
APPENDIX F

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

DUNN C&D FACILITY



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**TECHNICAL SPECIFICATIONS
DUNN C&D FACILITY
RENSSELAER, NY**

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DIVISION 1 - GENERAL

SECTION 01000
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. REFERENCE POINTS - Construction reference monuments and benchmarks have been established for use in controlling the construction work. All work shall be constructed based on and in relation to these reference points. The CONTRACTOR shall be responsible for re-establishing any reference points disturbed during construction. Disturbed or destroyed points shall be re-established at the CONTRACTOR's expense, as directed by the OWNER.
- B. SURVEYING - The CONTRACTOR shall be responsible for all surveying required to layout and control their work. The CONTRACTOR shall furnish the OWNER with "Record Drawings" (also referred to as "as-built" drawings) in accordance with Section 01780. All surveys shall use the coordinate system as required by the OWNER.
- C. CONSTRUCTION TOLERANCES - Unless otherwise stated herein, construction tolerances shall be +0.2 feet horizontally, and +0.1 feet vertically. All surfaces shall be reasonably free from irregularities. Slopes or grades shall not be less than specified minimums or greater than specified maximums as shown on the Drawings. Thicknesses of soil components shall be no less than specified and/or shown on the Drawings.
- D. PERMITS - The CONTRACTOR shall be required to obtain all local, state and federal permits related to specific construction equipment or techniques he intends to employ to accomplish the work.
- E. SEDIMENTATION, EROSION CONTROL, AND DEWATERING – The CONTRACTOR shall comply with all requirements for controlling erosion, water pollution, and dust emissions resulting from construction activities; the CONTRACTOR shall be responsible for any fines imposed due to noncompliance. The CONTRACTOR shall review, sign and agree to maintain the site in accordance with the Contract Documents, and the site specific Storm Water Pollution Prevention Plan (SWPPP) prepared for the Work, at a minimum. The OWNER has submitted to New York Department of Environmental Conservation a Notice of Intent (NOI) for the SWPPP for Storm Water Discharges associated with the construction activity, copies of which will be provided to the CONTRACTOR. Notwithstanding the provisions of other Sections of the Technical Specifications, the CONTRACTOR is responsible for developing an Erosion Control Plan implementing the requirements of the SWPPP. Each week,

CONTRACTOR shall provide to the OWNER a summary of all activities performed the previous week in order to comply with the SWPPP, including copies of inspection reports and other documentation.

- F. WORK LIMITS - All clearing, stripping, excavation, backfill, and surfacing shall be done to the lines, grades, and dimensions called for on the Drawings and Specifications unless directed otherwise by the OWNER and/or CERTIFYING ENGINEER. All work done beyond designated limits without prior approval shall be corrected to the OWNER's satisfaction, at no additional cost to the OWNER.
- G. PROTECTION OF EXISTING SERVICES AND WELLS - The CONTRACTOR shall exercise care to avoid disturbing or damaging the existing monitoring or observation wells, manholes, electrical poles and lines, permanent drainage structures, leachate forcemains, temporary utilities and structures, or items which exist at the site. If the CONTRACTOR encounters any unexpected underground utilities during the course of the work, the CONTRACTOR shall immediately inform the OWNER who will determine whether or not the utility is active. If the work requires the CONTRACTOR to be near or cross known utilities, the CONTRACTOR shall carefully uncover, support and protect these utilities and shall not cut, damage, or otherwise disturb them without prior authorization from the OWNER. All utilities or wells damaged by the CONTRACTOR shall be immediately repaired by the CONTRACTOR to the satisfaction of the OWNER, and no additional cost to the OWNER.
- H. EXCAVATED SOILS - Clean soils excavated during construction activities may be utilized for backfill only with the approval of the OWNER and/or the CERTIFYING ENGINEER.
- I. EXPLOSIVES - The use of explosives for demolition or excavation will not be permitted without prior written approval of the OWNER. If explosives are required to complete the job, the responsibility of any required permits and/or any required notifications to local, state or federal authorities is the responsibility of the CONTRACTOR.
- J. BURNING - The burning of any materials at the site will not be permitted without prior written approval of the OWNER. The responsibility of any required permits and/or any required notifications to local, state or federal authorities is the responsibility of the CONTRACTOR.
- K. TEMPORARY ROADS - The CONTRACTOR shall be responsible for constructing and maintaining all temporary roads that may be required in the execution of their work. Material laydown areas shall be designated, prepared and maintained by the by the CONTRACTOR. Material laydown areas shall be approved by the OWNER.

- L. ACCESS ROADS – The CONTRACTOR shall be responsible for cleaning any and all soil materials deposited on on-site access roads and public roadways by project-generated traffic. The CONTRACTOR shall maintain on site or maintain access to a broom or vacuum-type street sweeper for this purpose. CONTRACTOR shall routinely inspect all access points to public roadways by project-generated traffic to ensure there is no off-site tracking of materials. CONTRACTOR shall clean any soil deposited on off-site roadways to the satisfaction of the OWNER as soon as possible upon becoming aware of such an occurrence, but no later than one (1) hour after becoming aware of such an occurrence.
- M. CONSTRUCTION WATER - The quality of construction water used to accomplish construction work is crucial due to the nature of the facilities being constructed and environmental monitoring requirements imposed on the site. The CONTRACTOR may obtain water for general construction and dust control purposes from the reservoir between the north and south pits or other location on-site approved by the OWNER. The CONTRACTOR shall not add substances (such as soap) to construction water. The CONTRACTOR shall utilize measuring devices that allow the volume of water used to be tracked.
- N. COOPERATION - The CONTRACTOR shall cooperate with all other parties engaged in project-related activities to the greatest extent possible. Disputes or problems should be referred to the OWNER for resolution.
- O. FAMILIARIZATION - The CONTRACTOR is responsible for becoming familiar with all aspects of work and the site prior to performing the work.
- P. SAFEGUARDS - The CONTRACTOR shall provide and use all personnel safety equipment, barricades, guardrails, signs, lights, flares, and flagmen as required by OSHA, state, or local codes and ordinances. The CONTRACTOR shall be responsible for any fines imposed due to violation of any laws and regulations relating to the safety of the CONTRACTOR's personnel. The CONTRACTOR shall ensure all subcontractors comply with this requirement.
- Q. CLEAN-UP - The CONTRACTOR shall be responsible for general housekeeping during construction. Upon completion of work, the CONTRACTOR shall remove all of their equipment, facilities, construction materials and trash. All disturbed areas shall be re-vegetated or otherwise put into a condition satisfactory to the OWNER.
- R. SECURITY - The CONTRACTOR is responsible for the safety and condition of all of its tools and equipment. The OWNER and OWNER's agents will not be responsible for lost or stolen materials or equipment.

- S. HEALTH AND SAFETY TRAINING - The CONTRACTOR shall provide necessary health and safety training for all of the CONTRACTOR's and subcontractors on-site personnel in accordance with applicable local, state, and federal regulations. The CONTRACTOR and its subcontractors shall attend the OWNER'S health and safety training program. The OWNER may require evidence of health and safety training at any time for any of the CONTRACTOR's personnel and subcontractors working on site.
- T. EXCLUSION AREAS - The CONTRACTOR's personnel shall not enter any areas on-site identified with signs as exclusion areas without approval of the OWNER.
- U. WORK HOURS & DAYS – Work shall not begin before 6:30 a.m. and all work must end by 5:30 p.m., Monday through Friday. Work shall not begin before 8 AM and must end by 4 P.M. on Saturdays. No work will be permitted on Sundays or federal holidays. Work that does not generate noise above ambient levels at the property line may be performed at times outside these restrictions with the prior approval of the OWNER.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 01120
ENVIRONMENTAL PROTECTION PLAN

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Environmental requirements.
 2. Protection of soil and water resources.
 3. Spillages.
 4. Debris disposal.
 5. Dust, odor, and noise control.

1.02 SUBMITTALS

- A. Environmental Protection Plan
1. Submit prior to start of work. Work shall not commence until submittal is approved.
 2. Plan shall address protection of soil and water resources, debris disposal, dust control, odor control, noise control and spill control.
 3. Approval of the plans for environmental protection shall not relieve the CONTRACTOR of any responsibility for adequate and continuing control of potential environmental impacts.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Perform all Work while minimizing all potential environmental impacts on, but not limited to the air, water, and land.
- B. Minimize all environmental impacts in accordance with all applicable federal, state and local laws and regulations.

1.04 PROTECTION OF SOIL OUTSIDE WORK LIMITS

- A. Soil outside the limits of work performed under this Contract shall not be disturbed. Confine construction activities to areas defined by the Drawings or Specifications. Assure that any potential contaminated material does not migrate outside the limits of work.
- B. Disruption of soil beyond that specifically called for in the Contract Documents will not be permitted without the prior approval of the OWNER. CONTRACTOR shall not perform any unauthorized disruption of soil and shall be responsible for restoring such disruptions, including handling of any wastes generated there from at no additional cost.

1.05 PROTECTION OF WATER RESOURCES

Do not discharge waste materials to surface or groundwater. Comply with all applicable federal, state and local laws concerning pollution of surface and ground waters.

1.06 STORMWATER CONTROL

- A. Notwithstanding the provisions of other Sections of the Technical Specifications, the CONTRACTOR is responsible for developing an Environmental Protection Plan implementing the requirements of the site specific Storm Water Pollution Prevention Plan (SWPPP), a copy of which will be available to the CONTRACTOR.
- B. Each Monday, CONTRACTOR shall provide to the OWNER, a summary of all activities performed the previous week to comply with the SWPPP, including copies of inspection reports and other documentation.

1.07 SPILLAGES

- A. Take all necessary measures to ensure that no accidental contamination of the soil, groundwater, or other uncontaminated areas will occur from any of the activities required to perform the Work or from equipment or materials used to perform the Work. Report all spills to OWNER immediately. Take corrective action immediately, using approved emergency response and spill containment techniques in accordance with CONTRACTOR's Environmental Protection Plan and Health and Safety Plan (Section 01525).

1.08 DEBRIS DISPOSAL

- A. Dispose of all waste materials in accordance with the Contract Documents, except as otherwise directed by the OWNER. If any waste material is placed in unauthorized areas, immediately remove the material and restore the area to the original undisturbed condition.

1.09 DUST CONTROL

- A. As necessary, implement dust control measures to adequately protect the public, employees of CONTRACTOR, CERTIFYING ENGINEER, and OWNER. See Section 01560 for details.

1.10 ODOR CONTROL

- A. As necessary, implement odor control measures to adequately protect the public and employees of CONTRACTOR, CERTIFYING ENGINEER, and OWNER. See Section 01560 for details.

