i> | 2.19 | 32.18 | 6.00 | 24.23 |
| Poverty oatgrass | <i>Danthonia spicata</i> | 1.10 | 10.06 | 3.00 | 7.57 |
| Canada wild rye | <i>Elymus canadensis</i> | 0.73 | 1.39 | 2.00 | 1.05 |
| Revenue slender wheatgrass | <i>Elymus trachycaulum</i> | 1.46 | 5.33 | 4.00 | 4.01 |
| Junegrass | <i>Koeleria macrantha</i> | 0.18 | 13.41 | 0.50 | 10.09 |
| Lodorm Western wheatgrass | <i>Pascopyrum smithii</i> | 1.10 | 2.34 | 3.00 | 1.76 |
| Sand dropseed | <i>Sporobolus cryptandrus</i> | 0.37 | 26.81 | 1.00 | 20.19 |
| | Total Grasses | 10.0 | 97.9 | 27.4 | 73.7 |
| Yarrow | <i>Achillea millefolium</i> | 0.07 | 4.77 | 0.20 | 3.59 |
| Lead plant | <i>Amorpha canescens</i> | 0.22 | 1.29 | 0.60 | 0.97 |
| Stiff tickseed | <i>Coreopsis palmata</i> | 0.07 | 0.27 | 0.20 | 0.20 |
| Common ox-eye | <i>Heliopsis helianthoides</i> | 0.22 | 0.37 | 0.60 | 0.28 |
| Wild bergamot | <i>Monarda fistulosa</i> | 0.04 | 1.03 | 0.11 | 0.78 |
| Yellow coneflower | <i>Ratibida pinnata</i> | 0.15 | 1.61 | 0.40 | 1.21 |
| Black-eyed Susan | <i>Rudbeckia hirta</i> | 0.37 | 12.33 | 1.00 | 9.29 |
| Stiff goldenrod | <i>Solidago rigida</i> | 0.18 | 2.75 | 0.50 | 2.07 |
| Smooth Aster | <i>Symphotrichum laeve</i> | 0.07 | 1.47 | 0.20 | 1.11 |
| Golden Alexander | <i>Zizia aurea</i> | 0.11 | 0.44 | 0.30 | 0.33 |
| | Total Forbs | 1.5 | 26.3 | 4.1 | 19.8 |
| Oats | <i>Avena sativa</i> | 25.00 | 8.61 | 68.49 | 6.48 |
| | Total Cover Crop | 25.0 | 8.6 | 68.5 | 6.5 |
| | Total | 36.5 | 132.8 | 100.0 | 100.0 |

C. Cover Crop Seed Mix

- Cover Crop Seed Mix shall be State Seed Mix 21-111 or 21-112 as specified in Mn/DOT Standard Specification 3876.

D. Wetland Seed Mix

1. Wetland Seed Mix shall be State Seed Mix 34-271 as specified in Mn/DOT Standard Specification 3876.

E. Upland Buffer Seed Mix

1. Upland Buffer Seed Mix shall be State Seed Mix 32-241 as specified in Mn/DOT Standard Specification 3876.

F. Comply with current U.S. Department of Agriculture rules and regulations.

G. Any seed substitutions required shall be coordination with Owner and Engineer.

2.05 EROSION CONTROL

A. Erosion Control Blanket

1. See Section 31 25 00, Erosion and Sedimentation Control for Erosion Control Blanket requirements.

B. Mulch

1. Provide mulch for disturbed and seeded areas that do not require Erosion Control Blanket.
2. Wetlands
 - a. No mulch shall be applied within the wetland
3. General Mulch
 - a. General Mulch shall be Type 1 Mulch as specified in Mn/DOT Standard Specification 3882.
4. Upland Buffer Mulch
 - a. Upland Buffer Mulch shall be Type 3 Mulch as specified in Mn/DOT Standard Specification 3882.

2.06 WATER

- A. Contractor shall be responsible for water used for seed establishment.

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Cover all disturbed areas with topsoil to a minimum depth of 6 inches. Install seed, mulch, fertilize, and erosion control blanket in accordance with Mn/DOT Standard Specification 2575 and as specified herein.
- B. Coordinate the vegetation establishment work with the grading and finishing operations to provide protection as soon as possible after areas have been prepared.
- C. Do not begin ground preparation until rocks greater than 1 ½ - inch diameter, boulders, debris, and similar materials have been removed, depressions and ruts filled, and area to be seeded shaped, trimmed, and finished uniformly to grades and cross-sections shown on the Drawings, or to match original grade.

3.02 TOPSOIL PLACEMENT, GRADING, AND SITE PREPARATION

- A. Finish Grading
 - 1. Place topsoil uniformly over entire area to be planted to a minimum depth of 6 inches. In the event that topsoil has been disturbed or is not of acceptable depth prior to application of seed, add supplement topsoil in area to bring it up to the required depth. Work all areas receiving seed until the soil is completely fined and in a mellow condition, and to a smooth, even finish grade. Fill all holes, depressions and rivulets to ensure no disruption of established drainage patterns. Remove all rubble, sticks, branches, or stones and extraneous material over ¾-inch diameter on the surface, which will interfere with the seeding.
 - 2. Immediately prior to seeding, loosen topsoil to a depth of 3 inches on all areas using discs, harrows, tiller rakes, or hand tools as needed to produce fine grade and incorporate the compost into the soil.
 - 3. Prepare ground so top of newly seeded areas will be flush with adjacent soil, adjacent walks, and permanent surfacing.
- B. pH Adjustment:
 - 1. Adjust topsoil pH per the requirements/outcomes of topsoil analysis and in accordance with Mn/DOT Standard Specification Section 3879.
- C. Fertilizer Spreading:
 - 1. No fertilizer shall be applied within the wetland or upland buffer areas.
 - 2. Mechanically spread uniformly in two passes at right angles to each other.

3. 20 lbs. of active ingredients/10,000 sq. ft. (90 lbs. /acre) unless required otherwise by topsoil analysis.
4. Disk, harrow or rototill fertilizer into soil to depth of three (3) inches, or use other acceptable method to produce similar results.

D. Cleanup:

1. Remove and dispose of rock, trash or other materials brought to surface to off-site area in legal manner and per these Specifications.

3.03 SEEDING

A. Planting Seasons for Seeded Areas:

1. Planting seasons shall be as specified in Mn/DOT Standard Specification 2575.

B. Seed Application:

1. Seed areas with respective seed mix as designated on the Drawings.
2. Immediately prior to seed installation the site shall be inspected for adequate installation conditions including the complete eradication of any weeds that may be present.
3. Do not seed on saturated or frozen soil.
4. Perform seeding at a right angle to surface drainage.
5. Seed all areas disturbed by construction operations including temporary slopes.
6. Do not seed following rain or if surface has been compacted by rain.
7. Do not seed when wind velocity exceeds six (6) mph.
8. Hand seeded areas must be hand raked to ensure good seed-to-soil contact. Hydroseeding is not to be used for any seed mixture.
9. Wetland Seeding Areas:
 - a. Seeding will take place using a broadcast drop seeder designed for use with native seed mixes. Seeding equipment shall be checked at the end of each seeding pass to ensure even distribution of seed through each pass.
 - b. Within 12 hours, if conditions permit or as soon thereafter as practical, all seeded areas shall be rolled at right angles to the line of run-off with a roller or cultipacker to compact the seedbed to place the seed in contact with the soil.
10. General, Upland Buffer, and Cover Crop Seeding Areas

- a. Seeding shall be sown using a seed drill or drop type seeder. Seed shall be installed in rows no greater than 8-inch apart.
- b. Immediately prior to seeding operations, all seeding equipment shall be calibrated and adjusted to sow seeds at the proper seeding rate. The drill shall be calibrated at 1/2 the appropriate seeding rate and each area shall be drilled twice at opposite directions to help insure an even distribution. Seed shall be sown at approximately 1/8-inch to 1/4-inch deep and no deeper than 1/2-inch deep.

3.04 EROSION CONTROL BLANKET

- A. Use erosion control blanket on all seeded areas with slopes greater than 4:1 and as designated on the Drawings or by the Engineer following seeding operations.
- B. Install erosion control blanket in all areas as shown on Drawings in accordance with Mn/DOT Standard Specification 2575.3. Install blankets vertically on the slope. Use a minimum two inch overlap, where more than one width is required. Secure the outer most stitch of each blanket with a common row of staples. Trench blanket at the head of the slope if the blanket cannot be extended three feet over the slope crest or if overland flow is anticipated from upslope areas.
- C. Take precautions to prohibit pedestrian or vehicular traffic over the blanketed area. Replace at once, blanket displaced by such activities, but only after the work preceding the blanketing, which may have been damaged as a result of the displacement, has been acceptably repaired. Suspend or alter blanketing activities, as directed by Engineer, when soil conditions are excessively wet or dry.

3.05 MULCH

- A. No mulch shall be applied within the wetland.
- B. Install mulch on all seeded areas (other than wetlands) following seeding operations.
 1. Mulch in accordance with Mn/DOT Standard Specification 2575 with the following exception:
 - a. Type 1 mulch shall be anchored with straw and mulch crimper immediately after application.
 - b. Type 1 mulch shall be applied at a rate of 3,000 lbs per acre.
 2. On slopes, disc anchoring shall be at right angles to slope.
 3. Install erosion control blanket in all areas where disc anchoring cannot be performed.

3.06 CLEAN-UP

- A. Daily: Keep Work areas clean, neat, and orderly.

- B. Final: Clean-up the entire area around planting operations and restore to its original condition.
- C. Restore existing turf damaged by Contractor's planting operations by seeding.

3.07 MAINTENANCE AND ESTABLISHMENT

- A. Maintain seeded area as needed until establishment and acceptance.
- B. Maintenance may consist of watering, fertilization, reseeding, adding mulch and repair.
- C. Repair soil, reseed, fertilize, and re-install erosion control blanket on any areas on which the original mulch or erosion control blanket has eroded, washed away, or blown off, as directed by Owner or Owner's On-Site Representative.
- D. The Contractor is responsible for any supplemental watering that may be required to ensure thorough establishment of seed.
- E. Protection:
 - 1. Maintenance includes temporary protection fences and barriers, signs, and other Work incidental to proper maintenance.
 - 2. Contractor liable for damage to seeded areas caused by fertilizers, pesticides, and other materials supplied by Contractor.
- F. Reseeding and Repair:
 - 1. Any bare, open areas greater than 10 square feet shall be reseeded at one half of the original seeding rates.
 - 2. Bare spots shall be spot reseeded in accordance with Mn/DOT sowing and seeding specifications.
 - 3. Reseed area in accordance with drill seeding and maintenance requirements.

3.08 ACCEPTANCE

- A. Seed shall display reasonably uniform distribution of plants after any required reworking.
- B. Seed shall display vigorous growth and be healthy in appearance.
- C. Notify Engineer when seeded area is ready for final inspection.
- D. Guarantee seeded areas for duration of one (1) year after seeding installation to be established and in satisfactory growth at end of guarantee period.
- E. For purpose of establishing acceptable standard, scattered bare spots, none larger than one square foot will be allowed up to maximum of three (3) percent of seeded area.

END OF SECTION 32 92 00

Division 33

Utilities

SECTION 33 05 28

TRENCHING AND BACKFILLING FOR UTILITIES

PART 1: GENERAL

1.01 SUMMARY

A. Section includes providing all materials, equipment, and labor to excavate and backfill trenches for utilities including, but not limited to:

1. Excavating trenches for utilities.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

B. Related Sections

1. Section 31 01 00 Site Preparation
2. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
3. Section 31 23 23 Liner and Cover Soil Materials
4. Section 33 10 00 Water Utilities
5. Section 33 30 00 Sanitary Sewer Utilities
6. Section 33 40 00 Storm Drainage Utilities
7. 33 90 01 Landfill Leachate Piping and Appurtenances
8. 33 90 02 Landfill Gas Piping

1.02 DEFINITIONS

A. *Utility* – any buried pipe, duct, conduit, or cable.

1.03 REFERENCES

A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise.

1. Occupational Safety and Health Standards-Excavations (OSHA)

- a. OSHA set forth in 29 CFR 1926, Subpart P.

1.04 SUBMITTALS

- A. No submittals are required from this Section.

1.05 SEQUENCING AND SCHEDULING

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities for gravity flow systems.

1.06 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 FILL MATERIALS

- A. See Section Section 31 23 00, Mass Excavation, Embankment, and Stockpiles and Section 31 23 23, Liner and Cover Soil Materials.

PART 3: EXECUTION

3.01 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
 - 1. Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

3.02 PREPARATION

- A. Call Local Utility Line location service not less than 3 working days before performing Work to request underground utilities to be located and marked within and surrounding construction areas.
- B. Locate private utility lines that may impact the Work.
- C. Prepare the site in accordance with Section 31 01 00, Site Preparation.

3.03 TRENCHING

- A. Excavate trenches sufficiently wide to enable installation and allow inspection and in accordance with OSHA requirements. Remove water or materials that interfere with Work.
- B. Excavate bottom of trenches maximum 2 feet wider than outside diameter of pipe.
- C. Excavate trenches to a sufficient depth to install pipes as indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered.
- F. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Engineer.

3.04 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Design sheeting and shoring to be left in place as part of the completed Work, cut off 24 inches above top of utility.
- C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

3.05 BACKFILLING

- A. Place and compact pipe bedding soil with hand-operated compaction equipment, thoroughly compacting the soil beneath the haunches of the pipe being laid.
- B. Backfill trenches to contours and elevations with suitable fill materials.
- C. Backfill and compact trenches as specified in Section 31 23 00, Mass Excavation, Embankment, and Stockpiles and Section 31 23 23, Liner and Cover Soil Materials. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- D. Employ placement method that does not disturb or damage utilities in trench.
- E. Protect open trench to prevent danger to Contractor's or other personnel.

3.06 FIELD QUALITY CONTROL

- A. Perform field quality control as specified in Section 01 45 00, Quality Control.

- B. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.07 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION 33 05 28

SECTION 33 10 00

WATER UTILITIES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete buried water pipe and appurtenances and provide temporary sanitary service.
- B. Related Sections
 - 1. Section 33 05 28 Trenching and Backfilling for Utilities
 - 2. Section 40 90 00 Instrumentation and Control for Process Systems

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise.
 - 1. American Water Works Association (AWWA)/American National Standards Institute (ANSI):
 - a. AWWA C600: Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
 - b. AWWA C651: Disinfecting Water Mains
 - 2. City Engineers Association of Minnesota Standard Specifications, 2018 Edition, hereafter referred to as CEAM Standard Specifications

1.03 SUBMITTALS

- A. Submit for approval a temporary potable water plan. Plan shall include proposed temporary piping, proposed location of temporary piping, and proposed schedule of temporary and final piping.
- B. Manufacturer's product data including:
 - 1. Technical product data and installation instructions for all water system materials and products.

- C. Shop drawings including:
 - 1. Piping materials, size, locations, and elevations. Include details of underground structures, valves, connections, restrained joints, and anchors. Show interface and spatial relationship between piping and proximate structures.
- D. Test results and certificates including:
 - 1. Hydrostatic Test. Submit for approval 1 copy of results of hydrostatic test upon completion of water distribution backfilling operations.
 - 2. Electrical Conductivity Test. Submit for approval 1 copy of results of electrical conductivity test upon completion of water distribution backfilling operations.
 - 3. Bacteriological Tests. Submit for approval 1 copy of results of bacteriological tests upon completion.
- E. Record Drawings:
 - 1. At Project closeout, submit for information Record Drawings of installed piping and products including locations and elevations.

1.04 QUALITY ASSURANCE

- A. Manufacturer's Qualifications. Firms regularly engaged in manufacture of potable water systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications. Firm with at least 3 years of successful installation experience on projects with potable water piping work similar to that required for project

1.05 SEQUENCING AND SCHEDULING

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities for gravity flow systems.
- B. Maintain potable water service to Transfer Station during and after construction activities.
- C. Provide temporary water service prior to removing or shutting down the existing potable waterline.
- D. Temporary water service shall be tested to ensure it is potable prior to use.
- E. Sequence work such that temporary water service is not subject to freezing conditions.
- F. During construction work on the water system, the contractor will contact the Owner at least 72 hours in advance to request and schedule the Transfer Station water system shut off.

1.06 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements.

2.02 IDENTIFICATION

- A. Underground-Type Plastic Line Markers. Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide by 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW."

2.03 PIPING AND FITTINGS

- A. Ductile iron pipe, fittings, joints, and restraining devices to meet the requirements of AWWA C600 and CEAM Standard Specification 2611.2, with pipe and fitting for ductile iron pipe, Class 52.
- B. Accessories: See Section 40 90 00, Instrumentation and Control for Process Systems for heat trace requirements.

PART 3: EXECUTION

3.01 GENERAL

- A. Install buried waterline in accordance with CEAM Standard Specification 2611.3.
- B. Tying into existing potable waterline is limited to 12 consecutive hours.

3.02 INSPECTION

- A. Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.03 IDENTIFICATION

- A. During backfilling of underground potable water piping, install continuous underground-type plastic line markers, located directly over buried lines at 18 inches to 24 inches below finished grade.

3.04 PIPE AND PIPE FITTINGS

- A. Install ductile iron pipe waterline and fittings in accordance with AWWA C600 and CEAM Standard Specification 2611.3:
- B. Provide minimum cover over piping as shown on the Drawings.

3.05 FIELD QUALITY CONTROL

- A. Site Tests
 - 1. Compaction
 - a. Perform inspections prior to and immediately after placing bedding.
 - 2. Piping (general):
 - a. Perform Hydrostatic Testing for water pipe in accordance with Section 4 of AWWA C600 and CEAM Standard Specification 2611.3-G.
 - b. Owner will perform Operational Testing in accordance with CEAM Standard Specification 2611.3-H.
 - c. Perform Electrical Conductivity Testing in accordance with CEAM Standard Specification 2611.3-F.
 - d. Notify Engineer and Owner 48 hours prior to all pipe testing.

3.06 DISINFECTION

- A. Disinfect potable water system with chlorine in accordance with AWWA C651 and CEAM Standard Specification 2611.3-E.
- B. After disinfection, Contractor shall collect 2 consecutive days of water samples and bacteriological tests in accordance with AWWA specifications. Provide 1 copy of results of bacteriological tests to Engineer and Owner upon completion. Do not place distribution system in service until approval is obtained from Owner. The samples shall be confirmed to be free of coliform organisms prior to the waterline being put into service.

END OF SECTION 33 10 00

SECTION 33 30 00

SANITARY SEWER UTILITIES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to complete sanitary drainage pipe and provide temporary sanitary service.

1.02 RELATED SECTIONS

- A. Section 33 05 28 Trenching and Backfilling for Utilities
- B. Section 40 90 00 Instrumentation and Control for Process Systems

1.03 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date.
 - 1. American Water Works Association (AWWA)/American National Standards Institute (ANSI):
 - a. AWWA C600: Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 2. City Engineers Association of Minnesota Standard Specifications, 2018 Edition, hereafter referred to as CEAM Standard Specifications

1.04 SUBMITTALS

- A. Submit for approval a temporary sanitary service plan. Plan shall include proposed temporary piping, proposed location of temporary piping, and proposed schedule of temporary and final piping.
- B. Manufacturer's product data including:
 - 1. Technical product data and installation instructions for sewage system materials and products.
- C. Shop drawings including:

1. Piping materials, size, locations, and inverts. Include details of underground structures, connections, and manholes. Show interface and spatial relationship between piping and proximate structures.

D. Test results and certificates including:

1. Sanitary Sewer Leakage Test. Submit for approval 1 copy of results of leakage.

E. Record Drawings:

1. At project closeout, submit for information record drawings of installed sanitary sewage piping and products including locations and elevations.

1.05 SEQUENCING AND SCHEDULING

- A. Verify existing pipe material and dimensions prior to any Work associated with the sanitary service.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities for gravity flow systems.
- C. Maintain sanitary service to Transfer Station during and after construction activities.
- D. Provide temporary sanitary service prior to removing or shutting down the existing sanitary system.
- E. Temporary sanitary service shall be tested prior to use.
- F. Sequence work such that temporary sanitary service is not subject to freezing conditions.
- G. During construction work on the water system, the contractor will contact the Owner at least 72 hours in advance to request and schedule the Transfer Station water system shut off.

1.06 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated on the Drawings. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements. Provide sizes and types matching piping; provide fittings of materials which match pipe materials used in sanitary sewer

systems. Where more than one type of materials or products is indicated, selection is Contractor's option.

2.02 IDENTIFICATION

- A. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SEWER LINE BURIED BELOW."

2.03 PIPING AND FITTINGS

- A. Provide pipes of weight/class indicated on the Drawings. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
- B. Ductile iron pipe, fittings, joints, and restraining devices to meet the requirements of AWWA C600 and CEAM Standard Specification 2621.2, with pipe and fitting for ductile iron pipe, Class 52.
- C. Accessories: See Section 40 90 00, Instrumentation and Control for Process Systems for heat trace requirements.

2.04 TRACER WIRE

1. Tracer Wire to meet the requirements of CEAM Standard Specification 2621.2-A12.

PART 3: EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which sanitary sewer system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 IDENTIFICATION

- A. During backfilling of underground piping, install continuous underground-type plastic line markers, located directly over buried lines at 18 inches to 24 inches below finished grade.

3.03 PIPE AND PIPE FITTINGS

- A. Install ductile iron pipe waterline and fittings in accordance with AWWA C600 and CEAM Standard Specification 2621.3:
- B. Provide minimum cover over piping as shown on the Drawings.

3.04 TRACER WIRE

1. Install Tracer Wire in accordance with CEAM Standard Specification 2621.3-A5.

3.05 FIELD QUALITY CONTROL

- A. Perform testing of completed piping in accordance with local authorities having jurisdiction. All pipes shall be backfilled and cleaned by flushing with water prior to testing. A high velocity jet or other methods may be necessary.
 1. Perform Sanitary Sewer Leakage Test in accordance with CEAM Standard Specification 2621.3-E.2b.
 2. Notify Engineering and Owner 48 hours prior to all pipe testing.
- B. Pipe and pipe appurtenances installation will be subject to rejection for any of the following reasons.
 1. Failure to conform to the Specifications, with regard to:
 - a. Compaction under and around the pipe
 - b. Line and grade (+ or – 0.5 foot horizontally, + or – 0.10 feet vertically)
 2. Damaged ends where such damage would prevent making a satisfactory joint
 3. Damaged gasketed coupler system

END OF SECTION 33 30 00

SECTION 33 36 23
FIBERGLASS STORAGE TANKS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor for double-wall fiberglass coated to steel Underwriters Laboratories-labeled underground storage tank or Engineer approved equal.
- B. Provide the following including all fittings and accessories as shown on Drawings:
 - 1. Two 25,000 gallon double-wall fiberglass coated to steel underground storage tanks.
 - 2. One 10,000 gallon double-wall fiberglass coated to steel underground condensate storage tank.
 - 3. One 5,000 gallon double-wall fiberglass coated to steel underground condensate storage tank.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society of Testing Materials (ASTM).
 - a. ASTM D1998: Standard Specification for Polyethylene Upright Storage Tanks
 - b. ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
 - 2. American Water Works Association (AWWA)
 - a. AWWA D120-02: Standard for Thermosetting Fiberglass-Reinforced Plastic Tanks
 - 3. American National Standards (ANSI)
 - a. ANSI B-16.5: Pipe Flanges and Flanged Fittings
 - 4. Building Code: International Building Code - IBC 2009
 - 5. Underwriters Laboratories (UL)
 - a. UL 1316: Standard for Fibre Reinforced Underground Tanks for Flammable and Combustible Liquids

1.03 SUBMITTALS

- A. Submittals for Review
 - 1. Manufacturer's product data including:
 - a. Include detailed data covering specifications, drawings, materials, parts, sizes, dimensions, weights, distribution of weight with the unit empty and filled with leachate for the leachate tanks and condensate for the condensate tank, fitting

material, gasket style and material, bolt material, vents. Handling and installation instruction.

2. Dimensioned Tank Drawings
 - a. Location and orientation of molded in fitting, openings, fittings, accessories, restraints and supports.
 - b. Details of inlet and molded outlet fittings, manways, flexible connections, and vents.
3. Calculations shall be stamped and signed by a registered, third party engineer in the State of the installation.
 - a. Wall thickness determination.
 - b. Tank restraint system.
4. Submit service representative's complete signed report of results of the inspection, operation, adjustment, and tests. Report shall include detailed descriptions of points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. Include the manufacturer's certificate that equipment conforms to specified requirements and is ready for permanent operation and that nothing in installation will render manufacturer's warranty null and void.

1.04 QUALITY ASSURANCE

- A. Tank manufacturer shall be in the business of manufacturing tanks to UL 1316 standards.
- B. Manufacturer shall have a minimum of five (5) years of experience producing equipment substantially similar to that required and shall be able to submit documentation of at least ten (10) independent installations using the same size or larger equipment as specified.
- C. Each installation must have been in satisfactory operation for at least five (5) years.
- D. Provide equipment and components called for under this section by a single manufacturer or authorized sales representative. The equipment manufacturer or authorized sales representative shall, in addition to Contractor, assume the responsibility for proper installation and functioning of the equipment.
- E. Tanks shall be manufactured from materials certified to the requirements of ANSI/AWWA D120-02.
- F. Examine each component of storage tank for compliance with requirements specified. Redesign or modification of equipment to comply with specified requirements, or necessary redesign or modification following failure to meet specified requirements, shall receive particular attention for adequacy and suitability. This element of inspection shall encompass visual examinations and dimensional measurements. Noncompliance with specified requirements, or presence of one or more defects preventing or lessening maximum efficiency of storage tank, shall constitute cause for rejection.

1.05 DELIVERY, STORAGE, HANDLING

- A. Inspect materials delivered to site for damage; unload and store with minimum handling. Store materials on-site in enclosures or under protective coverings. Store materials susceptible to

deterioration by direct sunlight under cover and avoid damage due to high temperatures. Do not store materials directly on ground. Store and protect materials according to manufacturer recommendations.

- B. Ship the tank with blocks and slings to keep them from moving. AVOID sharp objects on trailers. Install all fittings and, if necessary, remove for shipping and ship separately.
- C. Stockpile and store delivered materials at locations approved by Owner until required for installation.
- D. Handle materials in accordance with manufacturer's instructions and the requirements of this specification. Handle storage tank in such a manner as to ensure delivery to final location in sound, undamaged condition. Take special care not to damage interior and exterior surfaces of the storage tank and associated equipment. Make satisfactory repairs to damaged material(s) at no cost. Carry and do not drag materials. Handle storage tank according to manufacturer's information.

1.06 WARRANTY

- A. The equipment manufacturer shall warrant the equipment being supplied to Owner against defects in workmanship and materials for a period of five (5) years under normal use, operation and service. The warranty shall be pro-rated. The warranty shall be in published form and apply to all similar units.
- B. A warranty offered by a representative will not be acceptable in lieu of the manufacturer's warranty.
- C. Multiple warranties for individual components shall not be acceptable.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 PERFORMANCE SPECIFICATION

| Property | Fiberglass Leachate Storage Tanks | Fiberglass Condensate Storage Tank 1 | Fiberglass Condensate Storage Tank 2 |
|----------------------------|-----------------------------------|--------------------------------------|--------------------------------------|
| Volume, gal | 25,000 | 5,000 | 10,000 |
| Diameter, ft (anticipated) | 12 | 8 | 8 |
| Access Manway Number | 2 | 1 | 1 |
| Access Manway Size, inch | 42 | 36 | 36 |
| Nozzle Location and Size | As shown on the Drawings | As shown on the Drawings | As shown on the Drawings |

2.02 REINFORCED FIBERGLASS TANKS

- A. Applications
 - 1. The leachate storage tanks shall be used to store leachate collected from leachate management system throughout closed landfill.

2. The condensate holding tanks shall be used to collect and store accumulated condensate from landfill gas system.

B. Manufacturing specifications:

1. Tank shall meet the following design criteria:

| Condition | Design Criteria | Comments |
|--|---|---|
| Internal Load | Withstand a 5 psig air-pressure test with a 5:1 factor of safety | Contractor shall test each tank for leakage prior to installation |
| Vacuum Test | Manufacturer to vacuum test at the factory to 11.5" of mercury | |
| Surface Loads | Tank to withstand surface H-20 axle loads | |
| External Hydrostatic Pressure and Bury Depth | Capable of bury depth of 15' of overburden over the top of the tank, the hole fully flooded with factor of safety of 5:1 against buckling | |

2. Leachate storage tanks and Condensate tanks shall be provided with multiple connections as shown schematically on the Drawings.
3. Tanks shall be vented to atmospheric pressure.
4. The following materials shall be used in the construction of the storage tank:
 - a. 100% premium resin and chopped glass. Fillers or extenders are prohibited from use.
 - b. General, Orthophthalic, or odd lot resin is prohibited from use.
 - c. All associated internal mounting hardware shall be rustproof and corrosion resistant.
 - d. Fittings / Connection: Two inches IPS or less shall be flanged or threaded; larger sizes shall be flanged. Flanged fittings shall conform to ANSI B16.5.
 - 1) Extend connections 6-inches out of tank.

C. Interstitial space:

1. Provide void space between primary and secondary walls to allow for the free flow and containment of leaked product from the primary tank.
2. Provide monitoring within void space.

D. Anchor System:

1. Provide anchor straps.
2. Number and location of straps to be specified by tank manufacturer.
3. Provide precast or cast-in-place concrete slab below tank, if required.

E. Manways:

1. Leachate storage tanks to be equipped with two (2) 42" manways.
2. Condensate storage tanks to be equipped with one (1) 36" manway.

3. Location as shown on the Drawings.
- F. Internal concrete pad platforms:
1. Concrete Pad platforms to be reinforced concrete as shown on the Drawings.
- G. Fittings:
1. All standard National Pipe Thread (NPT) threaded fittings shall be constructed with FRP or 304 stainless steel.
 2. All standard NPT threaded fittings shall be half-couplings or full.
 3. All NPT fittings shall withstand a minimum of 150 foot-pounds of torque and 1,000 foot-pounds of bending. Both with a 2:1 Factor of safety.
 4. All FRP nozzles to be flat-faced, flanged and gusseted, and shall conform to ANSI B16.5 150# bolting pattern.
 5. Each interstitial-space monitor fitting to consist of a 4" flanged fitting on the secondary tank.
- H. Restraint system:
1. Metal components to be stainless steel, including edge softeners, and tension ring with stainless steel, cables and clamps.
 2. Tank restraint system shall be supplied and the design of same certified by a Structural Engineer registered in the State of tank installation. Design shall conform to the most recent edition of the IBC code for seismic and wind load. Anchor bolts as required by the calculations shall be supplied by the tank manufacturer.

2.03 FACTORY TESTING

- A. Tank Testing
1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.
 2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking
 3. Hydrostatic test: Following fabrication, the tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1 hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

PART 3: EXECUTION

3.01 SITE VERIFICATION OF CONDITIONS

- A. Verify substrate conditions are acceptable for installation in accordance with manufacturer's instructions.
- B. Notify Engineer of discrepancies.
- C. Beginning installation indicates Contractor acceptance of conditions.

3.02 INSTALLATION

- A. Install all equipment per the manufacturer's recommendations.
- B. Install systems to verify system flexible connections, venting, and fittings are properly installed.
- C. Install intermediate supports if required by manufacturer or deemed necessary by Engineer.
- D. Prior to installation in the leachate storage tanks, fully assemble the pump/pipe assembly outside of the tank to confirm that all parts are correct and functional. Disconnect pump and pressure test discharge piping assembly using hydrostatic pressure in accordance with ASTM F714. Use test pressure of 50 psi.
- E. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as anchors, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.
- F. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

END OF SECTION 33 36 23

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to install storm sewer utilities.
- B. Related Sections
 - 1. Section 31 05 19.13 Geotextiles for Earthwork
 - 2. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
 - 3. Section 31 23 23 Liner and Cover Soil Materials
 - 4. Section 31 37 00 Riprap
 - 5. Section 33 05 28 Trenching and Backfilling for Utilities

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Association of State Highway and Transportation Officials hereafter referred to as AASHTO.
 - a. AASHTO M 252: Standard Specification for Corrugated Polyethylene Drainage Pipe
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM C361: Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
 - b. ASTM C443: Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 - c. ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
 - d. ASTM D1248: Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

- e. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - f. ASTM D3261: Standard Specification for Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - g. ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
3. Minnesota Department of Transportation Standard Specifications for Construction, 2020 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

- A. Manufacturer's product data including:
 - 1. Technical product data and installation instructions for storm drainage system materials and products.
- B. Shop drawings including:
 - 1. Piping materials, size, locations, and inverts. Include details of underground structures, connections, and cleanouts. Show interface and spatial relationship between piping and proximate structures.
- C. Record Drawings:
 - 1. At project closeout, submit for information record drawings of installed storm drainage piping and products including locations and elevations.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Pipe materials shall not be stacked. Each pipe section shall be blocked to prevent rolling. Pipe ends shall be covered to prevent entry of foreign materials.

1.05 SEQUENCING AND SCHEDULING

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities for gravity flow systems.

1.06 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in storm drainage systems. Where more than one type of materials or products is indicated, selection is Contractor's option.

2.02 PIPING AND FITTINGS

- A. Corrugated polyethylene Drainage Tubing (CPE)
 - 1. Corrugated Polyethylene (CPE) pipe and fittings shall meet AASHTO M 252.
 - 2. CPE pipe dimensions as shown on the Drawings.
- B. High Density Polyethylene Pipe (HDPE)
 - 1. HDPE shall be manufactured from materials meeting the requirement of ASTM D1248 for Type III, Grade P34, Category 5, Class C, and have a PPE rating of PE4710. The pipe produced from this material shall have the dimensions and wall thickness as set forth in ASTM F714 for the size and Dimension Ratio (DR) shown on the Drawings.
 - 2. Each HDPE pipe length shall be marked with the manufacturer's name or trademark, nominal size and DR, cell classification, and extrusion date, period of manufacture or lot number.
 - 3. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.
 - a. Fittings: ASTM D3261
 - 4. Contractor is responsible for compatibility between pipe materials, fittings, and appurtenances.
- C. Reinforced Concrete Pipe
 - 1. Reinforced Concrete Pipe (RCP), fittings and specials shall meet the requirements of Mn/DOT Standard Specification 3236. Joints shall meet the requirements of ASTM C361.

2.03 MANHOLES AND CATCH BASINS

- A. Reinforced concrete manholes and catch basins

1. Reinforced Concrete Manholes and catch basins shall be precast concrete conforming to the requirements of Mn/DOT Standard Specification 2506, Mn/DOT Standard Specification 3622, and Mn/DOT Standard Plates.
2. Provide rubber joint gasket complying with ASTM C443 at joints of sections.
3. Top: Precast concrete, flat slab top type or offset cone top type, as indicated.
4. Base: Precast concrete, with base riser section and separate base slab, as indicated.
5. Any structure greater than four (4) feet deep from invert to surface elevation shall have manhole steps included in the structure.
6. All castings shall be of the size and type shown on the Drawings and conforming to Mn/DOT Standard Specification 3321.

B. HDPE Manholes and Catch Basins

1. HDPE Manholes and catch basins shall be of the size and type shown on the drawings. Design service conditions, including installation environment and operating parameters, will determine the wall thickness, Pipe DR, and/or RSC of pipe and shall be specified or verified by the project engineer or the owner.
2. The bottom thickness of the manholes will meet the required limits for stress and deflection as required in ASTM F1759. Bottom or top plates may have additional support ribs, gussets or and bracing as methods to reduce stress and deflection to acceptable levels.
3. The inlets and outlets shall be extrusion welded on the inside and outside of the structure, where access is available. Gussets shall be attached at 90 degrees, 180 degrees, 270 degrees, and 360 degrees around the inlets and outlets unless impractical.
4. All manhole connections larger than 4" nominal OD pipe shall be butt fusion welded, electrofusion welded, or flanged connections. For 4" OD pipe and smaller threaded transition fittings can also be used as well as the acceptable connections listed. Mechanical connections may be employed when approved by the project engineer.
5. All butt fusion welds shall be made as described in ASTM F2620 and all butt fusion welds performed with hydraulically operated butt fusion equipment shall be recorded using a McElroy Manufacturing DataLogger. The fabricator shall maintain records of the temperature, pressure, and graph of the fusion cycle for a minimum of 3 years.
6. The ladders in the manholes, if specified, shall conform to OSHA requirements. Ladders will be of fiberglass material with stainless steel hardware, and will be mechanically affixed to HDPE braces welded to the manhole body.
7. Except for when impractical, lifting eyes will be integral to the manhole body and located on shop drawings.

8. Manhole structures and outlets should not be used as anchor points when axial loads or movement is anticipated. Where large changes in temperature are expected, restraints shall be designed to isolate the structure and prevent strain at the inlets or outlets. These restraints shall be cast into a concrete block or collar around the pipe. Anti-flotation and/or anti-settling measures such as anchor lugs, rings, or collars, if required, shall be provided as an integral part of the manhole by the fabricator/manufacturer of the manhole.
9. The top of the structure and/or manway of the manhole shall be built to meet the requirements of contract drawings. If testing is required, flanged tops or manways may be required, and additional bolts may be needed to withstand test conditions.
10. When practical and required, manholes shall be factory tested with water or with air. The hydrostatic test shall be conducted by filling the structure with water and checking for leaks. Minimum test duration will be one hour. If air is used, a minimum of 1 PSI shall be used for 30 minutes. Structures with a 72" inside diameter or smaller may be tested to 2 PSI. Data showing the structure to be leak-free will be supplied, when testing requirements are agreed to prior to fabrication. The owner or his representative may request to observe the test.
11. Base: Precast concrete, with base riser section and separate base slab, as indicated.
12. Any structure greater than four (4) feet deep from invert to surface elevation shall have manhole steps included in the structure.
13. All castings shall be of the size and type shown on the Drawings and conforming to Mn/DOT Standard Specification 3321.

2.04 PIPE BEDDING (IMPORTED)

- A. See Section 31 23 23, Liner and Cover Soil Materials for pipe bedding requirements.
- B. for pipe bedding material requirements.

2.05 RIPRAP (IMPORTED)

- A. See Section 31 37 00, Riprap for Riprap requirements.
- B. See Section 31 05 19.13, Geotextile for Earthwork for Riprap underlayment (geotextile)

PART 3: EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 EXCAVATION, PIPE BEDDING, UTILITY BACKFILL AND COMPACTION

- A. See Section 33 05 28, Trenching and Backfilling for Utilities and Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for excavation requirements.
- B. See Section 33 05 28, Trenching and Backfilling for Utilities Section 31 23 23, Liner and Cover Soil Materials for pipe bedding, utility backfill, and compaction requirements.

3.03 LOCATION OF WORK

- A. The Work shall be located as shown on the Drawings.
- B. It may be necessary for Engineer to shift lines a reasonable amount to avoid an obstruction to the construction work or to reduce difficulties. Contractor will not be allowed any additional compensation due to minor shift of lines. Additional compensation will be allowed only for lengthening of lines, or for providing additional fittings.

3.04 PIPE AND PIPE FITTINGS

- A. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
- B. Install piping and utility structures at the locations, lines, and grades as shown on the Drawings.
- C. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
- D. Before being lowered into laying position, Contractor shall make a thorough visual inspection of each pipe section and appurtenant units to detect damage or unsound conditions that may need corrective action or be cause for rejection. Contractor shall inform Engineer of any defects discovered.
- E. Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.
- F. At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support of the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than would be adequate. No pipe material shall be laid in water nor when the trench or bedding conditions are otherwise unsuitable or improper. Unless otherwise permitted by Engineer, bell and spigot pipe shall be laid with the bell ends facing upgrade and the laying shall start at the downgrade end and proceed upgrade.
- G. All gravity pipe shall be laid using laser beam control. Contractor shall provide and use a suitable grade rod to insure the proper grade of the pipe.

- H. Any defective or damaged pipe, or gravity pipe which has had its grade or joint disturbed after laying, shall be replaced.
- I. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
- J. Plastic Pipe: Install in accordance with manufacturer's installation recommendations, and in accordance with ASTM D2321.
- K. Joint Adapters: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

3.05 HDPE PIPE INSTALLATION

- A. Weld in accordance with manufacturer's recommendations for butt fusion methods.
- B. General steps for butt-fusion joints:
 - 1. Surfaces of fusion tools, pipe, and fittings shall be free of contaminants prior to use. Pipe ends shall be trimmed as necessary prior to joining.
 - 2. Heat both pipe ends simultaneously at specified temperature for specified time.
 - 3. Remove heater and press melted surfaces together to form joint.
 - 4. Maintain uniform pressure until solidified. Prevent rough handling (testing, stress movements, pulling, or laying) until fully cooled to ambient material temperatures.
- C. Fusion Unit Operators
 - 1. Each operator of fusion units shall demonstrate to Owner's On-Site Representative's satisfaction that operator is qualified to perform consistently correct fusion joints acceptable to Owner. Contractor shall replace without additional cost to Owner any fusion unit operator to which Owner's On-Site Representative has reasonable objection based on the operator's failure to perform consistently correct fusion joints as recommended by pipe manufacturer or the provision of this Section.

3.06 CPE INSTALLATION

- A. CPE pipe shall have minimum 12-inches of cover or as shown on the Drawings.

3.07 PRECAST STRUCTURE

- A. Install precast structures at the locations and grades as shown on drawings.
- B. Install in accordance with ASTM C891.

3.08 RIPRAP

- A. See Section 31 37 00, Riprap for Riprap requirements.
- B. See Section 31 05 19.13, Geotextile for Earthwork for Riprap underlayment (geotextile) requirements.