1.11 NOISE CONTROL

- A. As necessary, implement noise control measures to adequately protect the public and employees of CONTRACTOR, CERTIFYING ENGINEER, and OWNER. See Section 01560 for details.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION**3.01 SOIL AND WATER**

- A. Install barriers (e.g., silt fence, straw bale, diversion berms, temporary pipes, or other) as necessary to prevent migration of contaminated materials into or outside the work area limits (see Section 02100 for details).

END OF SECTION

SECTION 01200
PROJECT MEETINGS AND ADMINISTRATION

PART 1 - GENERAL

1.01 PRE-CONSTRUCTION CONFERENCE

- A. The OWNER will schedule and conduct one pre-construction conference prior to the commencement of any work at the site, to which all interested agencies will be invited to discuss their interests and requirements relating to the project. CONTRACTOR and all subcontractor representatives shall attend.

1.02 CONSTRUCTION PERIOD MEETINGS

- A. Construction period meetings will be conducted at the site at weekly intervals or at a frequency designated by the OWNER. These meetings shall be attended by the OWNER, CONTRACTOR, ENGINEER and any others that are invited by these people.
- B. The agenda of these project meetings will include reports on CONTRACTOR construction progress, the status of submittal reviews, the status of CONTRACTOR information requests, and any general business. The meetings will be conducted by the OWNER. OWNER shall keep and distribute minutes of the proceedings.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

SECTION 01330
SUBMITTALS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section contains requirements for administrative and work related submittals such as construction progress schedules, Shop Drawings, test results, operation and maintenance data, construction photographs, and other submittals required by Contract Documents.

1.02 COMPUTER BASED SUBMITTAL SYSTEM

- A. OWNER may elect to utilize a computer-based system (such as Sharefile) for managing the submittal process. OWNER will provide CONTRACTOR with instructions and software access prior to the implementation of such a system. This specification section may be revised by the OWNER prior to initiating the computer-based system.

- B. Submittal for Review:

Prepare and submit five (5) copies of each submittal for the OWNER's, or their designated representatives', review in accordance with requirements of the Contract Documents. Within two weeks of receipt by OWNER, Submittals for Review will be determined to be:

1. ACCEPTED
2. ACCEPTED AS NOTED (WITH CONDITIONS)
3. NOT ACCEPTED
4. REVISE AND RESUBMIT

and will be stamped as such. Submittals stamped REVISE AND RESUBMIT shall be re-submitted in accordance with changes or corrections noted on the original submittal.

- C. Submittal for Record:

Submit required materials for inclusion into the OWNER's records. Submittal materials may or may not be reviewed by OWNER and/or CERTIFYING ENGINEER.

1.03 CONTRACTOR PLANS

- A. The CONTRACTOR(S) shall prepare and submit five (5) copies of the required plan to the OWNER for review prior to the commencement of construction.

The Plans to be submitted include:

1. Construction Schedule (see Section 01310)
2. Environmental Protection Plan (see Section 01120)
3. Health and Safety Plan (see Section 01525)

1.04 SHOP DRAWINGS AND SAMPLES

- A. Shop Drawings, product data, and samples shall be submitted as required in individual specification sections.
- B. The CONTRACTOR shall maintain an updated submittal register identifying all required project submittals and current status for each submittal. The submittal register shall be updated and presented to the OWNER on a weekly basis.
- C. Shop Drawings, product data, and samples shall be submitted as required in individual specification sections.
- D. The CONTRACTOR's responsibilities:
1. Review shop drawings, product data, and samples prior to submittal.
 2. Determine and verify:
 - a. Field measurements.
 - b. Field construction criteria.
 - c. Catalog numbers and similar data.
 - d. Conformance with specifications.
 3. Coordinate each submittal with requirements of the Work and Contract Documents.
 4. Notify the OWNER in writing, at the time of the submittal, of deviations from requirements of Contract Documents.

5. Begin no fabrication or work requiring the submittals until return of the submittals with the OWNER's approval/comments.
6. Designate in the construction progress schedule, dates for submittal and receipt of reviewed Shop Drawings and samples.
7. Submittals shall contain
 - a. Date of submittal and dates of previous submittals.
 - b. Project title and number.
 - c. Contract identification.
 - d. Names of:
 - i. The CONTRACTOR(S)
 - ii. Supplier
 - iii. Manufacturer
 - iv. Summary of items contained in the submittal.
 - v. Identification of the product with identification numbers and the Drawing and Specification section number
 - e. Clearly identified field dimensions.
 - f. Details required on the Drawings and in the Specifications.
 - g. Manufacturer, model number, dimensions, and clearances where applicable.
 - h. Relation to adjacent or critical features of the Work or materials.
 - i. Applicable standards, such as ASTM or Federal Specification numbers.
 - j. Identification of revisions on re-submittals.
 - k. The CONTRACTOR's stamp, signed, certifying to review of the submittal, verification of the products, field measurements, field construction criteria, and coordination of information within the submittal with requirements of work and Contract Documents.

8. Re-submittal Requirements:
 - a. Corrections or changes in submittals required by the OWNER or CERTIFYING ENGINEER. Re-submittals are required until all comments by the OWNER or CERTIFYING ENGINEER are addressed.
9. Shop Drawings and Product Data:
 - a. Revise initial drawings or data and resubmit as specified for initial submittal.
 - b. Indicate changes made other than those requested by OWNER or CERTIFYING ENGINEER.
 - c. Distribute reproductions of Shop Drawings and copies of product data which have been accepted by the OWNER to:
 - i. Job site file.
 - ii. Record documents file.

1.05 TEST RESULTS AND CERTIFICATION

- A. Results of tests conducted by the CONTRACTOR(S) on materials or products shall be submitted for review so they may be included in the project record.
- B. Certification of products shall be submitted for review so they may be included in the project record.

1.06 SUBMITTAL REQUIREMENTS

- A. Provide complete copies of required submittals as follows:
 1. Construction progress schedule.
 - a. Five (5) copies of initial schedule.
 - b. Five (5) copies of each revision.

2. Schedule of values.
 - a. Five (5) copies of initial schedule.
 - b. Five (5) copies of each revision.
3. Shop drawings: five (5) copies.
4. Certification test results: five (5) copies.
5. Other required submittals:
 - a. Five (5) copies if required for review.
 - b. Five (5) copies if required for record.
6. Deliver the required copies of the submittals to the OWNER.

END OF SECTION

SECTION 01450
CONTROL OF WORK

PART 1 - GENERAL

1.01 RESPONSIBILITIES OF PARTIES

- A. OWNER - In the context of the project organization, OWNER is responsible for facility administration, regulatory oversight, accounting, purchasing, etc. On-site construction activities are monitored for the OWNER by OWNER's representatives, CERTIFYING ENGINEER, and CQA OFFICER.
- B. CONTRACTOR - CONTRACTOR is responsible for implementing and ensuring the completion of the work. CONTRACTOR is responsible for subcontracting all work required (as needed) to complete the project and producing Record Drawings delineating the construction area and elevations. The CONTRACTOR reports to the OWNER, but may communicate daily with the CERTIFYING ENGINEER and CQA OFFICER.
- C. CERTIFYING ENGINEER - The CERTIFYING ENGINEER is responsible for the design of the project and shall review any significant design changes or modifications. The CERTIFYING ENGINEER will decide all questions that arise regarding the interpretation of the Drawings and Specifications. The CERTIFYING ENGINEER reports to the OWNER. The CERTIFYING ENGINEER may communicate directly with the CONTRACTOR and CQA OFFICER to receive information. The CERTIFYING ENGINEER is responsible for preparing a final report documenting construction in accordance with the requirements of the New York State Department of Environmental Conservation.
- D. CQA OFFICER - The CQA OFFICER is responsible for observing construction activities on-site. The CQA OFFICER will collect all material certifications from the CONTRACTOR. The CQA OFFICER will also manage the activities of on-site construction observation and will be responsible for reviewing all Drawings and Specifications. The CQA OFFICER is responsible to coordinate with the CERTIFYING ENGINEER for preparing a final report documenting construction in accordance with the requirements of the New York State Department of Environmental Conservation.

The CQA OFFICER reports to the OWNER. The CQA OFFICER may communicate directly with the CONTRACTOR and CERTIFYING ENGINEER to coordinate activities and receive information.

1.02 INTERPRETATION OF PLANS AND SPECIFICATIONS

- A. Should it appear that the work to be done or any matters relative thereto are not sufficiently detailed or explained in the Drawings and Specifications, the CERTIFYING ENGINEER will further explain or clarify, as may be necessary. In the event of any questions arising respecting the true meaning of the Drawings and Specifications, the matter shall be referred to the CERTIFYING ENGINEER, whose decision thereon shall be final.
- B. The CONTRACTOR shall provide the OWNER with a minimum of three (3) days advance notice that interpretation pertaining to the plans or specifications is requested.

1.03 TEMPORARY SUSPENSION OF THE WORK

- A. The OWNER or their designated representative shall have the authority to suspend the work wholly, or in part, for such period as the OWNER may deem necessary, due to unsuitable weather, nuisance conditions caused by the work, unsafe work practices, or to such other conditions unfavorable for the suitable execution of the work.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 01500**CONSTRUCTION FACILITIES AND TEMPORARY UTILITIES****PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Furnish, install and maintain temporary utilities required for construction. Remove all temporary utilities on completion of Work.
- B. Furnish, install and maintain suitable barriers as required to prevent public entry, and to protect the Work, existing facilities, trees and plants from construction operations; remove when no longer needed, or at the completion of Work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with all federal, state and local electric codes.
- B. Comply with federal, state and local codes and regulations and with utility company requirements.

PART 2 - PRODUCTS**2.01 MATERIALS, GENERAL**

- A. Materials must be new and must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 CONSTRUCTION LIGHT AND POWER

- A. The CONTRACTOR shall make the necessary arrangements to provide and maintain temporary electric service during the construction period. All current consumed will be paid for by the CONTRACTOR. CONTRACTOR shall be responsible for all local permits and inspections associated with temporary electric services.
- B. The electrical service shall be of sufficient capacity and characteristic to supply the proper current for the various types of pumps and tools with motors, lights, temporary office trailers, and other required work. All necessary temporary supports, connections for utility wiring, panel boards, outlets, switches, lamps, lamp holders, circuit protection devices, controls, and accessories shall be provided by the CONTRACTOR.

- C. All wiring materials, devices, etc., installed as part of the construction light and power work, shall be completely removed by the CONTRACTOR as permanent work is completed and the temporary services are no longer required.

2.03 WATER SUPPLY

- A. The CONTRACTOR may obtain water for construction and dust control from a location to be determined at the site. The CONTRACTOR shall not add substance (such as soap) to construction water. The CONTRACTOR shall utilize measuring devices that allow him to track the volume of water used.