3.09 FIELD QUALITY CONTROL

- A. Establish and maintain quality control for work under this Section to assure compliance with contract requirements and maintain records of his quality control for all construction operations.
- B. Compaction
 - 1. Perform inspections prior to and immediately after placing bedding.
- C. Pipe and pipe installations will be subject to rejection for any of the following reasons:
 - 1. Failure to conform to the Specifications, particularly compaction under and around the pipe.
 - 2. Fractures or cracks passing through pipe wall.
 - 3. Chips or fractures on interior of pipes.
 - 4. Cracks which, in the opinion of Owner's On-Site Representative, may impair strength, durability, or serviceability of pipe.
 - 5. Defects indicating improper proportioning, mixing, or molding.
 - 6. Damaged ends where such damage would prevent making a satisfactory joint.
 - 7. Observable visual damage to any components involved in construction of the leachate management system.
- D. Precast structures
 - 1. Cracks which, in the opinion of Owner or Owner's On-site Representative, may impair strength, durability, or serviceability of the structure.
 - 2. Failure to conform to specifications, or related contract documents.
- E. Pipe and pipe appurtenances installation will be subject to rejection for any of the following reasons.
 - 1. Failure to conform to the Specifications, with regard to:
 - a. Compaction under and around the pipe.

- b. Line and grade (+ or – 0.5 foot horizontally, + or – 0.10 feet vertically)
- 2. Damaged ends where such damage would prevent making a satisfactory joint.
 - a. Damaged gasketed coupler system.

3.10 CLEANING

- A. All storm drainage utility piping and structures shall be cleaned of accumulations of silt, debris, or foreign matter, and be free from such accumulations at the time of final inspection.

END OF SECTION 33 40 00

SECTION 33 90 01

LANDFILL LEACHATE PIPING AND APPURTENANCES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes all materials, equipment, and labor to complete landfill leachate piping and appurtenances, but not limited to:
1. Providing High Density Polyethylene Pipe (HDPE) for leachate collection system, sidewall riser, and leachate forcemain system.
 2. Providing corrugated metal piping (CMP).
 3. Providing polyvinyl chloride (PVC) piping.
 4. Providing precast manhole.
 5. Providing appurtenances.
- B. Related Sections
1. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
 2. Section 31 23 23 Liner and Cover Soil Materials
 3. Section 33 05 28 Trenching and Backfilling for Utilities

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
1. American Association of State Highway and Transportation Officials hereafter referred to as AASHTO.
 - a. AASHTO M 36: Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
 2. American Society for Testing and Materials (ASTM).
 - a. ASTM C478: Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.

- b. ASTM C891: Standard Practice for Installation of Underground Precast Concrete Utility Structures.
- c. ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- d. ASTM D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
- e. ASTM D3261: Standard Specification for Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- f. ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fittings Material
- g. ASTM D4101: Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.
- h. ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- i. ASTM F2164: Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure.

1.03 SUBMITTALS

A. Submittals for Review:

- 1. Manufacturer's product data including:
 - a. Technical product data and installation instructions for all leachate management system materials and products.
 - b. Submit for record stock density, melt flow, flexural modulus tensile strength, coloration, resin type and cell classification where applicable.
- 2. Shop drawings including:
 - a. Piping materials, size, locations, and elevations. Include details of underground structures, valves, connections, restrained joints, and anchors.
 - b. Truck Fill Station Support and Accessories

B. Submittals for Information or Documentation:

- 1. Test results and certificates including:

- a. Leakage Test and Hydrostatic Pressure Test. Submit for approval 1 copy of results of leakage and hydrostatic pressure test upon completion of leachate management system backfilling operations.
- 2. Record Drawings:
 - a. At Project closeout, submit for information Record Drawings of installed piping, underground structures, valves, connections, restrained joints, anchors, etc. including locations and elevations.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature condition.
- 1.05 SEQUENCING AND SCHEDULING
 - A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities for gravity flow systems.
- 1.06 BASIS FOR COMPENSATION
 - A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

- 2.01 GENERAL
 - A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements.
- 2.02 CORRUGATED METAL PIPE (CMP)
 - A. Corrugated Metal Pipe (CMP) and fittings shall meet AASHTO M 36.
 - B. CMP dimensions as shown on the Drawings.
 - C. Jointing band provided by CMP manufacturer and compatible with CMP material.
- 2.03 LEACHATE DISCHARGE PIPE (SOLID WALL, BURIED)
 - A. High Density Polyethylene Pipe (HDPE):

1. ASTM D3350 with a cell classification of 445474C, and a PPE rating of PE4710. Dimensions and wall thickness as set forth in ASTM F714 for the size and Dimension Ratio (DR) 11.
2. Each HDPE pipe length shall be marked with the manufacturer's name or trademark, nominal size and DR, cell classification, and extrusion date, period of manufacture or lot number.
3. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.
 - a. Fittings: ASTM D3261
4. Contractor is responsible for compatibility between pipe materials, fittings, and appurtenances.
5. All solid wall leachate piping systems shall be dual walled unless as shown on the Drawings. Exceptions include:
 - a. Leachate collection pipe and fittings with structures (e.g., cleanout manholes or tanks).
 - b. Leachate Sidewall Riser Pump discharge piping.

2.04 LEACHATE COLLECTION PIPE (PERFORATED)

- A. High Density Polyethylene Pipe (HDPE): See Paragraph 2.04.
- B. Perforate pipe per the size, frequency, and location as shown on the Drawings.
- C. Thoroughly flush and clean pipe prior to installation, including removing cuttings from perforation and fusion preparation, construction debris, and soil.

2.05 SIDEWALL RISER

- A. High Density Polyethylene (HDPE): See Paragraph 2.03.
- B. Install sidewall riser pipe to accommodate for sidewall riser pump to move freely up and down the pipe for maintenance and pumping operations.

2.06 LEACHATE PUMP DISCHARGE PIPING (WITHIN LEACHATE TANK)

- A. PVC, Schedule 80, conforming to ASTM D1785.
- B. Solvent-weld socket joint, except at connections to pump, check valve, and tank.

2.07 PIPE TRANSITION FITTINGS

- A. Provide fittings where required to transition between different pipe materials (HDPE, PVC, and/or stainless steel).
- B. Provide adapters, retainers, O-rings, and other accessories as required.
- C. Transition fitting shall have the same or higher pressure-rating as the pipes it is connecting.

2.08 STAINLESS STEEL DISCONNECT (FOR SIDEWALL RISER DISCHARGE)

- A. 316 Stainless steel.
- B. Viton O-Ring seal.
- C. EPDM gasket for inner and outer wall seal.
- D. Tested to 300 PSIG.
- E. EPG Model NW 1.5 SS-C Stainless Steel Discharge Adapter or equal.

2.09 AIR RELEASE VALVE

- A. Body: PVC Cell Class 12454 per ASTM D1784 with PP Ball per ASTM D4101.
- B. Socket and threaded ends for easy installation.
- C. FPM Double O-ring stem seal
- D. Hayward ¾" PVC True Union Air Release Valve, or equal.

2.10 SIDEWALL RISER PIPE CHECK VALVES

- A. Type: PVC Check, suitable for wastewater or stormwater.
- B. A full flow area shall be provided through the valve when it is open, equal to or exceeding the area of the pipe in which it is installed.
- C. Allow for valve to be manually opened from the exterior.

2.11 LEACHATE TANK CHECK VALVES

- A. Type: PVC Flanged Ball Check Valve, suitable for wastewater or stormwater.
- B. A full flow area shall be provided through the valve when it is open, equal to or exceeding the area of the pipe in which it is installed.

- C. Valves shall be vertically oriented.

2.12 PRECAST MANHOLE

- A. Precast with integral base and have rubber gaskets at all joints. Conform to ASTM C478. All pipe penetrations shall incorporate flexible rubber sleeve or cast-in gasket that forms a watertight seal between the manhole and the pipe.
- B. Polypropylene encased steps.
- C. Manholes shall be sized and include all connections, fittings, and appurtenances as shown on Drawings.
- D. Cover
 - 1. Neenah R-1753-B cast iron cover, or equal.
 - 2. Must be vented and locking.

2.13 GATE VALVES AND VALVE BOXES

- A. PVC Cell Classification 12454-A per ASTM D1784.
- B. Body: One-piece molded PVC body flanged to ANSI 150.
- C. Stem Extension: 316 Stainless Steel shaft.
- D. Stem Housing
 - 1. 304 Stainless Steel for buried or actuated valves
 - 2. PVC for inside manhole
- E. EPDM or FKM (Viton) Seals suitable for municipal landfill leachate.
- F. A full flow area shall be provided through the valve when it is open, equal to or exceeding the area of the pipe in which it is installed.
- G. Install gate valves as indicated with stems pointed up.

2.14 MAGNETIC FLOW METER

- A. See Specification Section 40 90 00 for magnetic flow meter requirements.

2.15 TRUCK FILL STATION SUPPORT AND ACCESSORIES.

- A. Provide overhead pipe support as shown schematically on the Drawings, including footings, foundations, and above-grade support system.
- B. Piping: 304 stainless steel, secured to pipe support.
- C. Overhead Fill Support: galvanized.
- D. Provide rubber hose (suitable for municipal landfill leachate) as shown on the Drawings.
 - 1. Minimum pressure rating: 125 psi.
- E. Provide stainless steel cam-lock hose connector as shown on Drawings.

PART 3: EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which storm drainage system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 EXCAVATION, PIPE BEDDING, UTILITY BACKFILL AND COMPACTION

- A. See Section 33 05 28, Trenching and Backfilling for Utilities and Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for excavation requirements.
- B. See Section 33 05 28, Trenching and Backfilling for Utilities Section 31 23 23, Liner and Cover Soil Materials for pipe bedding, utility backfill, and compaction requirements.

3.03 PIPE AND PIPE FITTINGS

- A. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
- B. Install piping and utility structures at the locations, lines, and grades as shown on the Drawings.
- C. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
- D. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
- E. The lower segment of the pipe shall be in contact with the shaped bedding throughout its full length.

- F. Bell or groove ends of rigid pipe shall be placed facing upstream.
- G. Rigid pipe may be of "bell and spigot" or "tongue and groove" design unless one type is specified. Pipe sections shall be joined so the ends are fully entered and the inner surfaces are flush and even.
- H. Install piping at the locations and grades as shown on the Drawings.
- I. Install all valves and piping appurtenances as shown on drawings.

3.04 CMP INSTALLATION

- A. Provide 2-inch-thick Styrofoam protective layer underneath the CMP piping and above the composite liner system within the lined landfill boundary.

3.05 HDPE PIPE INSTALLATION

- A. Weld in accordance with manufacturer's recommendations for butt fusion methods.
- B. General steps for butt-fusion joints:
 1. Surfaces of fusion tools, pipe, and fittings shall be free of contaminants prior to use. Pipe ends shall be trimmed as necessary prior to joining.
 2. Heat both pipe ends simultaneously at specified temperature for specified time.
 3. Remove heater and press melted surfaces together to form joint.
 4. Maintain uniform pressure until solidified. Prevent rough handling (testing, stress movements, pulling, or laying) until fully cooled to ambient material temperatures.
- C. Fusion Unit Operators
 1. Each operator of fusion units shall demonstrate to Owner's On-Site Representative's satisfaction that operator is qualified to perform consistently correct fusion joints acceptable to Owner. Contractor shall replace without additional cost to Owner any fusion unit operator to which Owner's On-Site Representative has reasonable objection based on the operator's failure to perform consistently correct fusion joints as recommended by pipe manufacturer or the provision of this Section.

3.06 PRECAST STRUCTURE

- A. Install precast structures at the locations and grades as shown on drawings.
- B. Install in accordance with ASTM C891.

3.07 HYDROSTATIC PRESSURE TESTING (HDPE FORCEMAIN)

- A. Test in presence of Owner's On-site Representative.
- B. Perform hydrostatic pressure test generally in accordance with the procedures described in ASTM F2164 except as modified in these Specifications.
 - 1. Where double wall piping systems are installed, pressure test inner pipe only.
- C. Install blind flange at each end of cased pipe and pressurize pipe to 30 psi using water.
- D. Maintain pressure at ± 2 psi for one hour without adding water.

3.08 FIELD QUALITY CONTROL

- A. Establish and maintain quality control for work under this Section to assure compliance with contract requirements and maintain records of his quality control for all construction operations.
- B. Compaction
 - 1. Perform inspections prior to and immediately after placing bedding.
- C. Pipe and appurtenances will be subject to rejection for any of the following reasons:
 - 1. Failure to conform to the Specifications, particularly compaction under and around the pipe.
 - 2. Fractures or cracks passing through pipe wall.
 - 3. Chips or fractures on interior of pipes.
 - 4. Cracks which, in the opinion of Owner's On-Site Representative, may impair strength, durability, or serviceability of pipe.
 - 5. Defects indicating improper proportioning, mixing, or molding.
 - 6. Damaged ends where such damage would prevent making a satisfactory joint.
 - 7. Observable visual damage to any components involved in construction of the leachate management system.
- D. Precast structures
 - 1. Cracks which, in the opinion of Owner or Owner's On-site Representative, may impair strength, durability, or serviceability of the structure.
 - 2. Failure to conform to specifications, or related contract documents.

3.09 CLEANING

- A. All piping and structures shall be cleaned of accumulations of silt, debris, or foreign matter, and be free from such accumulations at the time of final inspection.

END OF SECTION 33 90 01

SECTION 33 90 02

LANDFILL GAS PIPING

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing equipment, tools, materials and labor to install landfill gas piping.
- B. Related Sections
 - 1. Section 31 23 00 Mass Excavation, Embankment, and Stockpiles
 - 2. Section 31 23 23 Liner and Cover Soil Materials
 - 3. Section 33 05 28 Trenching and Backfilling for Utilities

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society for Testing and Materials (ASTM).
 - a. ASTM D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
 - b. ASTM D2467: Standard Specification for Poly(Vinyl Chloride) PVC Plastic Pipe Fittings, Schedule 80
 - c. ASTM D2564: Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
 - d. ASTM D3261: Standard Specification for Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - e. ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fittings Material
 - f. ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
 - 2. Minnesota Department of Transportation Standard Specifications for Construction, 2018 Edition, hereafter referred to as Mn/DOT Standard Specifications.

1.03 SUBMITTALS

A. Submittals for Review:

1. Manufacturer's product data including:
 - a. Technical product data and installation instructions for all gas management system materials and products.
 - b. Submit for record stock density, melt flow, flexural modulus tensile strength, coloration, resin type and cell classification where applicable.
2. Shop drawings including:
 - a. Piping materials, size, locations, and elevations. Include details of underground structures, valves, connections, restrained joints, and anchors.

B. Submittals for Information or Documentation:

1. Test results and certificates including:
 - a. Leakage Test and Hydrostatic Pressure Test. Submit for approval 1 copy of results of leakage and hydrostatic pressure test upon completion of leachate management system backfilling operations.
2. Record Drawings:
 - a. At Project closeout, submit for information Record Drawings of installed piping, underground structures, valves, connections, restrained joints, anchors, etc. including locations and elevations.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature condition.
- B. Inspect materials delivered to the site for damage. Unload and store with minimum of handling. Store materials on-site in enclosures or under protective coverings. Keep inside of piping free of dirt and debris.
- C. Handle pipe, fittings, and other accessories in a manner that ensures delivery to the point of installation in sound, undamaged condition.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Contractor to comply with installation requirements.

2.02 PIPES AND FITTINGS

- A. Polyvinyl Chloride (PVC) Piping:

1. Location: Solid LFG vertical extraction well (blank and perforated)
2. Type: PVC, Schedule 80, ASTM D1785, Type 1, Grade 1.
3. Shop fabricate slotted (screened) pipe as shown on the Drawings. Use machining tools specifically designed for thermoplastic pipe. Cut pipe smoothly and uniformly, with no burrs or melt-down evident upon inspection by Engineer. Secure all joints with lag bolts as shown on the Drawings.
4. Temporary top cap: threaded, socket-type friction fit, or glued, if sufficient stickup is available to sacrifice when final wellhead is constructed.
5. Where indicated on the Drawings, provide PVC, Schedule 80 socket type fittings, ASTM D2467, Type 1, Grade 1.
6. Socket type joints, ASTM D2564.

- B. High Density Polyethylene Pipe (HDPE):

1. ASTM D3350 with a cell classification of 445474C, and a PPE rating of PE4710. Dimensions and wall thickness as set forth in ASTM F714 for the size and Dimension Ratio (DR) 17.
2. Each HDPE pipe length shall be marked with the manufacturer's name or trademark, nominal size and DR, cell classification, and extrusion date, period of manufacture or lot number.
3. All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe

shall be designed, constructed, and installed in accordance with the best practices and methods and shall comply with these Specifications.

- a. Fittings: ASTM D3261
4. Contractor is responsible for compatibility between pipe materials, fittings, and appurtenances.

PART 3: EXECUTION

3.01 EXCAVATION, PIPE BEDDING, UTILITY BACKFILL AND COMPACTION

- A. Examine and verify acceptability of surface to receive product.
- B. See Section 33 05 28, Trenching and Backfilling for Utilities and Section 31 23 00, Mass Excavation, Embankment, and Stockpiles for excavation requirements.
- C. See Section 33 05 28, Trenching and Backfilling for Utilities Section 31 23 23, Liner and Cover Soil Materials for pipe bedding, utility backfill, and compaction requirements.

3.02 PIPE INSTALLATION

- A. Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.
- B. Install piping and utility structures at the locations, lines, and grades as shown on the Drawings.
- C. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
- D. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
- E. The lower segment of the pipe shall be in contact with the shaped bedding throughout its full length.
- F. Bell or groove ends of rigid pipe shall be placed facing upstream.
- G. Rigid pipe may be of "bell and spigot" or "tongue and groove" design unless one type is specified. Pipe sections shall be joined so the ends are fully entered and the inner surfaces are flush and even.
- H. Install piping at the locations and grades as shown on the Drawings.
- I. Install all valves and piping appurtenances as shown on drawings.

3.03 HDPE PIPE INSTALLATION

- A. Weld in accordance with manufacturer's recommendations for butt fusion methods.
- B. General steps for butt-fusion joints:
 - 1. Surfaces of fusion tools, pipe, and fittings shall be free of contaminants prior to use. Pipe ends shall be trimmed as necessary prior to joining.
 - 2. Heat both pipe ends simultaneously at specified temperature for specified time.
 - 3. Remove heater and press melted surfaces together to form joint.
 - 4. Maintain uniform pressure until solidified. Prevent rough handling (testing, stress movements, pulling, or laying) until fully cooled to ambient material temperatures.
- C. Fusion Unit Operators
 - 1. Each operator of fusion units shall demonstrate to Owner's On-Site Representative's satisfaction that operator is qualified to perform consistently correct fusion joints acceptable to Owner. Contractor shall replace without additional cost to Owner any fusion unit operator to which Owner's On-Site Representative has reasonable objection based on the operator's failure to perform consistently correct fusion joints as recommended by pipe manufacturer or the provision of this Section.

3.04 FIELD QUALITY CONTROL

- A. Establish and maintain quality control for work under this Section to assure compliance with contract requirements and maintain records of his quality control for all construction operations.
- B. Compaction
 - 1. Perform inspections prior to and immediately after placing bedding.
- C. Pipe and appurtenances will be subject to rejection for any of the following reasons:
 - 1. Failure to conform to the Specifications, particularly compaction under and around the pipe.
 - 2. Fractures or cracks passing through pipe wall.
 - 3. Chips or fractures on interior of pipes.
 - 4. Cracks which, in the opinion of Owner's On-Site Representative, may impair strength, durability, or serviceability of pipe.
 - 5. Defects indicating improper proportioning, mixing, or molding.

6. Damaged ends where such damage would prevent making a satisfactory joint.
7. Observable visual damage to any components involved in construction of the leachate management system.

END OF SECTION 33 90 02

Division 40

Process Interconnections

SECTION 40 90 00

INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes leachate pumping process instrumentation and control system.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. National Fire Protection Association (NFPA)
 - a. NFPA 70 - National Electrical Code (NEC), latest edition
 - 2. National Electrical Manufacturers Association (NEMA)
 - a. NEMA ICS-2 - Industrial Control Devices, Controllers, and Assemblies
 - b. NEMA 250 - Enclosures for Electrical Equipment
 - 3. Underwriters Laboratories (UL)
 - a. UL 508 - Industrial Control Equipment
 - b. UL 698A - Industrial Control Panels for Hazardous Locations
 - c. UL 913 - Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II and III, Division 1, Hazardous Locations

1.03 BASIS OF BID

- A. All Work and materials specified under this Section shall be provided by one of the following offering products and services in full conformance with this specification:
 - 1. Automatic Systems Company – St. Paul, MN
 - 2. In Control, Inc. – Blaine, MN
 - 3. Telemetry and Process Controls, Inc. – Oakdale, MN
 - 4. Alternate provider in accordance with these specifications and the bid form.

5. The proposed company providing instrumentation and controls from the above list shall be indicated on the Bid Form in the space provided. Failure to provide such indication may disqualify the Bid.