2.04 TEMPORARY TELEPHONE SERVICE

- A. CONTRACTOR shall pay all costs for installation, maintenance and removal, and service charges for local telephone service at the construction site for the use of the CONTRACTOR, OWNER's representative(s), CERTIFYING ENGINEER, and CQA OFFICER.

2.05 TEMPORARY INTERNET SERVICE

- A. CONTRACTOR shall pay all costs for installation, maintenance and removal, and service charges for a dedicated high-speed internet service at the site for use by the CONTRACTOR, OWNER's representative(s), CERTIFYING ENGINEER, and CQA OFFICER. Using routers, direct connections, or OWNER-approved secure wireless devices, internet service shall be accessible from each office of the temporary offices.
- B. Internet download speed shall be at least six (6) megabytes and upload speed shall be at least 768 kilobytes.
- C. Internet access may be arranged through the temporary telephone service or the local cable company.

2.06 TEMPORARY SANITARY FACILITIES

- A. The CONTRACTOR shall provide sanitary facilities for use by CONTRACTOR's employees, Subcontractors and the OWNER's representatives, in compliance with laws and regulations, at the site.
- B. Service, clean and maintain facilities and enclosures.
- C. Location of temporary toilets shall be remote from public roadways and shall be locked when construction operations are not underway.

2.07 FIELD OFFICES AND SHEDS

- A. Prior to commencement of construction at the site, the OWNER shall designate the proposed locations of temporary offices, sheds, trailers, storage areas, assembly areas for the CONTRACTOR and temporary access roads.
- B. The CONTRACTOR shall provide and maintain a temporary office at the site of sufficient size for his own general use. CONTRACTOR'S temporary office shall have sufficient room to host construction progress meetings with the OWNER, OWNER'S representative(s), CERTIFYING ENGINEER, CQA OFFICER, and any subcontractors.
- C. The CONTRACTOR shall provide a separate temporary office at the site for use by the OWNER'S representative, CERTIFYING ENGINEER, and CQA OFFICER.

2.08 SPECIAL CONTROLS

- A. Safety
 - 1. The CONTRACTOR, for contract work on this project, shall be responsible for full compliance with the regulations established under the Federal Occupational Safety and Health Act of 1970 (OSHA), including agreements with the U.S. Department of Labor and New York State, and any applicable amendments or revisions thereof, whether associated with the furnishing of equipment and or systems, the furnishing and installation of equipment and/or systems, the construction of facilities, the performance of services or any other similar contractual relation.
 - 2. The CONTRACTOR shall be responsible for any violations of the regulations including payment of costs involved with correction of violations, hearing or appeal procedures, and claims and/or fines associated with said violations.
 - 3. The CONTRACTOR shall comply with applicable requirements of labor laws and regulations of New York State applicable to safety and the authorities having jurisdiction over same.
 - 4. In addition to the Federal and Statutory Safety Laws, the CONTRACTOR shall abide with the American National Standards Association Code A10.2 and the National Safety Council's Accident Prevention Manual, during the construction period.
 - 5. The CONTRACTOR shall maintain adequate protection against damage to life and property involved in the work and shall provide all necessary, protective devices until completion and final acceptance of project by the OWNER.

6. In any emergency threatening life or property, not considered by a CONTRACTOR as coming under the preceding provisions, he may act at his own discretion without authorization by the OWNER.
7. Should a storm watch, advisory, or warning for the site area be issued by a governmental agency, the CONTRACTOR shall take reasonable and customary precautions to minimize danger to persons and to the work.

B. Cleaning and Removal

1. The CONTRACTOR shall be responsible for removal of rubbish and debris of their own making. The CONTRACTOR shall at all times assure that the area within the limits of Contracts and the adjoining areas, including roadways, access areas and storage areas used by him are free of waste and rubbish, snow, ice and water, and he shall clean up the site and remove all rubbish as work progresses. The CONTRACTOR shall remove snow and ice from areas of his own work sufficiently to permit the work to be continued. Where products are delivered in crates, cartons or boxes, the CONTRACTOR installing such products shall remove the resulting rubbish.
2. CONTRACTOR shall maintain a separate dumpster at the site for project-generated wastes. Rubbish shall be removed from the premises regularly and shall not be permitted to accumulate on the premises.
3. The CONTRACTOR shall completely remove all items of temporary facilities, protection and construction provided by them upon completion of the work or when directed by the OWNER.

C. Anti-Pollution

1. The CONTRACTOR shall comply with all applicable anti-pollution laws and regulations, inclusive of applicable motor vehicle anti-idling restrictions.
2. Odors and/or noise shall be controlled so as not to create nuisance conditions.
3. If odors persist, OWNER reserves the right to stop all work until odors have been eliminated or controlled to the satisfaction of the OWNER.
4. Dust, dirt and other airborne waste materials shall be held to a minimum insofar as is practical by temporary enclosures and wetting.

D. Protection

1. During construction and until final acceptance of the work, the CONTRACTOR shall protect and be responsible for all work performed by the CONTRACTOR. CONTRACTOR shall protect their work immediately after installation.
2. Existing trees and other natural growth on the site indicated as remaining shall be protected, as required, from damage or any type that might result from contract operations.
3. The CONTRACTOR shall provide adequate interior barricades to prevent unauthorized access into construction areas.

E. Temporary Access Roads

1. The CONTRACTOR shall provide and maintain for the duration of the work, a means of access to and around the site as required for vehicular traffic and authorized personnel. The means of access shall be constructed to sustain the dimensions and weight of trucks and equipment customarily engaged for use in construction projects of this type and magnitude.
2. The CONTRACTOR shall furnish labor and materials to properly maintain this means of access in an acceptable condition, as determined by the OWNER, at all times regardless of the weather or the condition of the earth.
3. Access roads with ponded water and excessive tire ruts will not be considered acceptable and will be required to be repaired by the CONTRACTOR at no additional cost to the OWNER.

F. Traffic Over Trenches

1. The CONTRACTOR shall construct and maintain suitable and safe crossings over trenches as necessary to care for public and private traffic. The material excavated from trenches shall be compactly deposited along the sides of the trenches or elsewhere in such manner as shall give as little inconvenience as possible.

2.09 SIGNS

- A. Individual advertising signs will only be allowed with the prior approval of the OWNER.
- B. Signs needed to direct deliveries will be allowed with the prior approval of the OWNER.

- C. The CONTRACTOR shall furnish, erect and maintain approved danger, warning and “Keep Out” at places and locations where the placing of such signs is warranted, or directed by the OWNER. All such signs shall be sufficiently illuminated to make them visible at all times.
- D. The CONTRACTOR shall furnish traffic directional signage as necessary to maintain a safe flow pattern for construction vehicles and landfill operational vehicles.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Consult with the OWNER and CERTIFYING ENGINEER, review site conditions and factors that affect construction procedures and construction aids, including adjacent properties and public facilities that may be affected by execution of the work.

3.02 GENERAL

- A. Comply with applicable requirements specified in Sections of Division 2.
- B. Maintain and operate systems to assure continuous service.
- C. Modify and extend systems, as work progress requires.
- D. Relocate construction aids as required by progress of construction, by storage or work requirements of OWNER and other CONTRACTOR(s) employed at the site.
- E. Install facilities in a neat and reasonable uniform appearance structurally adequate for the required purposes.
- F. Maintain barriers during entire construction period.
- G. Relocate barriers as required by progress of construction.

END OF SECTION

SECTION 01525
HEALTH AND SAFETY PLAN/RESPONSIBILITIES

PART 1 - GENERAL

- A. Health and safety aspects of this project shall be the sole responsibility of the CONTRACTOR. The CONTRACTOR shall familiarize himself with the nature and the materials contained in the work area in which he shall be working, and all applicable regulations governing such work.

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall determine the level of personal protection required and provide all appropriate and legally required safety equipment during the performance of all potentially hazardous tasks. This safety equipment shall be provided to the appropriate personnel of the CONTRACTOR and other persons representing or serving the CONTRACTOR whom have a legitimate business at the active construction area. The CONTRACTOR shall control access to the construction area, provide appropriate decontamination facilities and equipment, and shall conduct weekly health and safety meetings for the CONTRACTOR's personnel. The CONTRACTOR shall prepare a detailed health and safety plan for this project.

1.02 PAYMENT

- A. All costs for health and safety equipment shall be included in the contract price. Payment will constitute full compensation for all labor, materials, equipment and all other items necessary and incidental to the performance of the work.

1.03 GENERAL REQUIREMENTS RELATED TO WORK ON LANDFILL SITES

- A. The CONTRACTOR shall be responsible for informing their employees and subcontractors and their employees of the potential danger in working in or near landfills.
- B. The CONTRACTOR is advised that the construction of this project is being performed adjacent to buried wastes and refuse. As these buried materials decompose, they will generate landfill gas (biogas), which normally consists of carbon dioxide (CO₂), methane (CH₄), hydrogen sulfide (H₂S) and other gases, depending on the composition of the buried materials. These gases usually vent to the atmosphere through the cover soil, but may migrate laterally over 1,000 feet to adjacent areas depending on site and weather conditions.

- C. During the work, CONTRACTOR may encounter and may be exposed to waste materials and may encounter leachate (liquids that have percolated through waste).

1.04 POTENTIAL FOR HAZARDS

- A. Landfill gases have the potential to create hazardous conditions if not controlled or recognized. Some of these hazards include:
 - 1. Fires, which may start spontaneously from exposed and/or decomposing refuse.
 - 2. Fires and explosions, which may occur from the presence of methane and/or hydrogen sulfide gases.
 - 3. Landfill gases, which may cause an oxygen deficiency in underground trenches, vaults, conduits, and structures.
 - 4. Hydrogen sulfide, a highly toxic and flammable gas, which may be present.
- B. Possible caving of trenches and excavations when working over or in refuse fills.

1.05 GENERAL SAFETY GUIDELINES

- A. Safeguard measures to protect the worker from the effects of the dangers from hazardous gases include, but are not necessarily limited to:
 - 1. Test the atmosphere
 - 2. Ventilate confined spaces
 - 3. Use appropriate safety equipment
 - 4. Provide backup safety personnel
- B. Before entering a workspace such as a trench, boring, excavation, underground vault, pit or crawlspace, the atmosphere should be tested to detect any adverse environmental conditions. The workspace should be tested for oxygen deficiency, toxic gases, and combustible gases with a gas-detecting instrument. Test instruments should be properly maintained and calibrated. The test should be conducted from top to bottom of the workspace.
- C. When testing the workspace, the presence of explosive gas conditions should be determined first. If this test indicates non-explosive conditions, the presence of asphyxiating (toxic) gases and oxygen deficiency conditions should be determined. Because carbon monoxide, carbon dioxide, hydrogen sulfide or other vapors may

accumulate in the lower levels of the workspace and their presence may not be detected by only testing the upper portions of the workspace, these tests should be performed throughout the workspace.