1.04 GENERAL

- A. It is the intent of the Contract Documents that all equipment specified in this Section of the specification be supplied by a single-source supplier ("Controls Supplier") except as specifically indicated. Contractor, along with the Controls Supplier, shall assume full responsibility for furnishing, installing and start-up procedures so as to make the system operate per the intent of the Contract Documents.
- B. The work specified in this Section includes furnishing, installing, start-up, testing and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process instrumentation and control system.
- C. It shall be the responsibility of Contractor (along with the Controls Supplier) to furnish a complete and fully operating system. Contractor shall be responsible for all details that may be necessary to properly install, adjust and place in operation the complete installation. Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the Contract Documents.

1.05 SUBMITTALS

- A. Technical data in Adobe PDF form including:
 1. Data sheets for all equipment and components indicated on the Drawings and specified in Part 2 of this Section.
 2. Software packages including complete description of features and capabilities.
- B. Shop Drawings in Adobe PDF form including:
 1. Panel drawings including system schematic drawings, terminal numbering, wire numbering, component schematic drawings, dimension drawings, layout drawing and nameplate schedule.
 2. Overall system diagram showing all components, converters, cables, and connectors.
 3. Programmable Logic Controller (PLC) programs in ladder format. Include verbal description of each rung's function. Assign point numbers to all inputs and outputs, and show point numbering in PLC program.
 4. Proposed operator interface unit graphic displays. Submit "rough" or hand-drawn copies prior to programming.

5. Proposed report formats written specific to the project.
 6. Provide modifications as requested by the Engineer.
- C. Operation and Maintenance data in Adobe PDF form including:
1. Panel equipment, field devices and instruments, including "as-built" system schematics.
 2. Final copy of PLC programs on 8½" x 11" sheets in ladder format. Include verbal description of each rung's function.
 3. Electronic copy of final PLC program, final operator interface application files and final distributed control software application files. Provide password if one was used.
 4. CD-ROMs or other electronic format acceptable to owner containing final system record drawings, wiring diagrams and panel details. The drawing files shall be in AutoCAD format (.DWG files).
 5. Complete software documentation including programming information and operator's guides. Include hard copies of all operator interface unit graphic screens.
 6. Point lists for all PLC inputs/outputs. Identify point number (tag), point description, point type, range in engineering units (if analog point), PLC number, rack and slot number, and point address.
 7. Include original manufacturer's manuals for all products provided in the panel.
- D. Start-up report from systems supplier.
- E. Spare Equipment Lists - Provide a list of recommended spare parts and equipment that is considered crucial to the operation of the system. Include list of prices for each item.
- F. All submittals shall be bound in 3-ring binders with labeled tabs separating sections.

1.06 QUALITY ASSURANCE

- A. The instrumentation and control system Supplier (or "Controls Supplier"), as a business entity, shall have a minimum of 5 years of experience in the assembly, installation, repair, and maintenance of municipal and industrial wastewater control systems. Substitution of individual experience in lieu of the required business experience shall not be allowed.
- B. The Controls Supplier shall maintain a minimum \$1,000,000 product liability insurance policy.
- C. The Control Supplier must maintain and operate a panel shop with both UL-508 and UL-698A labels.
- D. The Control Supplier shall have at least 5 references who are owners of successful Allen Bradley based PLC control panels provided by the Controls Supplier. In addition they shall have

provided at least five (5) successful systems of similar or larger complexity in the State of Minnesota or contiguous states in the last three (3) years.

- E. The Supplier shall modify or supplement the Supplier's "standard products" to meet these specifications. Standard products of a particular Supplier that do not meet the functional and technical requirements of the specification are not acceptable.
- F. The Supplier shall have a minimum of two (2) full-time qualified, trained service personnel on staff who are capable of maintaining, adjusting, troubleshooting, and programming the system furnished under this contract.
- G. Supplier shall have a staffed service office within 50 miles of the project site. The office shall have full-time service personnel.
- H. The Supplier shall be capable of offering an extended service contract after completion of the warranty period, including 24 hour, 7-day per week emergency services.
- I. Supplier shall design, engineer, assemble, program, test, and support the system using its own facilities and employees.
- J. Supplier shall produce all project drawings using computer-aided drafting.
- K. Included with Contractor's Bid, the supplier shall submit:
 - 1. A description of company organization, listing types and numbers of engineers, other engineers, technicians, and other technical employees, production staff and plant production capabilities and current lead-times.
 - 2. List of five (5) projects referenced above, including customer's name, customer contact person, engineering contact person, and phone numbers. Include a description of the project hardware, software, and cost.
 - 3. Description of service capabilities, including number of personnel, resumes, dates of hire, prior experience, their location, and types of service contract available.
 - 4. Provide a summary of current on-going work. Indicate which projects are bonded and the remaining amounts of bond authorization.
 - 5. One complete copy of an Operation and Maintenance Manual for a similar project completed in the last two years.
 - 6. Detailed list of all deviations to these Specifications including component manufacturer equipment model numbers and accompanying product information.

1.07 TESTING AGENCY CERTIFICATION

- A. All new panels and subpanels furnished under this Section shall be constructed in accordance with Underwriter's Laboratories (UL) Standard 508 - "Industrial Control Equipment", and

applicable portions of UL Standard 698A - "Industrial Control Panels for Hazardous Locations" and UL Standard 913 - "Intrinsically-Safe Apparatus and Associated Apparatus for use in Class I, II and III, Division 1, Hazardous Locations".

- B. Each panel and subpanel shall be shop-inspected by UL or constructed in a UL-recognized facility. Each completed panel shall bear a serialized UL label indicating acceptance under Standards 508, 698A and 913.

1.08 FUNCTIONAL DESCRIPTIONS - GENERAL

A. General

1. Functional descriptions define how each portion of the instrumentation and control system is to operate. The descriptions, in conjunction with the drawings and the minimum technical requirements for products as described in Part 2 of this Section, define the minimum requirements for the installation.
2. It is the intent of this specification that all products used to meet the functional descriptions shall be those specified in Part 2 of this Section.
3. Interface devices, buffer amplifiers, control relays and other components required by Contractor to cause the system to function in accordance with the functional descriptions and schematic drawings shall be considered incidental to the project. Contractor shall show such devices and define them in detail during the shop drawing review to confirm that it understands the requirements of the design.

B. System Overview

1. Contractor shall furnish and install, complete, a distributed instrumentation and control system including field instruments, control panels, programmable logic controllers (PLCs), and PanelViews installed in the control panels as specified.
2. All system control logic shall reside in the PLCs.
3. PLC and control panel components shall be backed by an uninterruptible power supply (UPS). The control panel shall implement a control relay logic circuit that allows the UPS to be removed from the control panel circuiting and automatically provides the controls with bypass power. Additionally, this relay shall provide relay contact indication to the PLC that indicates a UPS failure.

C. Control Panels - General

1. Furnish and install equipment, components and programmable logic controllers (PLCs) as indicated. Equip each PLC with inputs and outputs as indicated, plus 10% live spares of each signal type. Provide each PLC with a rack having enough empty slots for addition of more input/output modules at each PLC as indicated on Drawings.

2. Provide fiber optic cables, patch panels and connectors for fiber optic services as indicated on Drawings. Provide cable testing as specified elsewhere in this Section.
3. Provide cellular router as specified and indicated.

D. Operator Interface Terminal

1. Panel shall contain an operator interface terminal ("OIT", i.e. – Allen Bradley Panelview) for observing and changing data within the PLC. The unit shall be programmed so the operator can display and manipulate all control setpoints.
2. Provide graphic screens, prompts, and messages as described in this Specification as well as matching the Owner's existing screens in similar stations. All operator interaction with the operator interface shall use screen menu selection and fill-in-the-blanks techniques so that the operator is not required to know special codes, register numbers, etc.
3. The operator interface shall have a screen to display all current alarms in detail. When an alarm occurs, display the alarm description and time of occurrence.
4. Permit the operator to acknowledge alarms at the operator interface. When an alarm is acknowledged, indicate the time and date of acknowledgment.

E. Equipment "Fail" Alarms

1. Where a PLC calls for an equipment item to operate, the PLC shall monitor the associated equipment "RUNNING" contacts. If a RUNNING signal is not returned after five seconds (adjustable), then generate a descriptive alarm point.

F. Analog Value Alarms

1. For all analog values, allow the operator to establish "HIGH" and "LOW" alarm setpoints. Provide adjustable time delay on each setpoint. If the analog value goes out of the setpoint range for a period in excess of the time delay, then generate a descriptive alarm point.

G. Miscellaneous Status and Alarm Points

1. The Drawings show several miscellaneous status and alarm points that are not specifically described in these functional descriptions. Graphic screens shall include all of the status information that is available. Alarms shall be developed for each of the alarm points that are available.

H. Communication Failure Alarms

1. Provide alarms to indicate loss of communication with each device on the network and with the SCADA master.

1.09 FUNCTIONAL DESCRIPTION – FREEWAY LANDFILL PLC PANEL

A. Overview

1. The majority of the electrical and control components at the MPCA Freeway Landfill manage leachate water. The leachate water is created when rain falls on the landfill and collects in the fill above the liner. This leachate must be pumped out and sent to a treatment plant before it overflows the liner. The leachate management system consists of (6) separate remote pump stations, each with 2 pumps each, that pump leachate water to (2) central storage tanks that pump to collection by trucks or sanitary sewer. The central storage tanks are near the electrical building, which houses the main controller that controls the leachate tank pumps and all sump pumps.
2. There will be a flare to burn gas produced by the landfill. The flare will have a fiber connection to the PLC Cabinet for control and status information. Flare control requirements shall be coordinated with the flare manufacturer.

B. Sump Level Measurement

1. Provide a submersible pressure (level) transmitter for measuring sump pump level at each sump. The level transmitter shall be designed for wastewater applications, and shall have a large sensing head designed to reduce fouling. Nominal range shall be 0 to 10 feet (confirm during construction).
2. The operator shall have the option to configure for each sump:
 - a. Low low setpoint
 - b. Low setpoint
 - c. High setpoint
 - d. High high setpoint
3. If the low low setpoint or high high setpoint is reached on any sump, an alarm shall be generated. It is anticipated that the high setpoint will be approximately 3 feet, and the low setpoint will be approximately 1 foot.

C. Sump Pump Control

1. Each sump pump will have a dedicated hand-off-auto switch. In hand mode, the sump pump will run continuously regardless of sump level. In off mode, the sump pump will not run. In auto mode, the sump pump will be automatically started and stopped from the PLC. In auto mode, the sump pump will start when the level reaches the high setpoint, and stop when the level reaches the low setpoint. In hand mode, all level setpoints will be disregarded. Regardless of mode, the sump pump will only run if the selected leachate tank is below the high high setpoint and the backup high high float switch is not on. This

interlock shall be present both in the PLC code and with a hardwire contactor in the control circuit.

2. Between the (6) sump systems there are 2 shared force mains, and 2 shared leachate tanks. The program shall be configured so that only 1 sump pump using a given force main may run at a time.

D. Leachate Tank Level Measurement

1. Leachate Tank Level Measurement
2. Provide a submersible pressure (level) transmitter for measuring leachate tank level. The level transmitter shall be designed for wastewater applications, and shall have a large sensing head designed to reduce fouling. Nominal range shall be 0 to 15 feet (confirm during construction).
3. The operator shall have the option to configure for each tank:
 - a. Low low setpoint
 - b. Low setpoint
 - c. High setpoint
 - d. High high setpoint
4. If the low low setpoint or high high setpoint is reached on any sump, an alarm shall be generated. It is anticipated that the high setpoint will be approximately 9 feet, and the low setpoint will be approximately 1 foot.
5. There shall also be a high high float switch in each leachate tank to serve as a backup if the level transmitter malfunctions. The high high float switch should be mounted at the maximum allowable level in the tank, as decided during construction by the project engineer.
6. There shall also be a low low float switch in each leachate tank to serve as a backup if the level transmitter malfunctions. The low low float switch should be mounted at the minimum allowable level in the tank to ensure the pump does not run dry, as decided during construction by the project engineer.

E. Leachate Tank Selection

1. Between the (6) sump systems, there are (2) shared force mains. Sumps A, B, and C flow into one force main, and Sumps D, E, and F flow into the other force main. Each force main can be directed to one of two tanks based on the position of underground gate valves near the leachate tanks. The operator shall be able to enter the position of these 4 valves so that the program can determine which sumps are flowing to which leachate tank for the purposes of carrying out the high high setpoint interlocks.

F. Leachate Pump Control

1. Each leachate pump will have a dedicated hand-off-auto switch. In hand mode, the pump will run continuously regardless of leachate tank level. In off mode, the pump will not run. In auto mode, the pump will be automatically started and stopped as called for by the PLC. In auto mode, the pump will start and stop based on operator input to the HMI or the local control station near the truck loadout area. However, the pump will automatically stop if the leachate tank low setpoint, or lowlow float switch, is reached. In hand mode, all level setpoints will be disregarded.
2. The leachate pumps shall have temperature and seal failure alarm monitoring capabilities. If a pump overtemperature setpoint is reached, an alarm shall be generated and the pump shall be disabled. If a seal failure is detected, an alarm shall be generated, and the pump shall keep operating normally.

G. Electrical Building Temperature

1. Provide continuous temperature measurement of the Pump Station operating floor via RTD-based temperature sensor as shown on Drawings and specified below.
2. Continuous temperature measurement shall be utilized by the control system to enable the operator to select high temperature and low temperature alarm setpoints.
3. Allow the operator to access temperature trend data.

H. Electrical Building Alarms – in addition to alarms indicated above, provide the following specific alarms:

1. The following alarms will shut down its associated pump, send an alarm signal to SCADA, and require a reset at the station OIT after the fault is cleared:
 - a. Pump high motor temperature.
 - b. Pump starter fault.
2. The following pump alarms and associated pump station alarms will send an alarm signal to SCADA, but not shut down the pumps or require a reset:
 - a. Pump leak detection.
 - b. PLC control panel UPS fail
 - c. PLC local panel intrusion (unless over-ridden by momentary push-button)
 - d. Pump station door intrusion (unless over-ridden by momentary pushbutton)
 - e. Electrical building high and low temperature alarms.

1.10 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 CONTROL PANEL FABRICATION - GENERAL

- A. Enclosures for indoor control panels (Electrical Building) shall meet the following minimum requirements:
 - 1. Steel frame, steel panels, NEMA 12, unless otherwise specified
 - 2. 90 inches high, 20 inches deep, multiples of 36 inches wide, unless shown otherwise.
 - 3. Panels shall be flanged, corners welded and ground smooth
 - 4. All inside and exterior surfaces treated to prevent oxidation and painted. White on interior, manufacturer's standard color on exterior.
- B. Enclosures for exterior control panels (Remote Sump Panels) shall meet the following minimum requirements:
 - 1. NEMA 3R tamper resistant polished stainless steel, 2 door enclosure with minimum dimensions of 48" H x 60" W x 18" D. The enclosure shall contain an interior sub-panel for mounting all control components and the enclosure shall be sufficiently large to accept all control components without crowding. The panel shall be of not less than 12 gauge type 304 stainless steel with continuously welded seams. The enclosure shall contain door and panel stiffeners as required. The front doors shall have a rolled lip and the door flanged and the corners ground smooth. All enclosure welding seams shall also be ground smooth.
 - 2. The doors shall be fastened to the enclosure with a continuous type stainless steel piano hinge and locking three-point minimum, stainless steel hardware. The inside of the door shall contain data pockets. The sub-panel shall be painted white.
 - 3. Enclosure shall have full-height dead-front inner 12 gauge carbon steel hinged doors that house all front-panel components including switches, indicating lights, running time meters, overload reset pushbuttons, and other controls that require operator access.
 - 4. Circuit breakers that cannot be mounted directly to the inner door shall be elevated from sub-panel such that there operators are exposed through cut-outs on the inner door. The use of lever operators with extension shafts is prohibited.

5. The enclosure shall have thermostatically-controlled heaters to prevent condensation and freezing within the enclosure per the requirements on the Drawings and per the recommendations of the Supplier.
 6. Insulated with 1/2" cell foam insulation. Insulation shall be mechanically secured.
 7. 18 inch stainless steel floor stands, with stainless steel louvered skirts.
 8. Provide main circuit breakers, with interrupting rating of not less than 14,000 Amps, sym. Size these breakers per the one-line diagrams included in the plan set; Allen Bradley, Cutler Hammer or approved equal.
 9. Full-voltage NEMA rated starters; see Specification Section 26 24 19.
 10. Panel shall include a 3 phase power monitor for monitoring incoming 3 phase power. Phase monitor shall be Time Mark C2644 or equal.
 11. Top-mounted alarm beacon; Edwards Model 104FLEDR or equal.
- C. Label components per shop drawings.
1. Engraved labels attached with screws.
- D. All wiring terminated on barrier-type terminal strips. Terminal strips shall be labeled with engraved plastic labels.
1. Labels shall be attached with two-part epoxy adhesive.
 2. 600 volt terminal strips.
 3. Ring or spade type crimp connectors.
 4. Wiring laced using plastic wire ties and plastic wiring troughs.
 5. Wiring held down with straps attached to enclosure with screws.
 6. Separate power, control and signal conductors.
 7. Power wiring: #14 AWG, stranded, 600V copper minimum.
 8. Control wiring: #18 AWG, stranded, 600V copper minimum.
 9. Signal wiring: shielded, 300V, copper minimum. See Section 16100.
 10. Provide 15 amp, 10000 AIC breaker on power circuits using #14 wire.
 11. Connections to instruments via terminal strip or connectors. Soldering wires to terminal strips not acceptable.

- E. Tag all wires at each end with wire number matching shop drawings.

2.02 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. Programmable logic controller capable of performing relay logic, timing, counting, sequencing, mathematical, proportional-integral-derivative (PID) control, and other functions as required by the functional descriptions in this Section. Provide complete unit with rack, power supply, modules, cables and connectors.
- B. Auto start-up after power failure. Retain program and setpoints so that system starts automatically when power is restored.
- C. Provide live digital and analog inputs/outputs as indicated on Drawings, plus live spares and extra slots as specified in Part 1 of this Section. Minimum total inputs/outputs capability shall be 480 points per PLC.
- D. I/O Requirements
 - 1. Digital inputs
 - a. Optically-isolated input rated to withstand up to 1500 VAC transients.
 - b. Voltage as indicated, $\pm 10\%$.
 - c. Maximum of sixteen (16) input points per common neutral.
 - d. LED indicator.
 - 2. Digital outputs
 - a. Voltage as indicated.
 - b. Capable of continuously driving up to 0.5 amp load.
 - c. LED indicator.
 - 3. Analog inputs
 - a. Field selectable 4-20mA_{dc} or 1-5 VDC input on each channel.
 - b. 16-bit analog-to-digital conversion having overall accuracy of $\pm 0.75\%$ of full scale or better.
 - c. 250 ohm input impedance (on 4-20 mA input).
 - d. 1 Megohm input impedance (on 1-5 VDC input).
 - 4. Analog outputs

- a. 0 to 20mA_{dc} range. Nominal span of 4-20mA_{dc}.
 - b. Digital-to-analog conversion having overall accuracy of $\pm 0.75\%$ of full scale or better.
 - c. Capable of driving up to 750 ohm load.
- E. Programmable in ladder logic using IBM-compatible computer as described in the functional descriptions in this Section. Provide programming software that is a standard product of the PLC manufacturer. Software shall allow on-line program editing without interrupting PLC operation. Software shall have an advanced instruction set including timing, sequencing, relay logic, closed-loop PID control, mathematical, trigonometric, Boolean, floating-point and integer calculations, and time and event-based interrupts.
- F. PLCs shall have ethernet ports and RS-232 serial ports to allow communication between system components, all as described in the functional descriptions in this Section. Provide all required interface modules and converters.
- G. Environmental
- 1. Operating temperature - 0o to 50oC.
 - 2. Humidity - 0 to 95% (non-condensing).
 - 3. Noise immunity - comply with NEMA ICS-2-230.
- H. Manufacturer
- 1. Main Control Panel in Electrical Building: Appropriately sized Allen-Bradley "CompactLogix" Model from the "5380" line, including options specified, and manufacturer's programming software.
 - 2. Remote Sump Panels: Appropriately sized Allen Bradley MicroLogix 1400 with memory module.
 - 3. No substitutions.

2.03 OPERATOR INTERFACE TERMINAL (OIT)

- A. Manufacturer
- 1. Main Control Panel in Electrical Building: 12" Allen-Bradley model PanelView Plus 7 Touch OIT.
 - 2. Remote Sump Panels: 10" Allen-Bradley model PanelView Plus 7 Touch OIT.
 - 3. No substitutions.

2.04 INDUSTRIAL ETHERNET SWITCH

- A. N-Tron Corporation, select model as required for application and configuration.
- B. Or approved equal.