- D. To safeguard against toxic and combustible gases or oxygen deficiency, a workspace should be thoroughly ventilated before entry and during the entire time workers are in the confined space. Forced ventilation is one measure, and can be started by blowing air into the workspace until the air is suitable for entry.
- E. Ventilation equipment should be placed upwind from the excavation so that emerging gases will not be ignited by the equipment or recycled into the workplace. Ventilation equipment should also be located away from the exhaust of nearby motor vehicles so that the exhaust fumes are not introduced into the workspace. The air discharge hose from the ventilation equipment should be inspected periodically to check that it is not bent or kinked so that air flow to the workspace will not be reduced or restricted.
- F. All personnel should be instructed in the use of appropriate safety equipment that will be utilized during the course of the work. It shall be the responsibility of the CONTRACTOR, to verify that all safety equipment is being used when appropriate.
- G. Prior to any personnel entering a workspace, an additional individual should be positioned outside of the space, but always within eyesight of the personnel within the space, to assist should the workers be overcome by the loss of oxygen.

1.06 SAFETY OFFICER

- A. The CONTRACTOR shall provide a person who will be designated as the Safety Officer. The CONTRACTOR'S Safety Officer shall be thoroughly trained in rescue procedures, and the use of safety equipment and gas detectors. This person should be present at the site all times during working hours and shall have experience with health and safety related to the type of work to be performed for this project.
- B. The CONTRACTOR'S Safety Officer shall have appropriate instruments (detectors) to test for oxygen deficiency and for the presence of landfill gases. A portable gas detector should be available for this purpose. The instrument should have the accessories necessary to monitor the atmosphere at the bottom of excavations. The Safety Monitor should periodically calibrate their instruments, regularly test the excavation areas for safe working conditions, and make appropriate safety equipment available at the site. A record of the use and calibration of the instruments should be maintained at the job site.

- C. The CONTRACTOR'S Safety Officer should have the delegated authority to order any person or worker to follow the safety rules related to landfill gas. Failure to observe these rules should be sufficient cause for removal of the person or worker from the project site.

1.07 SAFETY PROGRAM

- A. Supplemental to the CONTRACTOR's regular safety program, they shall develop and institute procedures to inform all workers, and the public visiting the site, of the potential for the presence of methane and other landfill gases emanating from the natural decomposition of refuse buried at or near the job site, and the importance of safety precautions to provide for the safety of workers and the public. The CONTRACTOR shall also instruct all workers, and maintain strict control on construction activity, so as to protect and maintain the integrity of the gas collection system design features as they are installed.

1.08 GENERAL PRECAUTIONS

- A. In addition to conforming to the safety rules and regulations of the federal, state and local agencies having jurisdiction, the CONTRACTOR should consider the following precautionary measures:
1. Regularly during construction, the work area should be monitored for landfill gases. Workers shall not be permitted to enter workspace where there is an oxygen deficiency or a combustible mixture of gas without appropriate protection.
 2. Smoking shall be prohibited in or near open excavations or exposed waste, and in the vicinity of underground pipe laying activities. Smoking will be permitted only in those areas designated by the CONTRACTOR'S Safety Officer.
 3. Soil should be stockpiled adjacent to facility in areas of exposed waste for fire fighting purposes. Soil may be an effective means of extinguishing landfill fires by precluding oxygen availability.
 4. The use of explosives shall not be permitted with the exception of approved blasting requirements.
 5. No welding should be permitted in trenches, enclosed areas, or over waste unless performed in areas of the site tested and approved by the CONTRACTOR's Safety Officer.
 6. Construction equipment used in excavating activities and/or refuse removal should be equipped with vertical exhaust and spark arresters.

- B. If not already included in his standard safety practices, the CONTRACTOR should consider adding the following measures to his safety program:
1. Workers should be cautioned on the possibility of caving during construction facility near and in open excavations, particularly in waste-filled areas. Anyone working near the edge of deep excavations should be secured with a safety belt, harness, or rope to preclude the possibility of falling into the opening. (Waste filling and compaction are quite variable and therefore, may not provide the same slope stability as excavations in native soils).
 2. Any personnel working near the edge of well excavations, or similar construction, should wear a parachute-type harness securely attached to a rope. The rope should be made as short as possible and securely fastened to a safe object such as a parked vehicle or drill rig.
 3. Work performed within trenches shall be performed in accordance with OSHA compliance.
 4. Work parties of three may be best suited for work in excavations or confined spaces. No worker should be allowed to work alone in an excavation. An additional individual should be positioned outside the excavation to assist them should an emergency develop. Confined space permits shall be required and submitted to the OWNER.
 5. Inhalation of landfill gases should be avoided. Such gases (or oxygen deficient air) may cause nausea and dizziness, which could lead to accidents. Work should be done upwind from the excavation whenever possible, unless the excavation is constantly monitored and declared safe.
 6. Workers should avoid contact with exposed refuse wherever possible. Irritants or hazardous materials may be present.
 7. No excavation or drilled hole should be left unattended or left open overnight unless it is securely so as to prevent unauthorized access.
 8. Fire extinguishers with a rating of at least A, B, and C should be available.
 9. Start-up and shutdown of equipment should be avoided in areas of exposed waste.
 10. Personnel, when working in an open excavation or in the presence of landfill gas, should be fully clothed with non-sparking cloth, wear shoes with non-metallic soles, and wear a hard hat and safety goggles or glasses. The excavations should be monitored continuously in a manner satisfactory to the CONTRACTOR's

Safety Monitor for methane, hydrogen sulfide and oxygen deficiency for the duration that personnel are in an excavation. Workers should immediately vacate an excavation if methane, hydrogen sulfide, or an oxygen deficiency is detected therein, and should not be permitted to reenter the excavation until satisfactory measures are implemented.

11. Assembly of construction work should be performed outside of the trenches or excavations. Prefabricated items should be lowered into the excavation. Only final connections should be made within trenches with careful attention to the necessary precautions started within these special safety provisions.

END OF SECTION

SECTION 01560
DUST, ODOR, AND NOISE CONTROL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Dust Control.
 2. Odor Control.
 3. Noise Control.
 4. Dust Monitoring.
 5. Organic Vapor Monitoring.
 6. Noise Monitoring.

1.02 REFERENCES

- A. Occupational Safety and Health Administration (OSHA) Regulations – Part 1910.95.
- B. OSHA Regulations – Part 1910.1000 Table Z-1.
- C. Health and Safety Plan.

PART 2 – PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.01 DUST CONTROL

- A. No visible dust shall be permitted to leave the work area and the site.
- B. Prepare and submit a plan describing techniques and methods proposed to control dust during the project as part of the Environmental Protection Plan, as specified within Section 01120.

- C. Implement all necessary dust control procedures to prevent dust from leaving the work area or at the OWNER's request.
- D. Conduct all operations and maintain the work area (including sweeping and sprinkling) so as to prevent creation and dispersion of dust. Calcium chloride or other chemical methods shall not be used for dust control unless otherwise approved in writing by OWNER. Dust control may require the use of mulch, gravel, plastic sheeting or other temporary restoration or soil surface treatment methods subject to the approval of the OWNER.
- E. In the event that it becomes necessary in the opinion of OWNER to provide additional measures to control the release of dust, such measures shall be immediately implemented, at no additional cost.
- F. OWNER shall reserve the right to suspend work at any time if necessary due to dust generation, which causes a safety or air quality problem, or which may cause contamination of adjacent areas and CONTRACTOR shall not be entitled to any additional compensation for suspension of Work under such conditions.
- G. The OWNER may independently monitor and assess dust emissions from the Site, and may require CONTRACTOR to implement corrective measures based on the results. Such monitoring by OWNER does not relieve the CONTRACTOR from any such monitoring responsibilities.

3.02 ODOR CONTROL

- A. Conduct all operations and maintain the work area so as to minimize odors associated with the work activities.
- B. CONTRACTOR shall implement odor control procedures to suppress objectionable odors in the work area or at the OWNER's request.
- C. In the event that it becomes necessary in the opinion of OWNER to provide additional measures to suppress odors, such measures shall be immediately implemented, at no additional cost.
- D. OWNER reserves the right to suspend Work at any time if necessary due to objectionable odors, which cause a safety or air quality problem, and CONTRACTOR shall not be entitled to any additional compensation for suspension of Work under such conditions.

- E. The OWNER may independently monitor and assess odor emissions from the Site, and may require CONTRACTOR to implement corrective measures based on the results. Such monitoring by OWNER does not relieve the CONTRACTOR from any such monitoring responsibilities.

3.03 NOISE CONTROL

- A. CONTRACTOR shall take all necessary precautions to minimize noise from its activities and prevent disturbance of neighboring residential and commercial areas. Special attention shall be directed to noise generated before 9:00 a.m. and on weekends.
- B. CONTRACTOR shall not operate equipment outside of the approved work hours unless otherwise approved in advance by OWNER.
- C. OWNER reserves the right to suspend Work at any time if necessary due to noise generation causing a nuisance, or safety or excessive vibration hazard.
- D. The OWNER may independently monitor and assess noise at the Site, and may require CONTRACTOR to implement corrective measures based on the results. Such monitoring by OWNER does not relieve the CONTRACTOR from any such monitoring responsibilities.

END OF SECTION

SECTION 01600
MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 TRANSPORTATION AND HANDLING

- A. The CONTRACTOR or party who would normally transport and handle a particular material or piece of equipment shall be responsible for delivery to and/or return from the job site of all materials and equipment necessary to perform his work and shall pay all freight and handling charges for same. All unloading, storing and reloading necessary shall be the responsibility of the CONTRACTOR or party who would normally handle the material or piece of equipment, and shall be at their expense.
- B. The CONTRACTOR shall be responsible for unloading, stockpiling, storage, and protection of all materials purchased by the OWNER for the work.

1.02 STORAGE AND PROTECTION

- A. All materials delivered to and used on the project shall be suitably housed and protected. The areas to be used for storage are defined elsewhere in the contract documents or shall be as specified by the OWNER. The CONTRACTOR shall provide their own storage sheds.
- B. No materials or equipment shall be stored so as to interfere with the use by the public of adjacent sidewalks and roads, unless otherwise approved by OWNER and special permission is obtained from the local government having jurisdiction.
- C. The OWNER assumes no responsibility for damage, deterioration or theft of stored materials, equipment, tools and supplies.
- D. Deliver all construction materials in original, undamaged, sealed containers that are to be unbroken and with labels plainly indicating manufacturer's name, brand, type and grade.
- E. Containers that are broken, opened, watermarked, or otherwise damaged and/or which contain unsuitable or damaged materials are unacceptable and shall be immediately removed from the premises.
- F. Store all bentonite, cement, lime, sealants, aggregates, and similar items above ground and protect from dampness, weather and other damage.
- G. Sheds for flammable liquids shall be so placed or located to avoid damage and danger to OWNER's property and the public.

- H. The CONTRACTOR shall retain all loose and small detachable parts of apparatus and equipment furnished under his contract until the completion of their work. CONTRACTOR shall then turn same over to the OWNER and obtain an itemized receipt in triplicate. CONTRACTOR shall retain one copy of this receipt and shall attach the other two to the request for final payment for the work.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01669
TESTING PIPE SYSTEMS

PART 1 - GENERAL

1.01 SUBMITTALS

- A. Pressure Test Reports.

PART 2 - PRODUCTS

2.01 PROVISIONS

- A. The Contractor shall perform an air pressure test of the containment pipe and fittings, and a hydrostatic pressure test of the carrier pipe and fittings, in accordance with these Specifications.
- B. The total test time, including initial pressurization, initial expansion, and time at test pressure shall not exceed eight hours. If the test is not completed in eight hours, the pressure in the test section shall be released and the section allowed to "relax" for at least eight hours before initiating another test.
- C. Pipe lines shall be pressure tested in presence of QA/QC Engineer. Provide minimum 24 hours notice to the QA/QC Engineer before performing test.
- D. Provide necessary connections between section of pipe being tested and nearest available source of water or air supply, together with test pressure equipment, meters, pressure gauge, other equipment, materials and facilities necessary to make specified tests.
- E. OWNER will provide a source of water for testing of the carrier pipe.
- F. Provide bulkheads, flanges, valves, bracing, blocking, and monitoring apparatus as necessary to complete the pressure tests.
- G. Pipe to be tested shall be exposed for CQA OFFICER to observe, except that bends, reduced pressure rated fittings and components should be buried or restrained. Flange connections shall be visible to check for leaks.
- H. Contractor shall notify on-site personnel of the testing schedule, and only allow personnel required to perform the test in the test area for the duration of the test.
- I. Contractor shall provide a system without leaks.

PART 3 - EXECUTION**3.01 PREPARATION**

- A. Commence test procedures when the following conditions have been met.
1. Remove or isolate valves, flow meters, and instruments that may not withstand the required test pressure from within the test sections. Reconnect pipes with temporary fittings. Vent isolated equipment.
 2. Flush pipe, with clean water until pipe section to be tested is clean and free of dirt, sand, pipe shavings, or other foreign material.
 3. Plug pipe outlets with test plugs, blind flanges or other devices suitable for the test pressure. Brace securely to prevent blowouts. Verify test pressure does not exceed any component of the pipe system.
 4. Restrain or remove expansion joints.
 5. Pressurizing equipment shall include regulator, set to avoid over-pressurizing and damaging otherwise acceptable pipe.
- B. Provide necessary pipe connections between the section of line being tested and the compressed air supply, together with test pressure equipment, meters, pressure gauge, and other equipment, materials, and facilities necessary to perform the specified tests.
- C. Furnish and install bulkheads, flanges, valves, bracing, blocking or other temporary sectionalizing devices that may be required.
- D. Remove temporary sectionalizing devices after tests have been completed.

3.02 TESTING

- A. OWNER and ENGINEER shall be given 24-hr notification prior to test.
- B. Appropriate Safety precautions must be in-place.
- C. OWNER and ENGINEER shall be given 24-hr notification prior to test.
- D. Appropriate Safety precautions must be in-place.

3.2.1 Hydrostatic Pressure Testing

- A. Contractor shall use a hydrostatic test pump specifically designed for performing hydrostatic pressure tests on pipe.
- B. Pipe shall be tested at 1.5 times the rated working pressure of the pipe or the lowest rated pressure of any component of the system being tested.
- C. Apply test pressure slowly, and once the test pressure has been reached, allow the pressure to stabilize, without adding additional pressure. This may take 2 to 3 hours.
- D. Once pressure has stabilized, add additional water to achieve the test pressure and begin the test.
- E. After 1 hour, additional water shall be added to return to the test pressure. If the volume of water required to achieve the test pressure after 1 hour is less than shown in the table, then the pipe has passed the pressure test.
- F. The total test time, including the initial pressurization, initial expansion and time at test pressure, shall not exceed eight hours. If the test is not completed within that time, the test pressure shall be removed for at least eight hours, prior to performing the test again.
- G. Clean potable water shall be used as the testing medium to fill the pipes.

Allowable Water Loss Under Pressure	
Nominal Pipe Size (in.)	US Gals per 100 feet of Pipe
	1-Hour Test
1	0.06
2	0.07
3	0.10
4	0.13
6	0.30
8	0.50
10	0.80
12	1.1

3.2.2 Air Pressure Test

- A. Contractor shall provide ASME standard 840.1 Grade 3A pressure gauges (accuracy of $\pm 0.25\%$ of full span) to measure the test pressure in the pipe. Gauge pressure range shall be not more than 2 times the test pressure.
- B. Pipe test pressure shall be a minimum of 10 psig or the lowest rated pressure of any component of the system being tested.
- C. Apply the test pressure slowly, and once the test pressure has been reached maintain the pressure for 15 minutes or until it has stabilized.
- D. After the pressure has stabilized at 10 psig, begin the test.
- E. The pressure shall drop less than 0.5 psig, over 10 minutes, for an acceptable pressure test.

3.2.3 Test Pressures

- A. Dual Containment HDPE force main pipe.
 - 1. Carrier pipe: 150% of rated pressure.
 - 2. Containment pipe: 10 psig.
- B. In no case exceed maximum allowable pressure for any pipeline component, including valves, fittings, and instruments.
- C. If pressure test is not accepted, correct leaks or defects in the pipe and retest.
- D. Remove temporary sectionalizing devices after tests are complete.

3.2.4 Test Failure:

- A. If retest is necessary, allow pressure to relax to 0 psi for at least 8 hours prior to retest.
- B. Perform the following when pipe segment fails test.
 - 1. Check entire length of pipe and fusion welds for cracks, pinholes, perforations or other possible leakage points.
 - 2. Check blocked risers and capped ends for leakage and check gaskets at blind flanges.
 - 3. Verify leaks by applying a soapy water solution and observe for bubble formation.

- C. Repair pipe and fused joint leaks by cutting out leak areas and refusing suitable segments.
- D. After the leaks are repaired, retest the pipe after the 8 hour relaxation period.

3.03 TEST REPORTING

- A. Each test shall be reported in writing, on Attachment 1 included with this section.
- B. Include following information if failure occurs:
 - 1. Location of failure segment.
 - 2. Nature of leaks.
 - 3. Details of repairs performed.
 - 4. Retest results.

ATTACHMENT 1 TO SECTION 01669
HDPE PIPE PRESSURE TEST REPORT FORM

Project Name/No.: _____ Date: _____

Contractor: _____ Time: _____

Person _____

Performing Tests: _____

Description/Location of Test Segment: (Pipe Diameter, Length, and SDR's)

Location of Pipe Test Segment

Station From: _____ Station To: _____

T_i = Initial Temperature = _____ °F

P_i = Initial test pressure = _____ psi

P_c = Initial Pressure in psi corrected for temperature (T_t) at time "t"

t = Time in minutes from initiation of test

T_t = Temperature in °F at time 't'

P_t = Test pressure in psi at time 't'

$$P_c = \left[\frac{(P_i + 1013)(T_i + 273)}{T_i + 273} \right] - 1013$$

$$\text{Percent Pressure Drop} = \frac{P_c - P_t}{P_c} \times 100$$

	T _t	P _t	P _c	
	Temp	Gauge	Corrected	Pressure
Time	Reading	Pressure	Pressure	Drop
(min)	(°F)	(psi)	(psi)	(%)
0				
20				
30				
40				
50				
60				

Pass/Fail: _____ Retest (yes/no) _____

Description/Nature of leaks repair of retest segment:

ATTACHMENT 2 TO SECTION 01669
HYDROSTATIC PIPE PRESSURE TEST REPORT FORM

Project No.:			
Project Name:			
Project Location:			
Weather:			
Contractor:		Test No.:	
CQA Personnel:		Person/Company Performing Test:	
Date of Test:	Time of test:	Start:	Finish:
Pipe Length: ft.	Pipe Diameter: in.	Pipe Material	Pipe SDR/Sch:
Rated Working Pressure:		Test Pressure:	
Location/designation of pipe tested:			
t	Pt	Pc	Amount of Make-Up
Time	Pressure Gauge Reading	Pressure Drop	Water Added
(hours)	(psig)	(%)	(gal.)
0			
1			
2			
3			
4			
5			
6			
Pass	Fail	Retest?	Yes No
Description/location of defects for failed test:			
Test Procedure:			
1. Pressurize to 150 percent of rated pressure;			
2. Add make-up water each hour for three hours to maintain pressure;			
3. Test phase begins after the initial three hour phase;			
4. After one, two or three hours, add a measured amount of make-up water to return to the test pressure; and			
5. The amount of make-up water added to return to the test phase must not exceed the amount in the make-up water test values table on the next sheet.			
Comments:			

Signature:

MAXIMUM ALLOWABLE MAKE-UP WATER VOLUME

<i>Nominal Pipe Size (inches)</i>	<i>Make-Up Water Allowance (U.S. Gallons per 100 ft of Pipe)</i>		
	1 Hour Test	2 Hour Test	3 Hour Test
1 – 1/4	0.06	0.10	0.16
1 – 1/2	0.07	0.10	0.17
2	0.07	0.11	0.19
3	0.10	0.15	0.25
4	0.13	0.25	0.40
5	0.19	0.38	0.58
5 – 3/8	0.21	0.41	0.62
6	0.30	0.60	0.90
7 – 1/8	0.40	0.70	1.0
8	0.50	1.0	1.5
10	0.80	1.3	2.1
12	1.1	2.3	3.4
13-3/8	1.2	2.5	3.7
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.0	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	8.0	16.2	24.3
36	9.0	18.0	27.0
42	12.0	23.1	35.3
48	15.0	27.0	43.0
54	18.5	31.4	51.7

END OF SECTION

SECTION 01740
PROJECT FINAL CLEAN-UP

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The provisions of this section shall apply to each CONTRACTOR unless otherwise specified.
- B. Each CONTRACTOR shall do all removal of debris and cleaning work required resulting from operations in performance of his contract work. Cleaning work shall be performed throughout the duration of the project. Final clean-up shall be performed at the completion of the work.