2.05 FIBER OPTIC CABLE, PATCH PANELS AND TESTING

A. Fiber optic cables:

1. All-dielectric design, suitable for installing in duct, direct-buried, or lashed to aerial messenger.
2. Number of fibers as indicated on Drawings. Single-mode or multi-mode fibers as indicated on Drawings. Multi-mode fibers shall have 62.5 micron core, 125 micron cladding, and 250 micron buffer.
3. Multi-tube design with six (6) fibers per tube. Color-coded fibers and color-coded tubes. Fillers shall be provided in place of tubes depending on fiber count, for round overall cable.
4. Maximum optical attenuation of fibers shall not exceed 4.0 dB/km at 850 nm and 2.0 dB/km at 1300 nm for Multi-mode (62.5/125 μm)
5. Binder layer with strength member, and black medium-density or high-density polyethylene outer jacket with rip cord.
6. Operating temperature range of -40 degrees C to 70 degrees C.
7. Install all cable in strict accordance with manufacturer instructions. Do not exceed maximum allowable pulling tension. Do not allow cable to bend sharper than minimum bending radius required by manufacturer.
8. Provide cable in sufficient lengths for splicing only in locations shown on the Drawings.
9. Lubricate cables prior to installation in duct in accordance with manufacturer requirements.
10. Tag all cables in each building entrance, handhole and termination point. Tags shall be plastic imprinted with cable type, number and fiber number designations as indicated on Drawings, and covered with a clear plastic outer jacket.

B. Splicing and Testing

1. Contractor shall employ an experienced organization that is normally-engaged in testing and repairing fiber optic cables for all splicing and testing. Utilize materials and methods that strictly comply with the manufacturers of the fiber optic cable and splicing equipment.

2. Splices shall be made using a precision fusion splicer resulting in splice performance that meets or exceeds the following specifications:
 - a. Loss (single-mode fiber) - less than 0.05dB.
 - b. Loss (multi-mode fiber) - less than 0.03dB.
 - c. Reflection - Less than -60dB
 - d. Apply nylon-reinforced heat-shrink protective sleeve over each fusion splice.
3. Handhole splices shall be enclosed in a two-piece, non-metallic tubular splice closure unit. The splice closure shall contain splice trays in quantity as required by the splice location, and shall be waterproof when closed and sealed. Splice closure diameter shall be as required by the minimum fiber cable bending radius. Maximum length shall be 22 inches.
4. Provide test equipment, labor and materials for testing all project fibers after splicing is complete. Submit test records for each fiber, identifying the following information:
 - a. Date and time of test.
 - b. Name of test technician and company.
 - c. Name of test witnesses.
 - d. Location of test.
 - e. Location of fiber ends.
 - f. Recorded test results:
 - g. Fiber distance (measured using test instrumentation).
 - h. Loss (attenuation) in dB at 850nm, 1300nm and 1550nm wavelengths.
 - i. Reflection in dB at 850nm, 1300nm and 1550nm wavelengths.

C. Fibers having test results that do not meet the requirements of this Specification shall be re-spliced or replaced at Contractor's expense, and re-tested until the fiber meets specification requirements. Minimum requirements shall be determined by adding total allowable losses and reflectances for the number of splices and 'SC' connectors in each run.

2.06 CELLULAR ROUTER

- A. Sierra Wireles RV50 (to match owner's existing equipment).
- B. No substitutions.

2.07 SURGE PROTECTION

- A. Main Service Protection: Main surge protective device (SPD) shall meet UL 1449, latest edition, integrated within control panel including breaker bus connection. All units to use thermally protected metal oxide varistor (MOV) as the core technology. SPD shall provide protection between each of 5 modes (4-wire plus ground) with minimum surge current capacity of 80 kA. Dual-color LED indicating lights shall be utilized to indicate protection status.

- 1. SPD shall be Cutler Hammer SPD080480Y1K or approved equal.

- B. Control System Protection: 120 VAC, 15 Amp rated in-line device. Listed for protection from ANSI/IEEE C62.41 Category A and B transients.

- C. 300 V peak clamping voltage.

2.08 TERMINALS

- A. NEMA-style, barrier type, 0.4-inch spacing, nominal.

- B. 600V RMS, 55 amp rating.

- C. UL listed.

- D. Allen-Bradley 1492-CA1 series, or equal.

- E. Terminals for larger power circuits shall be 600 VAC barrier-type, sized for the conductors.

2.09 DIRECT CURRENT POWER SUPPLY

- A. Switching style with 2% maximum point-to-point ripple voltage.

- B. Operating source: 120 VAC, 60 Hz.

- C. Overcurrent protection with automatic reset. Overvoltage protection with 120% minimum shutdown.

- D. At initial operation power supply loading shall not exceed 50% of rating under any condition.

- E. Environmental: Operating Temperature of 14 to 140 deg F, 20 to 90% relative humidity non-condensing.

- F. Convection cooled.

- G. Din Rail mountable with 10% voltage adjustment on front.

- H. Idec PS5R series or approved equal.

2.10 CONTROL SWITCHES

A. Electronic Circuits

1. Selector, momentary pushbutton or momentary selector as required. Positions as required for application.
2. 30 mm, heavy duty, oil-tight type, contacts as required.
3. Gold flashed contacts; initial resistance, 0.01 ohms; 0.5 amps at 120 VAC, resistive.

B. Control Circuits

1. Selector, momentary pushbutton, or momentary selector as required. Positions as required for application.
2. 30 mm, heavy duty, oil-tight type, contacts as required.
3. Contact rating shall conform to NEMA A-600 designation.

2.11 CONTROL RELAYS AND TIMING RELAYS

A. Plug-in type with dust cover, socket and locking spring when relay mounted horizontally.

B. Coil: continuous operation at 120 VAC \pm 10% unless shown otherwise.

C. Contacts, 3 pole, double throw, minimum.

1. 10 amps, make-break, 120 VAC, resistive.
2. Insulation resistance: 1000 megohms at 500 VDC.
3. Dielectric: 2000 VAC, 60 Hz.

D. Operating time

1. 35 milliseconds (nominal) energization.
2. 100 milliseconds (nominal) de-energization.

E. Mechanical life: 100k operations

F. Temperature: 0 to 70 degrees C

G. Timing relays shall be of the same manufacturer and series as control relays. Provide electronic timers with range as indicated.

2.12 INDICATING LIGHTS

- A. 30 mm, opaque colored lens.
- B. Press-to-test feature.
- C. Heavy-duty, oil-tight.
- D. NEMA 4 rating.

2.13 UNINTERRUPTIBLE POWER SUPPLY (UPS) - IN CONTROL PANELS

- A. 120 VAC, 60 Hz single-phase input and output.
- B. Size at 150% of connected panel load, or 900 VA capacity (continuous), whichever is larger, with 5-minute battery reserve time (at full-load).
- C. Continuous on-line, double-conversion type that continuously rectifies, stores, re-creates the 120 VAC sinusoidal output waveform for the load. Include features that allow operation in critical environments and high-harmonic and/or noisy applications. Include adjustable input voltage parameters so that the input stage will accept low-quality input power.
- D. Control panel shall implement a control relay logic circuit that allows the UPS to be removed from powering the control panel and automatically provides the controls with bypass power. Additionally, this relay logic circuit shall provide a contact closure to the PLC that indicates a UPS failure.
- E. Powerware, or approved equal.

2.14 ENCLOSURE HEAT

- A. Manufactured unit with metal housing with integrated fan and integral thermostat and 0 - 100F adjustable range.
- B. UL labeled.
- C. Hoffman "Design-Aire" or equal.

2.15 FLOAT SWITCHES

- A. Water/Sludge Application:
 - 1. Polypropylene with encapsulated non-mercury type switch.
 - 2. Contact rating - 3 Amps at 120 VAC, resistive.
 - 3. Operating differential - 1 inch, nominal.

4. Extra-flexible cord in length suitable for the application.
5. Manufacturer: Anchor Scientific (Roto)
6. Or approved equal.

2.16 SUBMERSIBLE LEVEL TRANSMITTER

- A. Submersible unit that measures hydrostatic head of liquid, using variable-capacitance or variable-resistance transducer.
- B. Corrosion-resistant stainless steel and PVC construction.
- C. Two-wire, loop-powered integral transmitter that receives operating power from a 4-20 mA_{dc} loop, and controls the loop current in proportion to level over the specified range.
- D. Provide stainless steel hardware and lifting cable to allow removing unit without entering installation.
- E. Provide a PVC stilling well for leachate tank installation.
 1. Manufacturer: EPG Companies "LevelMaster" LT Submersible.
 2. Or approved equal.

2.17 MAGNETIC FLOWMETER

- A. Electro-magnetic induction type producing pulsed DC signal proportional to flow, over a range of 0-500 gpm.
- B. Size as shown on the Drawings.
- C. Stainless steel metering tube, PTFE liner.
- D. Field replaceable metering tube, 150 pound ASA flanges
- E. 316 stainless steel conical raised electrodes.
- F. Flowtube shall be suitable for accidental submergence.
- G. Stainless steel grounding rings shall be furnished with meter when used on nonmetallic pipe systems.
- H. Operating temperature, 0 - 60 degrees C; relative humidity 20% to 100%, condensing.
- I. The flowmeter shall be integral with the flowmeter converter.

- J. Manufacturer: Rosemount (Emerson), McCrometer, Endress & Hauser, Siemens, or approved equal.

2.18 MAGNETIC FLOWMETER CONVERTER

- A. Magnetic flow-to-current converter shall be microprocessor based solid state type, using a pulsed DC signal to determine flow.
- B. Output shall be 4-20mA DC signal, linear with flow, into load of 0 to 1000 ohms, minimum, isolated signal. Range of flow will be 0-500 gpm. Confirm flow range with engineer.
- C. Operating power shall be 120 volts, 60 Hz, +/- 3 Hz.
- D. Pulsed DC type shall include inherent zero.
- E. Minimum technical requirements:
 - 1. Accuracy: $\pm 1.0\%$ of calibrated span.
 - 2. Repeatability: $\pm 0.25\%$ of calibrated span
 - 3. Supply effect: $\pm 0.25\%$ of calibrated span for $\pm 10\%$ power supply variation.
 - 4. Temperature: $\pm 0.50\%$ of calibrated span over rated range.
- F. NEMA 4X construction. The flowmeter converter shall be integral with the flow tube.
- G. Converter shall have an integral LCD display and pushbuttons to allow field selection of display range and units. Program unit to display in engineering units specified for each loop.
- H. Manufacturer shall match flowmeter.

2.19 PIPE HEAT TRACE

- A. Provide self-regulating heat trace for riser piping as indicated on the Drawings, 5 W/ft, Raychem 5HBTV1-CT, Class 1 Division 1 rated, or approved equal, with power connection kit and end seal, Raychem HAK-C-100 or approved equal. Coordinate cable length, wattage, cold-lead length, etc. prior to ordering and installation. End seal shall be Class 1 Division 1 rated. Power connection kit shall be Class 1 Division 2 rated.
- B. Provide series resistant constant output heat trace for ductile iron water supply line and ductile iron sanitary sewer line as indicated on the Drawings, 12 W/ft, Raychem 2SC30-CT, or approved equal, with power connection kit, Raychem SC-JBP-S-A or approved equal, and end seal, Raychem SC-JBE-S-A or approved equal. Coordinate cable length, wattage, cold-lead length, etc. prior to ordering and installation. End seals shall be above ground. Each pipe is to be heat traced with its own single run of heat trace approximately 1100 feet long. Heat trace is to be a

continuous length of cable without any intermediate terminations. The heat trace is to be controlled by contactors controlled by an ambient sensing thermostat.

- C. Provide NEMA 4X 316 SS enclosure to house power connect kits, as indicated on the Drawings.
- D. Riser piping heating system shall be controlled/protected by a heat trace controller and ground-fault protection breaker (equipment protection per NEC 426.28). The heat trace controller unit operates heat trace below a set temperature, and shall be an Elexant 4010i SSR or approved equal. The heat trace controller shall have a Rchem RTD-200 ambient sensing RTD or approved equal. The ground-fault breaker shall include a 30 mA ground fault protection unit and an auxiliary contact to indicate a ground fault condition to the PLC. Provide breaker in NEMA 3R enclosure and with solid neutral as well as ground lug. See Drawings for more information.
- E. Ductile iron water supply and ductile iron sanitary sewer heating system shall be controlled/protected by a heat trace thermostat with ambient temperature sensing and ground-fault protection breaker (equipment protection per NEC 426.28). The heat trace thermostat operates heat trace below a set ambient temperature, and shall be a Raychem AMC-F5 or approved equal. The ground-fault breaker shall include a 30 mA ground fault protection unit. A single ambient sensing thermostat shall be used to control two NEMA 2 contactors, one for each heat trace run.
- F. Confirm heat trace will meet freeze protection requirements of final piping and backfill design and installation.

2.20 MAGNETIC DOOR INTRUSION SWITCH

- A. Corrosion resistant hermetically sealed reed switch encapsulated in polyurethane.
- B. 100 VA, 0.5A contact rating.
- C. 2.4 inch minimum sensing range, as measured on a non-ferrous surface.
- D. Switch shall be factory equipped with a 3 foot stainless steel length of armored cable.
- E. Sentrol Industrial 2500 Series or equal.

2.21 TEMPERATURE MONITOR

- A. RTD-based room temperature monitoring device, wall-mount style with transmitter capable of 0 to 150 degrees F span.
- B. TCS Basys Controls TS1000 with TX1505 transmitter or equal.

2.22 SCADA PROVISIONS

- A. The controls supplier shall equip the control panel to allow it to be integrated into the Owner's existing telemetry system. Controls Supplier shall coordinate with Owner to determine

communication equipment needed to communicate with the Owner's SCADA system. Power to communication equipment shall be wired such that it is UPS backed.

- B. All SCADA programming, SCADA startup, and SCADA configuration will be provided by Contractor. Examine SCADA screens for the other landfill leachate management systems, and provide similar screens in terms of quantity, appearance and function for this station.
- C. The SCADA system shall also allow for remote access and control of the system via hard-wire or cellular internet.

PART 3: EXECUTION

3.01 LABELING

- A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.
- B. Labels shall be engraved laminated plastic with ¼" high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.
- C. Labels for all components as specified above shall also be provided for all control panel internal components.

3.02 CALIBRATION, ADJUSTING AND TESTING

- A. Devices requiring field calibration shall be calibrated in the presence of Engineer's representative and documented.

3.03 PROJECT MANAGEMENT

- A. Supplier shall provide engineering and administrative services necessary to fulfill the requirements of this Specification.
- B. Supplier shall provide the services of an experienced project manager as the overall coordinator during the course of the project.

3.04 PROGRAMMING SERVICES

- A. Program the programmable logic controllers (PLCs) and panelview as required by the functional descriptions.
- B. Supplier shall be present at a four (4) hour meeting in Burnsville, MN, with Engineer and Owner to work out the details of the functional descriptions, prior to final programming.

- C. Provide HMI screen programming to fulfill the functionality described herein. Provide a minimum of the following separate screen views:
 - 1. Freeway Landfill overall
 - 2. Separate screens for each of the six (6) sumps
 - 3. Separate screens for each of the two (2) leachate tanks
 - 4. Screen dedicated to loadout operations
 - 5. Screen dedicated to the flare
 - 6. Screen dedicated to alarming
 - 7. Up to four (4) additional screens to be determined in consultation with the Owner
- D. Provide existing SCADA Master screen programming to fulfill the functionality described herein, under the Owner's supervision. Provide all screen views outlined above along with the following separate, additional screen views:
 - 1. Report screens, as per Owner requirements
 - 2. Up to four (4) additional screens to be determined in consultation with the Owner
- E. Provide additional programming during start-up, training, and call-back periods as specified. A minimum of two (2) non-consecutive four (4)-hour days of follow-up programming shall be provided, but not less than that required per the intent of the specifications.

3.05 INSTALLATION AND START-UP

- A. Supplier shall provide a skilled programmer/ instrumentation engineer or technician who shall complete troubleshooting and start-up to place the entire system into satisfactory operation. Engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions as required for start-up.
- B. Conduct a one-day demonstration test of the system. Demonstrate proper operation of all system features and functions to Owner's Rep and Engineer.
- C. Coordinate installation and start-up scheduling with Pump Wet Testing.

3.06 ON-SITE SERVICES

- A. In addition to other services specified, provide a competent programmer/instrumentation engineer or technician to perform the following services:

1. Software revisions - One (1), eight (8) hour days on-site to make software revisions per Owner and Engineer direction.
 2. Training - One (1) eight (8) hour days on-site to train Owner's personnel on:
 - a. Operation and maintenance of all equipment furnished.
 - b. Panelview software operation and programming including building graphics and modifying tags.
- B. All on-site service shall be at times approved by Owner.
- C. At project completion, Supplier shall certify in writing that all un-used service hours will be provided at Owner's request during the first three years of operation. The remaining service hours shall be fulfilled by either a software engineer or field service technician as required by the task requested by Owner, at no cost.

3.07 CALL-BACK SERVICES

- A. In addition to other services specified, provide a competent programmer/instrumentation engineer or technician to return to the project site for one (1) eight (8) hour day during the first year of operation. During this trip, the supplier's representative shall be prepared to calibrate and check equipment furnished under this contract, give miscellaneous training, and make software revisions.
- B. Call-back trips shall be at times determined by Owner.

3.08 SUPPLIES

- A. Contractor shall provide all expendable items such as lamps, fuses, etc. for system startup, checkout, and during the acceptance test.
- B. At Final Completion, Contractor shall furnish the following expendable items:
1. Twenty (20) percent spare fuses and lamps of each type furnished, but not less than four (4) of each type.

3.09 SPARE PARTS

- A. Contractor shall furnish the following spare parts to Owner. Spares shall be delivered in boxes labeled on the outside with manufacturer and part number identified on the box:
1. One (1) PLC power supply.
 2. One (1) PLC processor module.

3. One (1) each of every type of PLC analog and digital input and output module used on project.
4. One (1) DC power supply (as used in control panels).
5. Six (6) each of every type of control relay used in control panels.

END OF SECTION 40 90 00

Division 43

Process Gas and Liquid Handling, Purification, and Storage Equipment

SECTION 43 05 10

GAS EXTRACTION VALVES

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes valves required for gas extraction system operation.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society for Testing and Materials (ASTM).
 - a. ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

1.03 SUBMITTALS

- A. Submit the following information on all valves for approval prior to ordering or installing:
 - 1. Manufacturer's name, address, and telephone number.
 - 2. Valve model number.
 - 3. Valve component materials.
 - 4. Certification that valves meet requirements.
- B. Manufacturer's product data including:
 - 1. Valve manufacturer's installation, operating, and maintenance instructions.

1.04 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 VALVES

- A. All valves of similar type to be by the same manufacturer.
- B. Butterfly Valves
 - 1. ASAHI Butterfly valve gear-operated Type 57 or 75
 - 2. Valve seats and O-Rings; EPDM
 - 3. Seat to be non-liner type and interlocked to body
 - 4. Disc to be offset design with SS316 stainless steel stem
 - 5. Gear actuated equipped with position indicator
 - 6. Flanged w/ 150# flanges
- C. Ball valves
 - 1. Capable of blocking flow in both directions
 - 2. Full bore valve
 - 3. Body, PVC Type 1 ASTM D1784 Cell Classification 12454
 - 4. O-Rings; EPDM
 - 5. Union nuts to have buttress threads
 - 6. All components to be replaceable
 - 7. True-union type at both ends with double stop plastic
- D. Gate Valves
 - 1. Body, PVC Type 1 ASTM D1784 Cell Classification 12454
 - 2. O-Rings; EPDM
 - 3. Non-rising stem and polypropylene handwheel
 - 4. Polypropylene wedge
 - 5. All components to be replaceable
 - 6. 2-inch and smaller; true-union type at both ends

7. 4-inch and larger, flanged w/ 150# flanges and 2-inch square operating nut
- E. Valve Stem Extensions
1. Valves shall be equipped with extensions such that the gear actuator shall be a minimum of 18-inches above grade

PART 3: EXECUTION

3.01 EXAMINATION

- A. Examine and verify conditions to accept installation of valves.
- B. Verify size and location restrictions to place in and around structures.
- C. Submit required information and shop drawings for approval.

3.02 PREPARATION

- A. Prepare site and construction parts for installation.

3.03 INSTALLATION.

- A. Coordinate placement of pipe openings to accommodate valves.
- B. Install valves in locations shown on Drawings.
- C. Valve installation per submitted manufacturer's recommendations.
- D. Test for leakage.

END OF SECTION 43 05 10

SECTION 43 10 00

GAS BLOWER AND FLARE SYSTEM INSTALLATION

PART 1: GENERAL

1.01 SUMMARY

A. Section includes:

1. Enclosed Ground Flare System
2. Gas Handling System
3. Enclosed Ground Flare Station MCC/Control System

B. In the interest of total system compatibility, reliability, quality, cost, and single source responsibility, the systems, and assemblies furnished under this section shall be designed, manufactured, and/or supplied by a single vendor.

C. Work Included:

1. Provide and install the unitized, modular, enclosed landfill gas ground flare station including all components necessary for a complete and operational system. The flare station shall be sized to extract, demist, process the condensate, compress, and combust a maximum of 2,000 MMBtu/hr (2,000 SCFM of 50% CH₄) of landfill gas. Other combinations of flow and CH₄ content not exceeding 60 MMBtu/hr shall be accommodated as long as CH₄ is between 20% and 55%, and flow is between 333 and 2,000 SCFM. The combination of these sub-systems shall include, but not be limited to, the following components.

a. Enclosed Ground Flare System

- 1) Automatic actuated shutdown valve
- 2) Flame arrester
- 3) Burner Unit
- 4) Flare Stack
- 5) Interconnecting piping and isolation valves
- 6) Internal electrical wiring
- 7) Instrumentation and control devices
- 8) Junction and terminal boxes as required
- 9) Pilot and ignitions system

b. Gas Handling System

- 1) Landfill gas blower
- 2) Demister / Filter system
- 3) Process piping

- 4) System structural skid
- c. Enclosed Ground Flare Station Control System
 - 1) Enclosures / Cabinets / Junction boxes
 - 2) Control and annunciation devices
 - 3) Interconnecting conduit and wiring
 - 4) PLC supervisory control system
 - 5) Ethernet switch for remote connection capabilities
 - 6) All required electrical controls, motor controls, annunciation systems, alarm systems, and logic systems.
- d. Perform equipment and system testing
- e. Perform initial system start-up
- f. Demonstrate compliance with performance requirements as specified
- g. Provide operation start-up and training for designated personnel
- h. Prepare and deliver three copies of submittals and operation and maintenance manuals

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. ASTM A36, Standard Specification for Carbon Structural Steel

1.03 SUBMITTALS

- A. Shop Drawings: Before any of the materials of the Section are delivered to the job site, the Contractor shall submit complete shop drawings to the Engineer in accordance with the provisions of Section 01300 of these Specifications. Shop drawings shall show all details of:
 - 1. Equipment dimensions component parts and list of materials.
 - 2. Installation and mounting details.
 - 3. Electrical wiring diagram and details.
- B. Materials list: Submit three (3) copies of a complete list of all materials and equipment proposed to be furnished and installed under this portion of the work, giving manufacturer's name, catalog number, and catalog cut for each item where applicable.
- C. Following installation, the Contractor shall provide to the Engineer the equipment supplier's written report certifying that equipment:
 - 1. Has been properly installed and connected.

2. In accurate alignment
 3. Is free from undue stress imposed by piping or mounting bolts
- D. Submit warranties as specified in accordance with these specifications.
- E. Special arrangement: If proposed equipment requires an arrangement differing from that indicated on the drawings and as specified, prepare, and submit for review detailed structural, mechanical, electrical, and process/instrumentation drawings and equipment lists, materials of construction and operating instructions, showing all necessary changes and all special features of proposed equipment. The Contractor shall make such changes, if approved by the Engineer, at no additional cost to Owner.
- F. Other Manufacturers:
1. To consider systems of other manufacturers as an equivalent, (other than those named in Section 2.01B, "Acceptable Manufacturers, of this specification) prove and document that proposed substitution is equal to specified item in quality, dependability, durability, strength, design, performance (per Section 1.04 of this specification) substantial conformance, operation efficiency, maintenance, serviceability, energy requirements, warranty, total cost effectiveness and other pertinent criteria.
 2. The Contractor shall submit only proposed items which are duplicates of designs currently in satisfactory operation at similar facilities. In case of improper operation or failure, the Contractor shall insure that items are covered by a sufficient bond, approved surety or cash deposit for a period of ten years or pay for and guarantee suitable operating replacement which can be properly installed in the facility.
 3. The Contractor shall satisfactorily document cost differential between specified item and proposed substitution, with invoices and quotations on manufacturer's letterhead, showing discounts and other such means as necessary to satisfy Engineer. Credit all cost savings to the Owner Quality Assurance.

1.04 PERFORMANCE

- A. Operating conditions: The landfill gas flare station shall be capable of operating under the following performance requirements and operating ranges:
1. Gas flow rates: The flare system shall be capable of operating at a landfill gas flow rate and a landfill gas heat flow rate of 16.6% maximum load rating through 100% maximum load rating (6:1 Turndown ratio) described earlier in this section. The emission and destruction/reduction efficiencies and NO_x and CO levels shall remain in compliance with the specified emission limits set herein without the use of supplemental fuel.
 2. Gas Supply Pressure: The flare system shall require a maximum of 15 inches w.c. landfill gas pressure at the inlet of the flame arrester.

3. The minimum operating temperature shall be 1,400 °F. This minimum temperature shall be maintained for the duration of a minimum of 0.6 seconds.
4. Nitrous oxide (NOx) emissions: Less than 0.06 lbs./MMBtu.
5. Carbon monoxide emissions: Less than 0.20 lbs./MMBtu.
6. Minimum 98% DRE of non-methane organic compounds or <20 ppmvd NMOC's as hexane at 3% O₂.

*Based on carbon balance calculation derived exhaust flow rates and velocities, method TO-14 sampling methods and Method 25A (modified) analysis methods. Inlet gas sampling by EPA Methods 1, 2, 3 or 4. Landfill gas composition: In the absence of actual qualitative gas data, the composition of the landfill gas for this project shall assumed to be as follows:

- B. Landfill gas composition: In the absence of actual qualitative gas data, the composition of the landfill gas for this project shall assumed to be as follows:

| | | |
|----|----------------------|--------------------|
| 1. | <u>Constituents:</u> | <u>% by Volume</u> |
| a. | Methane | 25 to 55 |
| b. | Carbon Dioxide | 25 to 45 |
| c. | Oxygen | 0 to 3 |
| d. | Nitrogen | 5 to 25 |
| e. | Trace Components | 1 |

1.05 QUALITY ASSURANCE

- A. Qualifications of manufacturer: Products used in the work of this section shall be produced by manufacturers regularly engaged in the manufacture of landfill gas handling, processing, and combustion systems and with a history of successful production acceptable to the Engineer.
- B. Qualifications of installers: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- C. Basis of acceptance: The manufacturer's recommended installation procedures, when approved by the Engineer, will become the basis for inspecting and accepting or rejecting actual installation procedures used on this work.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Protection: The Contractor shall use all means necessary to protect the condition and integrity of the equipment provided under this section both during and after receipt of said equipment, and to protect the installed work and all other trades.

- B. Replacements: In the event of damage during installation, Contractor shall immediately make all repairs and/or replacements necessary to the approval of the Engineer and at no additional cost to the Owner.
- C. Deliver materials in manufacturer's original packaging with all tags and labels intact and legible.
- D. Store and handle material in such a manner as to avoid damage; store at site under cover if required to meet the conditions of this section.

1.07 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. Proprietary products: References to specified proprietary products are used to establish minimum standards of utility and quality. Other materials may be considered by the Engineer in accordance with the provisions of Section.
- B. Acceptable Manufacturers familiar to Owner's operation and maintenance crews.
 - 1. Perennial Energy, LLC
1375 CR 8690
West Plains, MO 65775
Telephone: (417) 256-2002
Fax: (417) 256-2801
Email: sales@perennialenergy.com
Website: <http://www.perennialenergy.com>

2.02 LANDFILL GAS FLARE SYSTEM

- A. The enclosed landfill gas flare system shall be a unitized, modular system including all components for a complete and operational system.
- B. The landfill gas flare system shall be pre-piped and pre-wired to the extent possible, requiring minimal field assembly.
- C. The landfill gas flare system shall include, but not be limited to, the following components which shall meet as a minimum the listed specifications:
 - 1. Main Gas Valve: 10" pneumatically (nitrogen) operated butterfly valve equipped with a stainless-steel disk and Viton seat. The operator shall be provided as a spring fail close device and shall close when directed by the logic in less than 2 seconds. The

manufacturer shall provide the regulator train and mounting facilities for Contractor provided nitrogen tank(s).

2. Flame arrester: A 10" flame arrester shall be installed at the inlet to the flare. The pressure drop it imposes on the system is a maximum of 3 inches w.c. The flame arrester is constructed of cast aluminum housing with aluminum flame element. Flame Arrester shall be manufactured by Groth. The flame arrester shall be provided with pressure monitoring such that both flare back pressure and flare + flame arrester back pressure can be monitored.
3. Flare stack: The flare stack shell shall be constructed of 1/4" minimum thickness ASTM A36 carbon steel and shall be a minimum 120-inch diameter by minimum 38 feet height. Sections of the flare cylinder shall be attached via continuous welds conforming to AWS D1.1 standard. The flare stack shall have the following properties and accessories.
 - a. Lifting lugs: Minimum two (2) lifting lugs shall be provided, each capable of carrying the entire weight of the unit.
 - b. Maximum internal temperature rating: 2,000 °F.
 - c. Maximum external skin temperature: 250 °F.
 - d. Concrete Pad Protection: Flare mounting shall be designed such that a minimum of 4-inch of passively ventilated air space is provided beneath the insulated flare floor and the concrete pad.
 - e. Insulation: Three (3) layers of ceramic fiber insulation blanket (maximum 2,300 °F) shall be provided as combustion cylinder protection. Two one-inch layers of 8 lb/ft³ blanket shall be installed, using overlap outer face construction methods, over one (1) 2-inch layer of 4 lb/ft³ ft. density material. Insulation shall be attached to the flare wall and floor with Inconel and stainless-steel studs and washers, appropriate to the temperature exposure zones in the combustion cylinder.
 - f. Insulation coating: High temperature, sprayed on surface sealer/protectant.
 - g. Manway: Min. 22 x 22 square inches, insulated, installed above burners.
 - h. View ports: Five (5) each 2-inch NPT with removable tempered glass covers and cooling holes. Two (2) each shall be located at the base of the flare to view the pilot flame and the base of the main flame. One (1) each shall be located such that they offer a view of each thermocouple.
 - i. Thermocouple ports: Three (3) each 2-inch NPT with bushing and cooling holes.
 - j. Source test ports: Two (2) each 4-inch NPT with cooling holes.
 - k. Main gas inlet nozzle: Stainless steel, raised faced slip-on weld flange meeting the requirements of 150 lb ANSI specifications, size is ANSI 6".
 - l. Propane fueled pilot gas inlet nozzle: 1/2" NPT.
4. Burner: The burner unit shall have the following properties and accessories:
 - a. Assembly: Multiple, small gas port, primary air mixed burner assembly consisting of multiple individual burners. The burner assembly shall be of the "primary air damper" type, designed to allow up to 60% of the theoretical stoichiometric air required for combustion to be mixed with the landfill gas prior to ignition. The primary air dampers beneath each burner port shall be adjustable throughout their range from outside the flare cylinder, with the flare in full operation.

- b. Construction: 304L Stainless-Steel (<0.03% carbon content) with castable refractory venturi liners.
- c. Burner Warranty: The Stainless-Steel portions of the burner assembly shall be warranted by the manufacturer to perform for the purpose for which it is intended, and to be capable of maintaining compliant operation over the range of specified design pressures, flow rates and heat rates for a minimum period of two (2) years from date of delivery to site when operated continuously (>85% Duty Cycle) within the specified design flow rate and heat loading limits. Offers which do not address this burner warranty requirement may be considered non-responsive.
- d. Refractory: Removable, cast venturi burner lining assemblies, 2,700 °F rating.
- e. Thermocouples: Three (3) each, type K, housed in Inconel sheaths.
- f. Flame safeguard controller: Honeywell or Engineer approved equivalent; factory mutual reviewed. Device shall include an ultraviolet signal amplifier module and shall display flame signal strength at the control panel.
- g. Ultraviolet scanner: Honeywell or Engineer approved equivalent, Factory Mutual reviewed. Device shall be "self-checking" type.
- h. Propane pilot system: Removable pilot assembly rated at 40,000 Btu/hr., including pressure regulator, pressure indicator, solenoid valve, manual shutoff valve and pilot gas pressure manometer port.
- i. Total combustion and quenching air control: Motor operated, 12–14-gauge, galvanized steel damper(s) with 3/4" shaft at each inlet. 4-20 mA actuator damper motor(s) shall be utilized at the louver(s). Actuators shall cause louver(s) to fail open on loss of signal.
- j. Flare temperature controller: Flare temperature control shall be directed by the inherent analog control capabilities of the supervisory PLC system, with capabilities of proportional, integral, and derivative control. Controller shall drive damper actuator motors via a 4-20 mA signal and shall include operator adjustable set-point control for both operational set point and low flare temperature. Logic in the PLC controller shall include auto start louver position signal and automatic switch over capabilities to control to an adjustable set-point flare temperature setting. Temperature control system shall be capable of controlling the flare temperature to within +/- 30 °F of set-point.
- k. Electronic spark ignition: 5,000 V electronic ignitor assembly removable from outside the flare without disconnecting conduit or wiring.
- l. Flare anchor system: Flare mounting feet shall be provided such that appropriate anchorage can be provided using a HILTI HIT C-100 System using HFA or HAS inserts. Embedment depth and spacing shall provide full overturn and seismic attachment to foundation. Flare shall be designed to withstand loads & stresses per the requirements of UBC 100 mph wind loading and seismic Zone 4 criteria.
- m. Finish: High temperature primer and finish coat over sand-blast prepared metal. Sand blasting shall be to SPC SP-6 guidelines.
- n. Ignition transformer enclosure: The enclosure for the ignition transformer shall meet NEMA 4 criteria and shall receive the 120 VAC power and hi-tension conduits.
- o. Flare junction enclosure/main control panel: The flare mounted junction box(s) / panel(s) shall meet NEMA 4 criteria and shall house all of the flare mounted electrical gear required to meet the operational requirements of this specification.

5. Sequence of Operation

- a. Upon receipt of an initiation signal from the master control panel, with the flare mode selector switch in the "AUTO" position, the unit shall go through an adjustable timed purge cycle (nominal 3 minutes). The inlet louvers shall open completely during this cycle to facilitate passive ventilation.
- b. The pilot solenoid valve opens, and the spark ignitor energizes up to 1 minute (adjustable) to ignite the pilot gas. If ignition does not occur within 60 seconds, the system shuts down and causes alarm.
- c. After pilot ignition, and with the U.V. scanner sensing flame, a signal is sent to the shutdown valve to open.
- d. Upon recognition of a "valve opening" signal, the landfill gas blower shall start.
- e. Normal operation mode on landfill gas is now achieved.
- f. If flare fails to reach normal operating temperature within 10 minutes, or experiences low temperature during normal operation for more than 10 minutes, the temperature controller shuts down the unit and sends a signal to annunciate "Low Flare Temperature".
- g. If the flare exceeds the maximum temperature set-point, an over temperature signal shall shut down the unit and shall send a signal to annunciate "High Flare Temperature".
- h. If the main flame is extinguished for any reason, the system shall shut down and send a signal to annunciate "Flame Failure".
- i. Should the landfill gas flow rate fall below an adjustable set point for nominally 30 seconds, the main control panel shall send a signal to the flare controls, the flare shall shut down and send a signal to annunciate "Flame Failure".
- j. Should the inlet valve fail to close upon logic or manual operator selection demand, the system shall shut down send a signal to annunciate "Inlet Valve Fail". This shut down shall require operator attention for remediation and manual restart.

6. Spare Parts - One each of the following devices, of the manufacturer, type and model installed in the system, shall be provided as a part of this scope of work and supply.

- a. Thermocouple
- b. Flame Safeguard module
- c. Flame Signal Amplifier Module
- d. U.V. Flame monitoring sensor
- e. Pilot gas ignitor
- f. Louver actuator motor
- g. Pilot gas ignition transformer
- h. Complete set of fuses applicable to system operation

2.03 GAS HANDLING SYSTEM

A. Performance and Design Requirements

1. Landfill gas blower: Two (2) each 1,000 SCFM landfill gas blower is required and shall have been designed for use with and in the presence of landfill gas. The blower shall be a multi-stage centrifugal device, with cast iron ends and sections, and aluminum cast impellers. All cast iron parts in contact with landfill gas shall be coated with a baked

phenolic coating system such as Heresite, or equivalent, for corrosion protection. The blower shall be designed with a highly effective shaft seal and shall be designed for direct coupled VFD controlled applications. The blower shall be capable of exerting a minimum of 30-inches of w.c. vacuum at the suction side and shall deliver sufficient pressure to service the landfill gas flare, including all system parasitic restrictions, throughout the full design range of this specification. The blower motor horsepower shall not exceed 40 BHP (or as selected by the blower manufacturer) when operating at the design flow and temperature. Under the design conditions listed above, blowers shall operate down to 333 SCFM without surging.

- a. Motor: The blower shall be furnished by the manufacturer with a 40 HP (or as selected by the blower manufacturer), 60 Hertz, 3 phase, 460 volt, TEFC enclosure, squirrel-cage induction motor with a 1.15 minimum service factor and shall be factory mounted with the blower. The motor shall be rated for service with a variable frequency drive. The motor shall be equipped with shaft grounding ring or insulated ODE bearing for protection against shaft currents.
- b. Variable Frequency Drive (VFD): A VFD suitable for control of the blower/motor assembly shall be provided. The VFD shall be capable of controlling the blower motor by either a manually selected speed control or by a 4-20 mA signal provided by the flow rate or landfill vacuum monitoring system(s). The operator shall be able to select a desired landfill gas flow rate or landfill vacuum at the operator interface console (Touch Screen), and the VFD will automatically control the blower speed to maintain the selected flow rate or vacuum. The VFD shall be supplied with internal line reactors.
- c. Accessories: The blower shall be furnished with a vibration sensor, mounted on or near the driven end bearing housing assembly of the blower, and shall develop an output of 4-20 mA representative of in/sec vibrations from the blower. The PLC shall accept this signal and shall process the signal for touch screen display as well as adjustable alarm and shutdown levels.
- d. Installation: All piping will be supported so as to preclude the possibility of exerting undue forces and moments on the blower flanges. Suitable flexible connectors will be furnished to isolate the blower from the piping system. Each unit shall be mounted flat and level on the gas handling system steel main skid.
- e. Experience: Blowers shall be manufactured in the United States. Compressor manufacturers shall have a minimum 5 years' experience in the design and manufacture of this type of equipment and have a minimum of 25 operating installations in the United States.
- f. Acceptable Manufacturers:
 - 1) Atlas Copco
 - 2) Gardner Denver
 - 3) Lone Star Blower
 - 4) National Turbine

2. Demister Filter: The demister filter shall be completely fabricated from 304L Stainless Steel. It shall be of a vertical, cylindrical design with element removal from the top. An 8-inch flanged, covered, inspection port shall be provided in the side near the bottom for manual clean out of accumulated debris. Nozzle flanges shall meet ANSI 125# specifications. The demister shall be able to remove 99% of droplets >6 micron and shall also remove particulates having a density equal to or greater than water which are >6 micron in size. At the design flow rates, temperatures and pressures, the demister shall not have a clean pressure drop greater than 3 inches w.c. The demister/filter vessel shall be capable of withstanding no less than 5 PSIG pressure/vacuum.
 - a. Demister/Filter Elements: The demister/filter pad elements shall be manufactured from polypropylene fiber and woven in pads. Over 90% of the fiber shall be perpendicular to the flow of the gas. There shall be three groups of pads, each pad shall be 4 layers thick. Each group of pads shall have the following gauge size fibers and percent void space: 1st - 37/97; 2nd - 16/97; 3rd - 8/96.
 - b. Condensate Removal: There shall be a minimum size 2-inch IPS pipe coupling in the bottom of the filter for condensate removal.
 - c. Pressure drop monitoring: There shall be two minimum sized 1/4 inch pipe couplings in the side of the filter, one each upstream and downstream of the filter element material, for the purpose of connecting a differential pressure monitoring device. The vessel shall be provided with a Dwyer Capsuhelic differential pressure gauge installed with valving for isolation and atmospheric calibration.
 - d. The demister/filter system shall be equipped with an ultrasonic level switch for monitoring high condensate level in the base of the vessel. This system shall provide a signal which shall be indicated on the touch screen as an alarm/shutdown lamp and provide shutdown for high condensate level condition.
 - e. Experience: Demister/Filter assemblies shall be manufactured in the United States. Manufacturers shall have a minimum of 5 years' experience in the design and manufacture of this type of equipment and shall have a minimum of 10 units operating successfully on landfill gas in this country.
 - f. The demister/filter assembly shall be located, installed and pre-plumbed on the gas handling system skid.
3. Butterfly Valves: Butterfly Valves in the gas piping shall be gear operated, lug type, cast iron bodied valves with Viton or EPDM resilient seats and stainless-steel disc and shaft. No part of the cast iron body shall be in contact with the landfill gas. The shaft seals shall be designed for landfill gas service. Valves shall be selected for a minimum pressure of 25 PSIG. At a minimum, appropriately sized butterfly valves shall be installed on the system skid at the inlet of the system (for isolation from the landfill) and in the suction piping to the blower.