1.02 DISPOSAL REQUIREMENTS

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. At completion, each CONTRACTOR shall clean all work of his contract and remove from site, all their debris and waste material. General CONTRACTOR shall then perform a general and final cleanup of the site.
- B. Employ skilled workers for final cleaning.
- C. Remove debris and packing material associated with construction activities from the project area.

- D. Prior to final completion the OWNER and CERTIFYING ENGINEER shall view all work areas, to verify that the entire work is clean.

END OF SECTION

SECTION 01770
CONTRACT CLOSE-OUT

PART 1 - GENERAL

1.01 SUBSTANTIAL COMPLETION

- A. When the CONTRACTOR considers the work is substantially complete, they shall submit to the OWNER and CERTIFYING ENGINEER:
1. A written notice that the work or designed portion thereof, is substantially complete.
 2. A list of items to be completed or corrected.
- B. Within a reasonable time after receipt of such notice, the OWNER and CERTIFYING ENGINEER will view the work to determine the status of completion.
- C. Should the OWNER and CERTIFYING ENGINEER determine that the work is not substantially complete:
1. The OWNER or CERTIFYING ENGINEER will promptly notify the CONTRACTOR in writing, giving the reasons therefore.
 2. The CONTRACTOR shall remedy the deficiencies in the work and send a second written notice of substantial completion to the OWNER and CERTIFYING ENGINEER.
 3. The OWNER and CERTIFYING ENGINEER will view the work.
- D. When the OWNER and CERTIFYING ENGINEER concurs that the work is substantially complete, he will:
1. Prepare a Certificate of Substantial Completion, accompanied by the CONTRACTOR's list of items to be completed or corrected, as verified and amended by the CERTIFYING ENGINEER.
 2. Submit the Certificate to the OWNER and CONTRACTOR for their written acceptance of the responsibilities assigned to them in the certificate.

1.02 FINAL VIEWING OF WORK

- A. When the CONTRACTOR considers the work is complete, CONTRACTOR shall submit written certification that:
1. Contract documents have been reviewed.
 2. Work has been inspected for compliance with Contract Documents.
 3. Work has been completed in accordance with Contract Documents.
 4. Equipment and systems have been tested in the presence of the CERTIFYING ENGINEER, and are operational.
 5. Work is completed and ready for final viewing by the OWNER and CERTIFYING ENGINEER.
- B. The OWNER and CERTIFYING ENGINEER will view the work to verify the status of completion with reasonable promptness after receipt of such certification.
- C. Should the OWNER or CERTIFYING ENGINEER consider that the work is incomplete or defective:
1. The OWNER or CERTIFYING ENGINEER will promptly notify the CONTRACTOR in writing, listing the incomplete or defective work.
 2. The CONTRACTOR shall take immediate steps to remedy the stated deficiencies, and send a second written certification to the OWNER and CERTIFYING ENGINEER that the work is complete.
 3. The OWNER and CERTIFYING ENGINEER will view the work.
- D. When the CERTIFYING ENGINEER finds that the work is acceptable under the Contract Documents, he shall request the CONTRACTOR to make closeout submittals.

1.03 RE-INSPECTION FEES

- A. Should the CERTIFYING ENGINEER have to view the work more than once after the CONTRACTOR notifies the CERTIFYING ENGINEER that the work is substantially complete due to failure of the work to comply with the claims of status of completion made by the CONTRACTOR:
1. The OWNER will compensate the CERTIFYING ENGINEER for such additional services.

2. The OWNER will deduct the amount of such compensation from the final payment to the CONTRACTOR.

1.04 CONTRACTOR'S CLOSEOUT SUBMITTALS TO CERTIFYING ENGINEER

1. Evidence of compliance with requirements of governing authorities.
2. Project record Documents: To requirements of Section 01780.
3. Loose and Small Detachable parts of Apparatus and Equipment.
4. Evidence of Payment and Release of Liens: To requirements of General and Supplementary Conditions.
5. Certificate of Insurance for Products and Completed Operations.
6. Guarantees and Warranties.
7. Operations and Maintenance Instructions.

1.05 GUARANTEES

- A. The CONTRACTOR and his subcontractors, as the case may be, shall guarantee that all work under this contract, shall be free from defects of faulty labor and/or materials for a period of one year from date of final acceptance. This guarantee is to be provided within the limitations of other guarantees or warranties in the Contract Documents. This requirement shall not expand or supersede any guarantees or warranties stated, implied, or offered or specified in these Contract Documents.
- B. Final payments are contingent upon the OWNER's and CERTIFYING ENGINEER's receipt of such guarantees from the CONTRACTOR and subcontractors, as the case may be.
- C. The CONTRACTOR shall make or cause his Subcontractor who is responsible to make any repair or replacement necessary by reason of any defects in materials or workmanship, or failure to meet the requirement of the specifications, which may develop within one year from date of final payment.
- D. If any CONTRACTOR chooses to use any system, equipment, facilities, or services that have been provided by any other CONTRACTOR, the former shall assume full responsibility for any damage and shall make arrangement with the installing CONTRACTOR so that the guarantee period shall not be jeopardized. If during the guarantee period, repair or changes are required as the result of such use, the

CONTRACTOR shall promptly, upon receipt of notice from the OWNER, and without expense to the OWNER, correct the condition to restore the guarantee.

1.06 OPERATION AND MAINTENANCE DATA

- A. At the completion of work, each CONTRACTOR and subcontractor shall provide the OWNER with two sets of each of the following items for equipment and devices provided furnished and/or installed for the project by the CONTRACTOR/subcontractors.
1. Catalog Date or Literature.
 2. Manufacturer's Operating Instructions.
 3. Manufacturer's Maintenance Instructions.
 4. Installation Instructions.
- B. In each of these, the model number and the data for the model number shall be checked off in ink where the literature covers more than one model. For items assembled by the CONTRACTOR for special functions, CONTRACTOR shall write and provide duplicate operating and maintenance instructions.

1.07 TESTS AND CERTIFICATIONS

- A. Completed installations of all equipment and systems shall be fully tested in the presence of the CERTIFYING ENGINEER and approved prior to acceptance of the OWNER.
- B. The CONTRACTOR shall make all necessary adjustments and/or replacements that are necessary to fulfill the requirements, to comply with the directions and/or recommendations of the manufacturer and to comply with all applicable codes and regulations.
- C. The CONTRACTOR shall certify to the OWNER that the work has been performed in compliance with the Contract Documents.

1.08 FINAL ADJUSTMENTS OF ACCOUNTS

- A. Submit a final statement of accounting to the OWNER and CERTIFYING ENGINEER.
- B. Statement shall reflect all adjustments to the Contract Sum:
1. The original Contract Sum.

2. Additions and deductions resulting from:
 - a. Previous change orders.
 - b. Unit prices.
 - c. Deductions for incorrect work.
 - d. Deductions for re-inspection payments.
 - e. Other adjustments.
 3. Total Contract Sum, as adjusted.
 4. Previous payments.
 5. Sum remaining due.
- C. The CERTIFYING ENGINEER will prepare a final Change Order, reflecting approved adjustments to the Contract Sum, which were not previously made by Change Orders.

1.09 FINAL APPLICATION FOR PAYMENT

- A. CONTRACTOR shall submit the final application of Payment in accordance with procedures and requirements stated in Conditions of the Contract.
- B. A certificate of completion of contract work will be issued at the completion of project after receipt of required and maintenance instructions, record drawings, Guarantees and Release of Liens. The date of said certificates shall be the beginning date of all guarantees.
- C. The CONTRACTOR shall not reuse any of the Contract Document in any manner.
- D. All Contract Documents, except for one complete set for record purposes, shall be returned to the CERTIFYING ENGINEER upon completion of the project.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION

DIVISION 2 - SITEWORK

TECHNICAL SPECIFICATIONS
DUNN MINE AND C&D FACILITY
DIVISION 2 – SITEWORK

Section	No. Section	Page No.
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02820	HDPE PIPES & FITTINGS	02820-1
02850	STORMWATER CONTROLS	02850-1
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SECTION 02100
EROSION CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to installation and maintenance of erosion control measures, as specified herein and on the Drawings.

1.03 RELATED WORK

- A. Section 02880 – Loam/Seeding/Erosion Mat
- B. Section 02850 – Storm Water Controls

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

1.05 INTENT

- A. The intent of the work under this Section is to provide erosion control measures to prevent siltation from entering adjoining properties, wetlands, or water bodies. In addition, the intent is to comply with requirements of the federal National Pollution Discharge Elimination System Construction General Permit by complying with the site-specific Storm Water Pollution Prevention Plan.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Silt Fence

1. Silt fence shall be 36 inches in height and fabricated of polypropylene.

B. Jute Netting

1. The jute netting shall be woven netting as manufactured by Fabriscape, Inc., or an approved equal. The jute netting shall meet the following specifications:

Typical Specifications	
Structure	Woven
Yarn	Jute, undyed, unbleached
Weight	0.92 lbs/sy
Yarn Count Wrap	78 (width, min)
Weft	42 (linear yard, min)
Absorption	450%
Open Area	60 – 65%
Life (Years)	2 Years

C. Erosion Control Mat

1. The erosion control mat used within the proposed drainage swales shall be VMax[®] P550[®] Turf Reinforcement Mat, as manufactured by North American Green, or approved equal. The selection of an erosion mat is subject to the approval of the CERTIFYING ENGINEER.
2. The erosion control mat used for slope stabilization shall be ECP-3[™] Polypropylene Turf Reinforcement Mat, as manufactured by East Coast Erosion Blankets, LLC, or approved equal. The selection of an erosion mat is subject to the approval of the CERTIFYING ENGINEER.

PART 3 - EXECUTION

3.01 SEDIMENT CONTAINMENT

- A. Place silt fence as close as feasible to work so as to prevent siltation from entering adjacent properties and areas outside the limits of work.
- B. Silt fence shall be installed at the locations indicated on the Drawings and adjacent to other work areas as directed by CQA OFFICER.

- C. Silt fence shall be constructed or installed as shown on the Drawings and shall be maintained in such a manner so as to prevent siltation of wetlands for the duration of the project.
- D. Silt fence shall be replaced or repaired as required by OWNER and/or CERTIFYING ENGINEER.

3.02 EROSION CONTROL

- A. All areas disturbed by CONTRACTOR that exhibit erosion potential prior to the completion of work shall, at the direction of OWNER and/or CERTIFYING ENGINEER, be provided with an acceptable temporary vegetative cover or mulch.
- B. Protect work areas against erosion. Repair and re-grade as needed to restore work areas. Place and compact soils in areas disturbed by CONTRACTOR.
- C. Erosion control mat shall be placed within all locations as shown on the Drawings.
- D. Prior to the installation of vegetative support soils and seeding, the external slopes of all soil fill areas shall be protected against erosion.