4. Piping: All piping on the gas handling system skid shall be of schedule 10 304L stainless steel. The same specification shall apply to tees, elbows, wyes, etc., except that carbon steel flanges may be used with stainless steel piping if the piping is provided with welded stainless steel stub ends. All flanges shall conform to ANSI 125# drilling specifications. All welding of piping and appurtenances shall conform to the appropriate AWS specifications.
5. Flexible Connectors: System piping shall be provided, where required to relieve expansion and/or vibration stresses, with stainless steel corrugated, ANSI flanged flexible connection devices. At a minimum, these devices shall be employed at the inlet and outlet of each blower.
6. Packaging: The complete gas handling system shall be designed and manufactured as a pre-packaged, pre-plumbed, pre-conduited, prewired and factory pre-tested system. In areas where field installation requires connections to piping systems or wiring systems, flanged connections and terminal/junction boxes shall be provided. The intent is to have as fully pre-assembled a system delivered to the job site as is possible.
7. Structural Skid: The structural skid shall be manufactured from ASTM A36 structural members. The sizes, weights and shapes of the structural members shall be Engineered to support all assemblies and sub-assemblies in loading, transport and operation. Design criteria for the structure(s) shall be UBC 100 mph wind overturn loading and zone 4 seismic loading. All welding shall be accomplished per AWS Section 1.1. Skid finishing shall be in compliance with the preparation, priming, and painting methods described in Section 3.06 of this specification.
8. Gauges and Instrumentation Transmitters / Transducers: Where direct read-out pressure gauges are required, Dwyer Capsuhelic or Engineer approved equal shall be employed, and shall be selected in appropriate ranges and/or scales. Where analog transmitters / transducers are required for installation on the system process piping or in the control panel(s) for compliant control, such transducers shall be provided and installed as 2-wire, 4-20 mA devices. Pressure, Vacuum, and differential pressure transducers shall be provided as Rosemount, or Engineer approved equal products. For temperature signals, thermocouple type sensing devices selected for the appropriate temperature ranges are acceptable, with the thermocouple EMF signals processed in the system PLC. The minimum required list of monitoring devices for this system is:
 - a. Landfill Vacuum Gauge, Dwyer Capsuhelic
 - b. Landfill Temperature Gauge, 4-1/2-inch dial
 - c. Landfill Vacuum Transmitter
 - d. Demister differential pressure Gauge, Dwyer Capsuhelic
 - e. Blower discharge Temperature Gauge, 4-1/2-inch dial
 - f. Flame Arrester Pressure Gauge, Dwyer Capsuhelic

9. Recorders: Where process recorders are required for installation on the system or in the control panel(s) for specification and/or permit compliance, such recorders shall be provided as Yokogawa paperless strip chart type devices capable of collecting, accumulating, storing, and presenting digital records of monitored systems. Provide one (1) each:
 - a. 6 Channel DX-106 Yokogawa Digital Recorder with math function.

2.04 ENCLOSED GROUND FLARE CONTROL SYSTEM

- A. General: The control panel for the enclosed ground flare system shall be compliant with NEMA 4 specifications at a minimum and shall include a weather shield for protection against rain and heat radiation. The shield shall extend 36-inches in front of the panel and 12-inches to either side. The control panel shall be sized 72"H x 36"W x 24"D at a minimum, shall be provided with a swing out panel. The control panel shall be mounted, installed and pre-wired to the extent possible by the system manufacturer. The control panel system shall be designed for installation on the gas handling system skid or as a remotely mounted system, whichever is depicted in the specification drawings. For gas handling system mounted systems, all conduiting and wiring shall be completed at the factory to the maximum extent possible. The complete control system shall be manufactured, wired, and tested by the flare manufacturer in a UL approved panel shop, and shall be specifically designed for the performance of the electrical and logical control requirements of this project. The control panel shall bear the official UL label confirming UL 508A classification as an "Industrial Control Panel". The panel shall include as a minimum, but not be limited to, the following components:
 1. A Load and Motor Control Center for all the motors, fixtures, controls, and devices included with the system. The electrical system shall include voltage transformer(s), disconnects, main and branch circuit protectors and any other protection and/or control devices required for complete operation of the system based on a single electrical service supply of 480 VAC, 3 Phase, 60 Hz. The MCC section shall house the Variable Frequency Drives for the blowers.
 2. Panel Temperature Control: The electrical motor control panel(s) and/or the logical control panels shall be provided with thermostatically controlled heating and cooling systems as required insuring proper operation of all motor control and logical supervisory control sub-systems.
 3. A PLC based control center to receive all the signals from the various safeties, controls, and monitoring equipment, and to automatically control all the various components of the system. The PLC system shall include an Ethernet connection to connect with an internet source provided by others, such that the control system can be accessed remotely by authorized personnel.
 4. Surge protection devices shall be installed for the 3-phase electrical service, the 120 VAC circuit(s), the DC voltage circuit(s), and the telephone/data line circuit(s).

5. An operator interface panel to allow either manual or automatic selection for the control of the operational components of the system. Such operator interface shall be provided as a "Touch Screen" and shall be fully compatible with the PLC and shall be designed for industrial duty applications.
6. Safeties: The system shall be equipped with the following safeties as a minimum:
 - a. Blower Motor overcurrent
 - b. Blower motor undercurrent (surge)
 - c. High Flare Temperature
 - d. Low Flare Temperature
 - e. Flame Failure
 - f. Low LFG Flowrate
 - g. High demister condensate level
7. Control Panel Face Mounted Devices: The system shall be equipped with the following control panel face mounted devices as a minimum:
 - a. Auto Dialing Alarm System (ADAS) to accept a minimum of four (4) each inputs and shall be capable of being programmed to contact a minimum of eight (8) each phone numbers.
 - b. Digital Recorder as specified in 2.03.A.9 above
 - c. Alarm and shutdown message annunciation (Touch Screen Display)
 - d. Load center circuit breakers as required for full system operation.
 - e. Test/Off/Auto Switch for the blower
 - f. Test/Off/Auto Switch for the system
 - g. Open/Closed/Auto switch for the flare shutdown valve
 - h. Flame failure annunciation for the flare (Touch Screen)
 - i. High flare temperature annunciation (Touch Screen)
 - j. Low flare temperature annunciation (Touch Screen)
 - k. Inlet Valve Failure annunciation (Touch Screen)
 - l. Low LFG Flow Rate annunciation (Touch Screen)

- m. Test/Off/Auto Switch for the pilot ignition system
- n. Flame Failure Reset

PART 3: EXECUTION)

3.01 EXISTING CONDITIONS

A. Inspection:

1. Prior to all work of this section, the Contractor, and the flare manufacturer representative in charge, shall carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, the Contractor shall immediately notify the Engineer.
2. The Contractor shall not permit the manufacturer's representative in charge of system start-up to proceed with commissioning in areas of Discrepancy until such discrepancy has been resolved.

3.02 INSTALLATION

- A. General: Install the work of this section in strict accordance with the manufacturer's recommendations as approved by the Engineer.
- B. Installation shall proceed in compliance with the submitted installation schedule, as approved by the Engineer.
- C. The work of this section shall be installed plumb and perpendicular to piping where required on Construction Drawings.
- D. Painting: Marred or abraded surfaces shall be cleaned and refinished in accordance with the manufacturer's recommendations.

3.03 STARTUP AND TESTING

- A. Factory Test: The entire system, including all controls shall be tested at the manufacturer's plant before shipment. Complete test reports shall be made available which shall show all system controls operate correctly prior to shipment.

- B. Startup: The manufacturer shall furnish his factory trained representative for a minimum of three days of start-up & training labor. The representative will remain on site until start-up of the system has been completed to the Engineer's satisfaction, unless failure to achieve a successful start-up is NOT the fault or cause of the manufacturer.
- C. Functional and validation tests: Upon completion of the installation, functional and validation tests shall be performed by the Contractor with the assistance of the manufacturer's representative. The Owner and/or Engineer shall provide the necessary air quality monitoring agency support for monitoring inlet and outlet conditions of the properly operating flare system. The manufacturer's representative will demonstrate compliant operation of the system to the Engineer's satisfaction. Should the system NOT perform to the requirements of this specification, the expense of any re-testing, if required, will be borne by the system manufacturer, unless failure to achieve successful operation is neither the fault nor cause of the manufacturer.

3.04 INSTRUCTIONS

- A. When all required approvals of this portion of the work have been obtained, and at a time designated by the Owner and/or Engineer, the Contractor and/or the manufacturer's representative in charge of start-up and testing shall thoroughly demonstrate to the Owners operation and maintenance personnel the operation and maintenance of all items installed under the work of this section.
- B. The instructions shall be separate from the installation, start-up, and equipment adjustment services.

3.05 CLEANING

- A. Clean exposed surface of all grease, dirt, and other foreign materials.
- B. Touch up all marred or abraded surfaces as specified herein.

3.06 PAINTING

- A. Surface preparation
 1. All surfaces to be painted shall be dry and shall meet the recommendations of the paint manufacturer for surface preparation. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss of previously painted surfaces shall be dulled, if necessary, for proper adhesion of finish coats.
 2. All metal surfaces that require painting and are continually exposed to temperatures of less than 2,000 F shall be commercially sand blasted to SPC SP-6 requirements.

3. The flare and all surfaces exposed to temperatures greater than 2,000^o F shall be commercially sandblasted to SPC SP-6 requirements.
4. All surfaces to be painted shall be prepared and cleaned in accordance with the paint manufacturer's recommended procedures, prior to applying paint or surface treatment.
5. All surfaces shall be thoroughly cleaned and shall be free from oil, grease, dirt, dust, and other foreign substances.
6. All removable items which are in place and are not to be painted shall either be removed or properly protected prior to surface preparation and painting.

B. Material Preparation

1. Paint shall be thoroughly mixed each time any is withdrawn from the container to provide a mixture of uniform density. Paint containers shall be kept tightly closed except while paint is being withdrawn.
2. Paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below the thickness recommended by the paint manufacturer.

C. Paint and Primer Application

1. All external, exposed surfaces of the flare shall be blast-cleaned in accordance to above, and then primed and top-coated with Forrest Technical Coatings' 54-H-050 High Temperature (1,200 deg F) Primer and 51-H-30 High Temperature Paint. This coating system, applied with airless spray equipment in accordance with the manufacturer's directions and consisting of a Silicon Epoxy Primer and Silicone Paint, provides superior protection from rust and acids in harsh service conditions, as well as the compatible high temperature substrate not provided by organic zinc or alkyd primers.
2. All welded structural steel bases for the unitized gas delivery system will be blast-cleaned as above, and primed and painted with an Acrylic Modified Alkyd Enamel System, prior to the installation of the equipment and components mounted on these skids.
3. The mounted equipment, components, structural skids, and all other surfaces requiring shop painting and subject to damage by blast cleaning, will be cleaned in accordance with SSPC-1, 2, or 3, as applicable, then primed and painted as above following final assembly of the system. The burner manufactured from 304L stainless-steel will not be painted. No painted surface shall be in direct contact with unburned biogas.

END OF SECTION 43 10 00

SECTION 43 10 01

GAS EXTRACTION WELLS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes the furnishing of all labor, equipment, materials, and other facilities and incidentals to perform the following Work for the landfill gas extraction wells:
 - 1. Drill boreholes of 36-inch diameter to a maximum depth as shown on Drawings.
 - 2. Construct 8-inch diameter PVC perforated extraction well pipes to a maximum depth as shown on the gas extraction well detail Drawing.
 - 3. Drilling equipment and tools will be steam cleaned prior to being mobilized onto the site and before leaving the site.
 - 4. Meet all health and safety requirements prior to beginning Work as well as for the duration of the project.
 - 5. Disposal of waste material on-site.
- B. These Specifications are intended to give a general description of what is required but do not cover all variations that may occur during extraction well construction. The Specifications are intended to cover the successful completion of the gas wells as herein specified, whether every detail is specifically mentioned or not.
- C. Related Sections
 - 1. Section 31 23 23 Liner and Cover Soil Materials

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society for Testing and Materials (ASTM).
 - a. ASTM D2464: Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - b. ASTM D2466: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

- c. ASTM D2467: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

1.03 SUBMITTALS

- A. The following documentation shall be submitted by the Contractor to the Engineer for approval prior to construction.
 - 1. A complete list of construction materials and supplies including the name of the manufacturer, for the items listed below:
 - a. PVC pipe and fittings
 - b. Perforated screen
 - c. Drilling fluid additives, if necessary
 - d. Gravel pack material samples
 - 2. The source and location of potable water supply, written authorization of the suppliers, method of transporting and containing the potable water, if necessary.
- B. During all gas well drilling, a daily detailed driller's report shall be maintained and submitted as requested by the Engineer. The report shall give a complete description of all subsurface material encountered, number of feet drilled, number of hours on the job, shutdown due to breakdown, feet of screen and casing set and other pertinent data requested by the Engineer.
- C. During drilling of each borehole, the CONTRACTOR shall maintain at the extraction well site a complete log setting forth the following (ENGINEER will completed duplicate logs as a QC measure):
 - 1. The reference point of all depth measurements.
 - 2. The depth at which each change of material occurs.
 - 3. The identification of the material.
 - 4. The depth interval of the material.
 - 5. Other pertinent data requested by the Engineer.
- D. Upon completion of each gas well, the CONTRACTOR shall also submit to the ENGINEER a report to include the following:
 - 1. The name and location of the job.

2. The date of the pilot and borehole drilling (start and finish).
3. Gas well number and coordinates.
4. Surface elevation.
5. Sample numbers and depths of natural soil, if encountered, or saturated conditions.
6. The depth or location of any lost drilling fluid, drilling materials, or tools.
7. Amount of drilling fluid and additives, if used.
8. The depth, diameter, and description of the gas well casing and screen.
9. The total depth of the completed gas well.
10. The nominal hole diameter of the pilot and borehole.
11. Amount and size description of gravel pack and sand/bentonite used.
12. The amount of grout (number of bags used).
13. Other pertinent data requested by the Engineer.

1.04 QUALITY ASSURANCE

- A. The Contractor responsible for constructing the gas wells shall employ only competent workers for the execution of this Work and all such Work shall be performed under the direct supervision of an experienced driller satisfactory to the Engineer.
- B. The driller shall be capable of identifying subsurface conditions and maintaining complete and current logs and daily notes for the gas extraction well completion reports.
- C. The Contractor shall complete the Work described in accordance with the applicable portions of the Rules per 29 CFR 1910, OSHA Standards for Hazardous Waste site workers.
- D. The driller shall be trained and experienced as required by OSHA for hazardous waste site workers.
- E. The driller's assistant(s) shall be trained and experienced as required by OSHA for hazardous waste site workers.

1.05 DESCRIPTION OF THE GAS EXTRACTION WELL

- A. The gas wells shall be 8 inches in diameter slotted PVC, installed at various depths shown on the Drawings in the 36-inch diameter boreholes.

- B. Gas wells shall be drilled at the locations and depth as indicated on the Drawings, unless otherwise approved by the Engineer. Depths may vary depending on the findings of the pilot boring.
- C. Alternate drilling or construction methods may be approved by the ENGINEER where justified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All parts and materials shall be properly protected so that no damage, deterioration, or contamination will occur from time of shipment until installation is completed.
- B. If in the opinion of the Engineer, parts and materials are damaged, deteriorated, or contaminated before acceptance of gas well the material and/or the gas well will be rejected. The Contractor shall replace the labor, parts, and materials at no additional cost to the Owner.
- C. Materials shall be stored to ensure preservation of their quality and fitness for Work. When deemed necessary, they shall be placed on wooden platforms or other hard clean surfaces and not on the ground. Stored materials shall be located so as to facilitate prompt inspection.

1.07 CONDITIONS AND HAZARDS AT THE SITE

- A. Typical subsurface conditions at the landfill may include very loose fine sands, municipal refuse, methane, leachate, and obstructions such as large, buried items.
- B. The CONTRACTOR shall be aware that unfavorable subsurface geologic conditions may exist at the site selected for the gas wells, which could cause loss of circulation and collapse of the formation.
- C. The information concerning the subsurface conditions and problems of which the Contractor is advised is for the sole purpose of assisting the Contractor in the preparation of his or her bid. The Owner, Engineer, and their consultants do not guarantee the accuracy and the conditions and concerns stated above. These conditions and concerns may not be indicative of the conditions at the site.
- D. In the event subsurface conditions are found extraordinarily different from what has been indicated, the Contractor shall promptly and before such conditions are disturbed, notify the Engineer verbally and in writing of such conditions.
- E. The Contractor must take necessary precautions to prevent damage to any aboveground or below ground existing structures. Notify the Engineer of any damaged underground structures and make repairs or replacements before backfilling.

- F. During the progress of construction, it is expected that minor relocations of the Work will be necessary. Such relocations shall be made only by direction of the Engineer. If obstructions are encountered during drilling, notify the Engineer verbally and in writing before continuing with the construction in order that the Engineer may make such field revisions as are necessary. If the Contractor shall fail to so notify the Engineer when an obstruction is encountered and shall proceed with the construction despite this interference, he or she shall do so at his or her own risk.
- G. The Contractor is required to perform all required health and safety monitoring to comply with the Health and Safety Plan. The Contractor shall supply the results of all monitoring activities to the Engineer when requested.
- H. Contractor will stake proposed well locations and provide time for Owner to confirm each well location and verify the depth of each borehole prior to drilling.

If necessary, record offset distance from survey stake to final location of borehole. Offset locations shall be approved by Owner prior to drilling.

Some drilling may occur on steep side slopes of the landfill. Contractor will provide necessary soils and grading to construct work pad for drilling equipment. Contractor is responsible for hauling, placing, and removal of soil work pad; and for salvaging and replacing topsoil at work pad location.

Contractor will provide equipment necessary to move drill rig if wet weather conditions are encountered.

- I. Excavated Refuse Disposal: Contractor to load, haul, and dispose of drilling spoils on-site in Owner identified areas.

1.08 NOTIFICATION

- A. The Contractor shall supply to the Engineer, in writing at the preconstruction conference, the proposed Work schedule, including the following:
 - 1. The starting date of the gas well construction.
 - 2. The dates and order of drilling.
 - 3. The completion date of drilling.
 - 4. Any anticipated Work interruptions of duration greater than 24 hours with exception of weekends and holidays.
- B. The Contractor shall notify the Engineer, in writing, at the preconstruction conference, the number of drilling rigs and personnel to be used on the project. Any change in the number of rigs and personnel shall require written notification of the Engineer 48 hours prior to the change.

- C. The Contractor shall notify the Engineer 24 hours prior to start of any drilling activities.
- D. No Work shall be performed by the Contractor without completing the notification requirements specified above.

1.09 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 PIPE

- A. Gas Extraction Well
 - 1. Well Pipe: 8-inch diameter non-perforated Schedule 80 PVC.
 - 2. Slotted Well Screen: 8-inch diameter slotted Schedule 80 PVC pipe with socket-type PVC cap.
 - 3. Slots, as shown on the Drawings.

2.02 FITTINGS

- A. Fittings shall be as designated in ASTM D2467 or D2466, except where threaded as shown on the Drawings and as designated in ASTM D2464 and shall be compatible with the pipe where installed.

2.03 AGGREGATE

- A. As defined in Section 31 23 23 Liner and Cover Soil Materials.

2.04 CAPS

- A. The bottom of each extraction well casing shall be fitted with a PVC cap.

2.05 BENTONITE

- A. Bentonite pellets or chips will be used in the installation of the gas extraction well as shown on Drawings.

2.06 WIRE MESH GRATE

- A. Each wire mesh grate shall meet the following requirements:
1. ¼" thick welded bars
 2. Galvanized or epoxy coated (to prevent corrosion)
 3. Minimum 5' x 5' in size
 4. Minimum of 6" x 6" for each opening.

PART 3: EXECUTION

3.01 GAS WELL BOREHOLE DRILLING

- A. A minimum 36-inch diameter borehole will be drilled at each site for a gas extraction well to the approximate depth as shown on Drawings, or 3 feet above the encountered water table, whichever is higher.
- B. The Contractor shall drill the 36-inch boreholes for the gas extraction wells using an open bucket method with a drill rig with sufficient torque and weight capable of boring to the required depths, or other methods as approved by the Engineer. Material removed from this landfill as a result of borehole drilling will be disposed of onsite in Owner designated area.

3.02 DRILLING OBSTRUCTION PROTOCOL

- A. If there is a drilling obstruction encountered in the landfill that, despite the best reasonable efforts of the Contractor, cannot be penetrated after one hour of drilling, a minimum of five (5) feet in vertical depths has not been reached in that hour, the Contractor shall request relief from the Owner or Engineer from completion of the well. The Owner or Engineer shall be the sole authority for deciding one of the following:
1. The borehole shall be abandoned. The Contractor shall backfill the well to the pre-drilled condition or to the satisfaction of the Owner or Engineer. The Contractor shall be compensated for the abandonment of the well as indicated in the contract documents. At this time, the drilling will commence for the same well approximately 25-50 feet from the current location. The new location shall be agreed upon by the Owner and Engineer. The drilling depth shall be verified at this time by the Surveyor and Engineer.
 2. The well shall be accepted at the obstructed depth agreed upon by the Owner and Engineer. The well shall be completed at this new depth. Compensation shall be for the modified footage of the well.

3. The Contractor will stay at the current location per the order of the Owner. At this time, after the one-hour time period, the Contractor will continue drilling at an hourly rate and the contract price for drilling of the borehole will no longer be taken into consideration.

3.03 WELL PIPE INSTALLATION

- A. The string of 8-inch diameter pipe shall be secured approximately 24 inches above the bottom of the borehole to allow the gravel pack to form beneath the screen as shown on the Drawings. The screen shall extend as shown on the Drawings.
- B. Every effort shall be made on the part of the Contractor to assure casing plumbness and centralization in the borehole.
- C. The installation of plastic pipe for casing and screen shall be strictly in accordance with the manufacturer's technical data and printed instructions.

3.04 AGGREGATE AND FILL MATERIAL INSTALLATION

- A. All gravel pack installation shall be performed in the presence of the Engineer. The gravel pack shall be installed in the annular space by tremie pipe, or an alternate manner approved by the Engineer which will avoid bridging. The gravel pack shall have a minimum installed diameter of 30-inch. The Contractor shall tamp the top of the gravel pack before placing the bentonite plug.
- B. All installation of the gravel pack, and fill material must be performed in the presence of the Engineer.

3.05 WIRE MESH GRATES

- A. Wire mesh grates shall be installed at each of the gas extraction well locations as shown on Drawings.
- B. Each wire mesh grate shall be installed at a depth of 6 inches below grade to prevent tripping.
- C. Installation should be sequenced prior to wellhead installation to avoid unnecessary removal and replacement of the wellhead apparatus.

3.06 PROTECTION AND SITECLEAN-UP

- A. At all times during the progress of the site Work, the Contractor shall use all reasonable precautions to prevent either tampering with the gas wells or the entrance of foreign material.
- B. All gas wells shall be protected by the provision of temporary support or other means of protection approved by the Engineer. The Contractor shall replace any which are damaged by construction operations at the Contractor's expense.

- C. The Contractor shall protect any open boreholes overnight with an oversized piece of plywood or other plate to protect against anything falling into the well.

- D. Immediately upon completion of site Work, The Contractor shall remove all equipment, materials and supplies from the site of the Work, remove all surplus materials and debris, fill in all holes or excavations and restore any disturbed areas to their original condition. The Contractor shall properly dispose of the refuse and material removed from the borehole. The disposed material shall be covered daily with a minimum of 6 inches of soil. Waste placed in the active disposal area during regular landfill hours will be covered in accordance with the normal landfill operations. The Contractor is responsible to provide and install the daily cover for waste placed in the active disposal area beyond the regular landfill working hours. Failure to comply with these requirements shall give authority to other Contractors or Workers, required by the Engineer, to enter upon the site and complete the clean-up, grading, etc. The cost of this Work shall be deducted from money due or become due to the Contractor for construction of the wells.

END OF SECTION 43 10 01

SECTION 43 10 02

GAS EXTRACTION WELLHEAD ASSEMBLY

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes the minimum requirements for the supply and installation of gas extraction system wellheads.
- B. It is the intent of this Specification that the gas extraction wellhead assembly be supplied as a prefabricated and shop tested assembly from QED Environmental Systems.

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section.
- B. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society of Testing Materials (ASTM).
 - a. ASTM D1784: Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - b. ASTM D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
 - c. ASTM D1869: Standard Specification for Rubber Rings for Fiber-Reinforced Cement Pipe
 - d. ASTM D2467: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
 - e. ASTM D2855: Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
 - 2. American National Standards (ANSI)
 - a. ANSI B16.1: Cast Iron Pipe Flanges and Flanged Fittings
 - b. ANSI B16.5: Pipe Flanges and Flanged Fittings

1.03 SUBMITTALS

- A. The following documentation shall be submitted by the Contractor to the Engineer for approval prior to construction.
 - 1. Manufacturer's Installation Instructions
 - 2. Isometric Drawings showing the dimensions and components of the wellhead and adapters where applicable.
 - 3. Manufacturer's Installation and Operation Manual.
 - 4. Manufacturer's Warranty Information.

1.04 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 GENERAL

- A. The landfill gas collection system wellheads shall be QED Environmental Systems and shall consist of wellhead piping, flow control gate valve, gas temperature gauge port, quick connect gas sampling, static and impact pressure ports, flexible hose connector, PVC union disconnect and dust cap.
- B. The equipment shall be capable of withstanding the rigors of landfill gas recovery application including internal high vacuum, weathering, gas constituent and ultraviolet light exposure.
- C. The wellhead shall be airtight and leak free and shall be height adjustable in the field using adapter bushings.
- D. It is the intent of this Specification that the wellhead assembly shall be supplied as a complete manufactured unit.

2.02 APPLICABLE CODES AND STANDARDS

- A. Pipe Material and Fittings
 - 1. PVC piping used in the manufacture and installation of the wellhead shall meet the requirements of ASTM D1785 for Schedule 80 PVC pipe.
 - 2. PVC fittings used in the manufacture and installation of the wellhead shall meet the requirements of ASTM D2467 for PVC socket type fittings.

3. PVC joint connections shall meet the requirements of ASTM D2855 for solvent-cemented PVC joints.
4. Flanges used for installation of the wellhead on existing well casings made from non-PVC material shall conform to ANSI B16.1 or ANSI B16.5.
5. Adapters shall conform to applicable parts of ASTM D1869.

B. Valve Material

1. Material used to manufacture the flow control valve bodies shall meet the requirements of ASTM D1784 for rigid PVC compounds.

2.03 WELLHEAD SIZE

| | | |
|----|---------------------------|---|
| A. | <u>Nominal Size</u> 2" | <u>Use</u> Vertical Extraction Wells |
|----|---------------------------|---|

2.04 MATERIALS

A. Unions

1. The wellhead shall have a PVC union fitting upstream of the flow control gate valve.

B. Fittings

1. PVC fittings shall be Schedule 80 socket fittings.

C. Sample Ports

1. Sample ports shall be 1/4" brass laboratory petcock type.

D. Flow Measurement Device

1. QED Environmental Systems 2" diameter offset orifice or approved equivalent.

E. Valves

1. As specified in Section 31 23 23 Liner and Cover Soil Materials.

F. Kanaflex hose as shown on Drawings.

1. Sample ports shall be 1/4" brass laboratory petcock type.

G. Wellhead connection kit – as shown on Drawings.

PART 3: EXECUTION

3.01 INSTALLERS

- A. Work shall be performed in accordance with the Manufacturer's Written Instructions and installation detail drawings.

3.02 INSTALLATION

A. Above Grade Installation

1. The wellhead shall be handled according to Written Instructions supplied by the Manufacturer.
2. The wellhead shall be installed such that the measurement tube assembly is concentric with the well casing.
3. The wellhead shall be installed on the well casing in accordance with the Manufacturer's Written Instructions. Where the well casing is made of PE or other material, matching 125 lb. or 150 lb. flat face flanges conforming to ANSI B16.1, B16.5 or the appropriate adaptor kit from the manufacturer, shall be installed between the casing and wellhead.
4. Where a flex connection is used, the flex connection shall be installed in accordance with the Manufacturer's Written Instructions. A stainless-steel hose clamp shall be used on both ends of the flex connection.

3.03 TESTING

- A. After installing the wellhead, the following minimum tests shall be performed:
 1. Test static and impact pressure ports.
 2. Test valve.

END OF SECTION 43 10 02

SECTION 43 21 40

LEACHATE PUMPS

PART 1: GENERAL

1.01 SUMMARY

- A. Section includes providing all materials, equipment, and labor to perform the required Work, including, but not limited to:
 - 1. Providing sidewall riser pumps, valves, piping, and appurtenances as required.
 - 2. Providing submersible leachate pumps (located in leachate tanks), valves, piping, and appurtenances as required.
- B. Related Sections
 - 1. 33 90 01 Landfill Leachate Piping and Appurtenances
 - 2. 40 90 00 Instrumentation and Control for Process Systems

1.02 REFERENCES

- A. The following are complete titles of references cited in this Section. The date of the standard is that in effect as of the certification date, unless noted otherwise:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM A48: Standard Specification for Gray Iron Castings
 - b. ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

1.03 SUBMITTALS

- A. Submittals for Review
 - 1. Manufacturer's product data including:
 - a. Pump performance curves; include capacity head curves, brake horsepower (BHP), net positive suction head (NPSH) requirements, operating points, efficiency data, recommended operating range, and variable speed curves.
 - b. Pump materials of construction

- c. Pump motor
- 2. Shop Drawings:
 - a. Pump installation, dimensions, clearance distances, weights, lifting points, guide rail system installation (for submersible pumps), connection details, and other accessories forming part of equipment for the complete operational system.
 - b. Pumps:
 - 1) Name of manufacturer
 - 2) Type of model
 - 3) Design rotative speed
 - 4) Type of pump bearings
 - 5) Size of shafting
 - 6) Impeller diameter
 - 7) Weight of complete assembly
 - 8) Type of seals
 - 9) Materials of component construction
 - 10) Lift out rail system details (for submersible pumps)
 - 11) Clearance requirements for installation as shown on Construction Drawings
- 3. Operation and Maintenance instructions including:
 - a. Pump/motor
 - b. Recommended maintenance requirements and schedule

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store pumps on-site as directed by Owner and per manufacturer's recommendations.

1.05 BASIS FOR COMPENSATION

- A. Compensation for all Work included under this Section shall be as set forth in Section 01 29 00, Measurement and Payment.

PART 2: PRODUCTS

2.01 SUBMERSIBLE SIDEWALL RISER LEACHATE PUMP

- A. Pump :
 - 1. High Density Polyethylene (HDPE) shrouded vertical well pump.
 - 2. All 304 or higher stainless steel construction for wetted parts, hardware and fittings.
 - 3. Rubber parts: Viton or equal.
 - 4. Suitable for use with municipal landfill leachate water contaminated with small amounts of hydrocarbons; suitable for inclined installation in sidewall riser pipe (3H:1V slope) with minimum submergence at the top of the pumping unit as shown on the Drawings.
 - 5. EPG Series 5 Size 4 Wheeled Sump Drainer SurePump, or Engineer approved equal.
- B. Motor:
 - 1. 1 hp, 480v, 3 Phase, 60 Hz.
 - 2. Class1, Division 1 rating for explosive environments.
- C. Motor Lead:
 - 1. Approximately 150 ft., continuous lead without splices between motor and control panel. Confirm in field.
 - 2. Sized for pump installation as shown on the Drawings.
- D. Minimum operating conditions:
 - 1. Primary Operating Condition: 25 gpm @ 32 ft. TDH
- E. Pump Accessories/Appurtenances:
 - 1. 150 ft. stainless steel pull cable.
 - 2. Level sensor mounting slot welded to pump assembly.
- F. Provide 12 pumping units total. All pumps supplied shall be identical.

2.02 SUBMERSIBLE LEACHATE PUMP

- A. This specification is based on Flygt NP 3127 HT3~ Adaptive 489 submersible pump.
- B. Performance Specification:

| | |
|---|--|
| Location/Purpose | Leachate Tank – Submersible Pump to MCES Interceptor or Truck Loadout Facility |
| Type | Submersible motor/pump capable of pumping municipal landfill leachate |
| Minimum Sphere Diameter Passing (in.) | 3 |
| Number of Pumps | 2 (one per tank) |
| Design Conditions | Primary Operating Conditions |
| Flow (gpm) | 162.5 |
| Head (ft) | 55 |
| Minimum Shutoff Head (ft) | 69 |
| Motor Speed (rpm) | 1800 |
| Maximum Horsepower (HP) | 10 |
| Power | 460V/3 Phase/60 Hz |
| Impeller Diameter (mm) | 195 |
| Impeller Type | Semi-open |
| Pump Discharge Elbow (in.) | 4 |
| Guide Rail System | Double guide rail system |
| Pump Model/Product Number (or approved equal) | Flygt NP 3127 HT3~Adaptive 489 |

C. General Pump Considerations:

1. Vibration in excess of the Hydraulics Institute standards shall be sufficient cause for rejection of equipment.
2. Constantly increasing head characteristics from design condition to shutoff head.
3. Capable of operating without overloading electric motor at any point on the curve from shut-off to run out.
4. Pumps operating at lower RPMs may be acceptable subject to approval by Engineer. Pumps operating at higher RPMs shall not be acceptable.
5. Cooled by pumped liquid; capable of running dry without damage to any part of the pump while out of pumped liquid for extended periods.

D. Pump construction:

1. Volute: ASTM A48
2. Shaft: AISI series 400 stainless steel, one-piece integral pump and motor shaft.
3. Stator housing, oil chamber housing, and seal housing: grey cast iron, ASTM A48, Class 35B or better.

4. All rubber parts: Viton or other material compatible with municipal landfill leachate.
 5. External mating surfaces: machined and o-ring sealed, profile gasket sealed, or sealed by an alternative method pre-approved by the Engineer.
 6. Fasteners exposed to the pumped liquids: 316 stainless steel.
 7. Lifting handles: capable of supporting a load at least 50-percent greater than the wet pump weight.
- E. Impeller:
1. Non-clogging impeller.
 2. ASTM A48, Class 35B cast iron.
 3. Impeller bolt: 300 or 400 series stainless steel.
- F. Bearings:
1. Upper radial and lower thrust bearings required.
 2. Grease lubricated with over-greasing protection.
 3. AFMBA anti-friction type with minimum L-10 life of 100,000 hours.
- G. Shaft Seal:
1. Each pump shall be provided with two totally independent, mechanical seals, installed in tandem, each with its own independent single spring system acting in a common direction.
 - a. Sealing shall not depend on the direction of rotation.
 - b. Seal face material: carbon-ceramic, silicon-carbide, or tungsten carbide.
 - c. Seal leak detection probe and warning system that does not shut down the pump when seal failure is detected.
- H. Discharge Elbow:
1. Furnished by the pump supplier, match marked to its respective pump and shipped and crated with the pump.
 2. Cast iron or cast steel and consist of a flange for automatically mating with the pump discharge bowl when the pump is lowered into place.
 3. Long-radius-type elbow with a cast iron or cast steel shoe for anchoring to the sump floor.

4. Seal between the pump volute and discharge shoe shall remain tight and intact under any pump thrust.
5. No pump thrust shall be induced on the guide rails.

I. Motor:

1. Class1, Division 1 rating for explosive environments.
2. Designed to work in tandem with the pump in a submerged condition.
3. Premium efficiency, squirrel-cage, induction-type housed in watertight chamber.
4. Designed for continuous operation in pumped media of 40 degrees C, minimum 15 starts per hour.
5. Service Factor minimum: 1.15. Non-overloading over the entire range of pump curve from shut-off to run-out.
6. Stator windings insulated with Class H for air-cooled motors, Class F for oil-cooled motors.
7. Capable of continuous submergence underwater without the loss of watertight integrity to a depth of 65 feet.
8. Power: 480V, 3-phase, 60 Hz
9. Provided a moisture detection system to detect water intrusion into the stator chamber and into the junction chamber.
10. Provide manufacturer pump protection control module for pump overtemperature and seal failure monitoring.

J. Motor Lead:

1. Sized for pump installation as shown on the Drawings.
2. Submersible cable designed specifically for submersible pump applications and sized according to NEC and ICEA standards for the length of cable required.
3. Length: sufficient for pump installation plus 10 feet. Excess coiled and attached beneath the platform (estimate 150 feet).
4. Outer jacket: oil resistant chloroprene rubber.
5. Capable of continuous submergence underwater without the loss of watertight integrity to a depth of 65 feet.

6. Rated for 600 V and 90 degrees C with a 40 degree C ambient temperature.

7. Approved by UL, CSA, or FM.

K. Pump Accessories/Appurtenances:

1. Guide Rails, Cable Holder, and Lifting Chain

a. Provide double guide system to guide the pump into proper alignment with the discharge elbow.

1) Shall permit easy removal and reinstallation of the pump without the need for personnel to enter the wet well.

b. Guide rail diameter as recommended by pump manufacturer, but not less than 1.5 inches diameter.

c. Guide rail bracing spacing as recommended by the pump manufacturer, but not less than 10 feet.

d. Provide stainless steel cable holder.

e. Provide stainless steel cable rated for no less than twice the pump weight. Cable must be long enough to allow secure tie off when pump is lowered for service.

2. Anchor Bolts:

a. Provide anchor bolts of ample size and strength required to securely anchor each item of equipment in accordance with equipment manufacturer's requirements.

b. Anchor bolt length: sufficient to accommodate a minimum of 1.5 inches of grout beneath the baseplate.

c. Materials: stainless steel unless noted otherwise.

3. Coating:

a. Provide manufacturer's recommended finish system suitable for submerged environments.

b. Provide at least 1 quart of the finish coat material for field touch-up.

L. Provide two pumping units total, one per storage tank. All pumps supplied shall be identical.

2.03 SUBMERSIBLE LEVEL SENSOR

A. See Section 40 90 00, Instrumentation and Control for Process Systems for submersible level sensor requirements.

2.04 SIDEWALL RISER PIPE STAINLESS STEEL DISCONNECT

- A. See Section 33 90 01, Landfill Leachate Piping and Appurtenances for sidewall riser pipe stainless steel disconnect requirements.

2.05 SOURCE QUALITY CONTROL

- A. Products supplied as specified under the specific paragraphs of this Section shall be of the same manufacturer and be identical and interchangeable with products of the same specification and size. Products of the same type, but of different diameter or size, shall be supplied by the same manufacturer.
- B. Contractor shall be responsible for ensuring that the products meeting the requirements of this Section are supplied. Maintain records to establish that products supplied meet or exceed referenced standards as specified in this Section.

PART 3: EXECUTION

3.01 INSPECTION

- A. Contractor shall be responsible for all materials required to provide the products as specified and no defective products will be allowed for installation.

3.02 SUBMERSIBLE SIDEWALL RISER PUMP INSTALLATION

- A. Prior to installation in the sidewall riser, fully assemble the pump/pipe assembly at the surface to confirm that all parts are correct and functional. Disconnect pump and pressure test discharge piping assembly using hydrostatic pressure in accordance with ASTM F714. Use test pressure of 50 psi.
- B. Install pump and related accessories in strict accordance with the Drawings, specifications, manufacturer's recommendations and referenced standards for a complete and operable system.
- C. Place transducer in receptacle on pump. Securely tether the transducer cable and the pump motor cable to the discharge pipe with nylon straps a minimum of 5 places on each pipe section after the couplers are in place.
- D. Verify the pump location within the sidewall riser/sump with Owner or Owner's On-Site Representative to provide adequate submergence. Keep accurate records of the final total length of the discharge pipe/pump assembly. Place a highly visible permanent mark near the upper end of the discharge pipe or coupling and sidewall riser to indicate the correct placement of the pump. Also place marks or words noting that the marked pipe section is the uppermost section to assure that the pump is accurately placed on subsequent installation.

- E. Coil excess cable and store inside of sidewall riser pipe for the sidewall riser pumps. Do not cut cables on any pumps or transducers to shorten.

3.03 SUBMERSIBLE LEACHATE PUMP INSTALLATION

- A. Install pump and related accessories in strict accordance with the Drawings, Specifications, manufacturer's recommendations and referenced standards for a complete and operable system.
- B. Permanently install discharge elbow.
- C. Plumb and properly install and orient guide rails.
- D. Install intermediate supports if required by manufacturer or deemed necessary by Engineer.
- E. Verify the pump location within the leachate collection tank with Owner or Owner's On-Site Representative to provide adequate submergence. Keep accurate records of the final total length of the discharge pipe/pump assembly.
- F. Coil excess cable and store inside of sidewall riser pipe for the sidewall riser pumps. Do not cut cables on any pumps or transducers to shorten.

3.04 PUMP TRAINING

- A. Provide services of an experienced, competent, and authorized representative of manufacturer for a minimum of two (2) hours at the Owner's convenience prior to equipment being operational.
- B. Additional Manufacturer services for starting and adjusting shall be the responsibility of the Contractor.

3.05 PUMP STARTING AND ADJUSTING

- A. Notify Engineer and Owner 48 hours prior to beginning test.
- B. Conduct functional and performance tests on each pump individually.
 - 1. Verify proper operation of the pumping unit.
 - 2. Operate the pump at different flows and pressures, and different speeds over the operating range.
 - 3. Operate the pump at design flow for a minimum of 15 minutes without a shutdown.
- C. Conduct testing only after all pumping equipment, drives, piping and valves, and supporting systems, including controls, and related work, has been completed.

- D. Provide all materials and equipment necessary to conduct the test including any necessary temporary facilities.
- E. Provide a copy of manufacturer's report from all inspections and tests.

3.06 FIELD QUALITY CONTROL

- A. Pumps may be rejected for failure to conform to specification.

END OF SECTION 43 21 40