3.03 MONITORING

- A. CONTRACTOR shall monitor surface waters in accordance with the OWNER's Stormwater Pollution Prevention Plan and CONTRACTOR's Environmental Protection Plan.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of OWNER, and at no additional cost to OWNER.

END OF SECTION

SECTION 02150
EXCAVATION & TRENCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: excavation and trenching, including preparation, excavation, bedding, backfilling, disposal of excess and unsuitable materials, and other related and incidental work within the designated area and as required for construction of other work, as shown, specified or required.
- B. Strip and remove any existing vegetative soil from the proposed Phase 4 area to the grades as indicated on the Drawings.
- C. Locate all existing utilities in work areas prior to commencing any excavation activities. CONTRACTOR shall be responsible for preserving and protecting all utilities.

1.03 RELATED WORK

- A. Section 01120 – Environmental Protection Plan
- B. Section 02175 – Clearing and Grubbing
- C. Section 02100 – Erosion Control
- D. Section 02200 – General Fill
- E. Section 02210 – Subgrade
- F. Section 02820 – High-Density Polyethylene (HDPE) Pipe

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

- B. All materials and labor furnished under this section shall comply with OSHA, ASTM, AA, NEC, ANSI and all other applicable Federal, State and Municipal codes and regulations including revisions to date of Contract.
- C. Use adequate number of skilled workers who are thoroughly trained and experienced in the specified requirements and the methods needed for proper performance of the work in this Section.

1.05 CLASSIFICATION OF EARTHWORK

- A. Excavation: consists of removal of soil, waste, rock, debris and all other materials to the proposed grading indicated in the Contract Documents. No classification of type of excavated materials will be made. Excavation includes all soil, and waste materials if encountered, regardless of type, character, composition, moisture, or condition thereof.
- B. Unauthorized Excavation: consists of removal of materials beyond indicated areas without specific approval of the CQA OFFICER. Unauthorized excavation shall be at CONTRACTOR'S expense.
- C. Unauthorized excavations shall be backfilled as specified for authorized excavations at no additional cost to the OWNER, unless otherwise directed by the CQA OFFICER.
- D. Additional Excavation: When excavation has reached required subgrade elevations, notify the CQA OFFICER, who will make an inspection of conditions. If the CQA OFFICER determines that materials at required subgrade elevations are unsatisfactory, continue excavation until satisfactory materials are encountered. Backfill, stockpile or replace excavated material as approved by the CQA OFFICER.

1.06 PROTECTION OF PEOPLE AND PROPERTY

- A. The CONTRACTOR shall plan and conduct operations so as to prevent damage to existing structures and utilities, safeguard people and property, protect the structures to be installed, and provide safe working conditions.
- B. Excavation may be made without sheeting and bracing within the limitations and requirements of the governmental agencies having jurisdiction. Failure of the CQA OFFICER to order the use of bracing or sheeting and shoring or direct changes to systems in place, shall not in any way or to any extent relieve the CONTRACTOR of any responsibility concerning the condition of excavations or of his obligations under the Contract. The CONTRACTOR shall be responsible for the condition of all excavations made by him. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances they may occur.

- C. Work is restricted to the land provided for the CONTRACTOR'S use.
- D. Side slopes will be maintained in stable condition under all normal anticipated weather conditions for the period that the excavation will be open. The CONTRACTOR shall regrade side slopes to a more stable configuration if so directed by the CQA OFFICER.
- E. In cases where excavation without sheeting or bracing is not feasible solely because of protection of workers, trench boxes may be used.
- F. Stockpiles of clean excavated soil that are approved by the CQA OFFICER shall be carefully placed at a location approved by the OWNER, and the surrounding area shall be protected by placement of silt fence, or an equivalent erosion control structure.
- G. Excavated clean soil, which will be replaced by other fill materials such as sand, crushed stone, pea gravel or low permeability backfill, shall be placed on-site at a location approved by the OWNER.
- H. It shall be the CONTRACTOR'S complete responsibility to adequately control water that may be present in the excavation. CONTRACTOR shall provide for the disposal of water removed from excavations, in such a manner not to cause damage to public property, private property or to any portion of the Work, whether completed or in progress. CONTRACTOR shall not cause any impediment to the use of any area by the public; nor shall he discharge any flushing, ground water or any material of any nature into existing sanitary sewers or streams.
- I. The CONTRACTOR shall be responsible for the condition of all excavations made by him. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances they may occur.
- J. In the event that any act by the OWNER and CQA OFFICER results in the keeping of any excavation open longer than would otherwise have been necessary, the CONTRACTOR shall not be relieved from his responsibility of properly and adequately protecting the excavation from caving or slipping nor from any of his obligations under the contract relating to protection of persons and property. Neither shall any failure of or refusal by the CQA OFFICER to direct bracing, sheeting and shoring to be left in place relieve the CONTRACTOR of his responsibilities as set forth in these Specifications.

1.07 SUBMITTALS

- A. A completed bill of materials list showing all items to be furnished and installed under this Section.

- B. Sheeting, shoring, bracing and trench boxes shall be designed and signed by a registered professional engineer and submitted.

1.08 SAFETY

- A. All excavation shall comply with the applicable requirements as stated in the:
 - 1. OSHA excavation safety standards 29 CFR, 1926-650, Subpart P.
 - 2. State and OWNER construction safety regulations.
 - 3. Trench safety guidelines as specified by the Landfill Gas Division of the Solid Waste Association of North America (SWANA).
- B. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by New York State Department of Transportation.
 - 2. Protect existing slopes, embankments, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Excavation shall mean the removal from place of all materials and shall include soil, structures above and below ground, rock, pavements, topsoil, demolition waste material, rubbish, tree stumps, boulders, logs, ashes, cinders or organic material such as peat, humus or organic silt.
- B. Muck excavation shall mean the excavation and removal of soft, wet unsuitable subgrade material to the depth as directed by CERTIFYING ENGINEER.
- C. No frozen earth shall be used for backfill or subgrade fill materials. All fill materials shall be free from all perishable and objectionable materials.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Drawings, these Specifications and any pertaining local ordinances.

3.02 PREPARATION

- A. Identify required lines, levels, contours and datum locations.
- B. Locate, identify and protect utilities from damage prior to work.
- C. The CONTRACTOR shall notify the OWNER at least 5 days prior to removal or relocation of utilities and shall coordinate such work with the OWNER.
- D. Protect plant life, lawns and other features remaining as a portion of final landscaping.
- E. Protect benchmarks, survey control points, monitoring wells, existing structures and fences from excavating equipment and vehicular traffic.
- F. Remove and replace soft areas of subgrade not capable of in-situ compaction. Backfill with fill material as directed by the CQA OFFICER and compact to density equal to or greater than requirements for subsequent backfill material.
- G. Dewatering:
 - 1. The CONTRACTOR shall at all times during construction provide and maintain proper equipment and facilities to remove water entering excavations, and shall keep such excavations dry so as to obtain a satisfactory foundation condition until the fill, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural levels.
 - 2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottom, and soil changes detrimental to stability of subgrades and foundations. Subgrade soils, which become soft, loose, "quick", or otherwise unsatisfactory for support of structure as a result of inadequate dewatering or other construction methods shall be removed and replaced by crushed stone as required by the CQA OFFICER at the CONTRACTOR's expense. The bottom of excavations shall be firm and without standing water before placing structures or pipes. Provide and maintain pumps, well points, sumps, suction and

discharge lines, and other dewatering system components necessary to convey water away from excavations.

3. Establish and maintain temporary drainage ditches and/or other diversions outside excavation limits to convey rainwater and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.
4. Disposal of Water Removed by Dewatering System:
 - a. Water conveyed away from excavations that has not contacted waste materials shall be routed to existing sedimentation basins or discharge to areas approved by the OWNER or CQA OFFICER.
 - b. Water in contact with waste shall be pumped and disposed of in the existing leachate collection system at the site. The CONTRACTOR shall coordinate leachate disposal with OWNER.

3.03 EXCAVATION

A. General:

1. Excavation shall not commence until the CONTRACTOR has staked out the proposed work, including the alignment of trenches and this alignment is approved by the CQA OFFICER.
2. Excavations, except as specified hereinafter, shall be adequately sheeted and braced. Where the installation of sheeting is impractical or might cause damage, as a result of, but not limited to, vibration settlement or lateral movement, the CONTRACTOR shall utilize other acceptable methods.
3. Grade top perimeter of excavation to prevent surface water from draining into excavation.
4. Notify CQA OFFICER of unexpected subsurface conditions and discontinue affected work in area until notified by the CQA OFFICER to resume work.
5. Excavation shall be carried to the dimensions indicated, specified or as required, to provide sufficient clearance for the construction and inspection of the structure to be installed.
6. Underpin adjacent structures that may be damaged by excavating work.

7. Excavation equipment operators and other concerned parties shall be familiar with subsurface obstructions as shown on the Contract Drawings.
8. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against hazards and in accordance with the Health and Safety Plan. Excavations shall provide adequate working space and clearances for the work to be performed therein. If walls of the excavation cannot be kept stable, the excavation shall be properly shored and braced.
9. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered. Well/boring/test pit logs performed on-site are available for information purposes only to the CONTRACTOR. Excavated waste shall not be relocated except as approved by the OWNER. If excavated waste is allowed to be relocated and disposed of in landfill areas, the CONTRACTOR shall provide an approved daily soil cover or alternative daily cover over the waste at the end of each day. Temporary measures to minimize stormwater run-on to the waste disposal areas shall be implemented by the CONTRACTOR at no additional expense to the OWNER.
10. Excavation shall conform to the limits indicated on the Contract Drawings and as specified herein. This work shall include shaping, sloping, grading and other work necessary in bringing the site to the required grade, alignment, and cross-section.
11. Unsatisfactory materials shall be removed to the required depth and replaced to the satisfaction of the CQA OFFICER with General Fill or Subgrade material. Unsatisfactory materials shall be removed and disposed of in the designated areas on-site as directed by the CQA OFFICER or OWNER.
12. Clean excavated materials shall be stockpiled in such a manner as to prevent nuisance conditions. Surface drainage shall not be hindered.
13. Rock may be encountered during construction outside the landfill area. If encountered, rock excavation limits shall be approved by the CQA OFFICER in accordance with the following criteria before the work commences:
 - a. Pipe Trenches:
 - i. The width of trenches shall be established as the outside diameter of the pipe plus 18 inches, unless otherwise specified, exclusive of

bells, branches, hubs, spurs, or cradles. The sides of the trench shall be considered as vertical.

- ii. The depth of the trench shall be established at a depth of 6 inches below the outside of the pipe, unless otherwise specified.
- iii. The length shall be equal to the laid length of pipe, measured horizontally (plan view).
- iv. Additional width in pipe trenches at field joints or beyond the lines described above will be considered outside the limits described.

b. Structures:

- i. The bottom of the footing, drainage course material, or compacted backfill or as shown on the drawings.
- ii. The surface of the rock.
- iii. Vertical planes located 12 inches outside the footing.

3.04 STRIPPING AND STOCKPILING OF VEGETATIVE SUPPORT SOILS

- A. CONTRACTOR shall strip any vegetative support soils from all cleared areas. Avoid mixing vegetative support soils with subsoil and stockpile in areas on the site approved by the OWNER. Vegetative support soils shall be stockpiled free from brush, trash, large stones, and other extraneous material and protected until it is placed for surface restoration efforts as specified under the applicable section of these Specifications. Any vegetative support soils remaining after all Work is completed shall remain at the site in stockpiles as directed by the OWNER.

3.05 TRENCHING

- A. Trench excavation for pipes and drainage structures (outside waste area limits):
- 1. Trench width shall be minimized to greatest extent practical but shall conform to the following:
 - a. Sufficient to provide room for installing, jointing, and inspecting piping, but in no case wider than shown on the Construction Drawings unless otherwise approved by the CQA OFFICER.
 - b. Enlargements at pipe joints may be made if required and approved by the CQA OFFICER.

- c. Sufficient for sheeting, bracing, sloping, and dewatering.
 - d. Sufficient to allow thorough compacting of backfill adjacent to bottom half of pipe.
2. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil or bedding material.
 3. No more than 200 feet of trench within landfill areas may be opened in advance of pipe laying operations at one time unless approved by the CQA OFFICER.
 4. All trenches shall be constructed in a uniform grade, and free of standing water. The CONTRACTOR shall be responsible for maintaining these conditions. Subgrade soils that become soft, loose, or unsatisfactory as a result of inadequate dewatering and cannot be stabilized or re-compacted shall be removed and replaced with fill material as directed by the CQA OFFICER at the CONTRACTOR's expense.
 5. Excavation for appurtenances shall maintain a minimum clearance of 12 inches between their outer surfaces and the face of the excavation, or sheeting, if used.

3.06 STABILITY OF EXCAVATIONS

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations during period excavations will be open. Extend shoring and bracing as excavation progresses.

3.07 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials acceptable for potential reuse, in accordance to respective specifications, where approved by the OWNER and/or CQA OFFICER. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain excavated soil and backfill materials away from edge of excavations. No excavated materials or other construction materials shall be placed within thirty (30) feet of the edge of pavement of any public road unless otherwise approved by the CQA OFFICER.
2. Comply with all erosion and sediment control requirements by state and local authorities.

3.08 DISPOSAL

- A. CONTRACTOR shall coordinate the disposal of any and all suitable excess excavated materials with OWNER.

3.09 FINISHING WORK

- A. Unless otherwise stated herein, construction tolerances shall be +0.2 feet horizontally, and +0.1 feet vertically. All surfaces shall be reasonably free from irregularities. Slopes or grades shall not be less than specified minimums nor greater than specified maximums as shown on the Drawings. Thicknesses of soil components shall be no less than specified and/or shown on the Drawings.
- B. Grass areas disturbed by the operations under this section shall be restored to the grades indicated on the Contract Drawings, seeded, and mulched as specified in Section 02880, Loam/Seeding/Erosion Mat.
- C. Existing bituminous pavements damaged by the CONTRACTOR'S operations shall be restored by the CONTRACTOR to equal or better condition at no additional cost to the OWNER.
- D. During trench excavation, no trench may be left open overnight. All open excavations must be covered by 2-inch thick plywood or steel sheeting and adequately barricaded.

3.10 FIELD QUALITY CONTROL

- A. The depth and limit of excavation will be in accordance with these Contract Documents and the CQA OFFICER'S direction, and will be verified during the course of excavation by the CQA OFFICER.

END OF SECTION

SECTION 02175
CLEARING & GRUBBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials, the protection of certain existing trees and vegetation, removal of trees, stumps, roots and other vegetation, and the disposal of waste materials, as specified herein and on the Drawings.

1.03 RELATED WORK

Not applicable.

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Drawings, these Specifications and any pertaining local ordinances.
- B. All work shall be performed within the Contract Limits shown on the Drawings.
- C. Clearing may not be performed until adequate erosion and sedimentation controls have been established to the satisfaction of the OWNER and/or CERTIFYING ENGINEER.

3.02 PROTECTION OF EXISTING TREES AND VEGETATION

- A. Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
- B. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during courses of construction operations.
- C. Provide protection of roots over 1 ½-inch diameter from being cut during construction operations. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations. Repair or replacement shall be done in a manner acceptable to OWNER. Employ qualified tree surgeon to repair damages to trees and shrubs.

3.03 CLEARING

- A. Clear site of trees, shrubs and other vegetation with the exceptions of those that are to remain.
- B. In areas where more than ten (10) feet of filling is to occur, trees may be cut to within 12-inches above the existing ground surface and the stumps may be left in-place.
- C. CONTRACTOR shall chip the small trees, shrubs and other vegetation and remove from site. Large trees shall be logged and removed from site.

3.04 DISPOSAL OF WASTE MATERIALS

- A. Roots, stumps, brush, foliage, and other vegetation that are not suitable for reuse shall become the property of the CONTRACTOR, and shall be removed and disposed of off-site in a manner complying with all applicable local, State, and Federal regulations.
- B. Burning of waste materials shall not be permitted without the consent of OWNER and local Fire Department. If burning is permitted, it shall be conducted in accordance with all pertaining State and local ordinances.
- C. All waste materials and debris, including chips, roots, and logs shall be removed from site at no additional cost to OWNER.

- D. All off-site disposal locations shall be approved by OWNER prior to any deposition of material at the designated site. Should the disposal site be located on private property, the CONTRACTOR shall provide the OWNER with a copy of the individual property owner's written permission to utilize that site.

3.05 PROTECTION OF INSTALLED MATERIALS

- A. CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of OWNER, and at no additional cost to OWNER.

END OF SECTION

SECTION 02200
GENERAL FILL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limiting to: hauling, grading, drying, removal of stormwater, removal of unsuitable materials, protection of installed materials, and all work incidental to installation or excavation of general fill material, as specified herein and on the Drawings.

1.03 RELATED WORK

- A. Section 02210 – Subgrade

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

1.05 CLASSIFICATION OF EARTHWORK

- A. All earthwork shall be unclassified; consequently, the bid price shall be taken to include all materials required to excavate, handle or compact whether wet or dry and regardless of the character of the materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General Fill material shall be a non-plastic material, free of contamination, sharp rocks, debris of any kind, organic matter, vegetation or any unsuitable objects.
- B. General Fill soil shall be substantially free of particles over 6-inches in diameter. Particles over 6-inches in diameter may be placed in the bottom portion of the containment berms, fill areas, and/or perimeter roads. These particles shall be placed at intervals no less than

approximately two particle diameters apart and not within approximately two feet of the subgrade surface.

- C. The surface of installed General Fill layer shall be substantially free of particles over 3 inches in diameter.
- D. Suitable excavated materials shall be considered as General Fill.

PART 3 - EXECUTION

3.01 GENERAL FILL INSTALLATION

- A. The existing site soils shall be used to the maximum possible extent.
- B. Fill shall be constructed in horizontal layers as nearly even as practicable to prevent the thickness of lift from exceeding that specified.
- C. The general fill shall be installed to the line and grade, as shown on the Drawings.
- D. The bonding surface between adjoining lifts shall be moistened and scarified or tracked prior to installing overlying lifts.
- E. Grading of the general fill soil shall be accomplished via grade stakes set to establish the thickness of the layer. Grade stakes must be removed once the layer has been completed and before subsequent materials are installed. Grade all surfaces to achieve a uniform grade and consistent surface free of ruts, voids, rills and soft spots.

3.02 MAINTENANCE OF GRADING

- A. Repair any settlement or washouts that occur prior to acceptance of work. Re-establish all grades to required elevations and slopes.
- B. Scarify, reshape and compact all areas disturbed by subsequent operations or adverse weather.

3.03 PROTECTION OF INSTALLED MATERIALS

- A. CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of OWNER, and at no additional cost to OWNER.

END OF SECTION

SECTION 02210
SUBGRADE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limiting to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to the proper placement and preparation of subgrade soil, as specified herein and as indicated on the Drawings.

1.03 RELATED WORK

- A. Section 02200 – General Fill

1.04 PRE-CONSTRUCTION TESTING REQUIREMENTS

- A. Pre-construction testing is required on all proposed subgrade materials and excavated on-site soil proposed for use as subgrade material. All sampling and testing will be conducted by the CQA OFFICER. CONTRACTOR will provide labor and equipment as necessary to allow the CQA OFFICER or third party representative to collect a sample at source.
- B. CQA OFFICER or designated representative shall conduct a minimum of one grain size test (ASTM D422), one modified proctor test (ASTM D1557) and one direct shear test (ASTM D3080) on a representative sample of each source of subgrade soil (including in-place soil to remain). This testing shall be conducted prior to the installation of imported Subgrade Soil. The results of this testing shall be submitted for approval a minimum of 5 days before the installation of Subgrade Soil.
- C. OWNER and CERTIFYING ENGINEER reserve the right to require additional tests, and more frequent testing when there is a change (i.e. source or physical properties) in the material being delivered to the project site, or when the materials do not comply with the specifications, at no additional cost to OWNER. CQA OFFICER or third party representative is responsible for collecting the samples and testing.

1.05 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Subgrade Soil shall be a non-plastic material, free of contamination, sharp rocks, and debris of any kind, organic matter, vegetation or any unsuitable objects.
- B. Subgrade soil shall be substantially free of particles over 6-inches in diameter. Particles over 6-inches in diameter may be placed in the bottom portion of the containment berms, fill areas, and/or perimeter roads. These particles shall be placed at intervals no less than approximately two particle diameters apart and not within approximately two feet of the subgrade surface.
- C. The surface of installed subgrade layer (top 6-inches) shall be substantially free of particles over 3 inches in diameter.

PART 3 - EXECUTION**3.01 GENERAL**

- A. All work shall be performed in accordance with the Drawings, these Specifications and any pertaining local ordinances.
- B. CONTRACTOR will install a construction control grid. The control grid shall have defined positions every 50 feet across the area of the proposed baseliner. All aspects of construction shall be defined by the control grid including, but not limited to: the floor, tops and toes of slope, anchor trench, berms, and roadways. The construction control grid shall be established in rectangular coordinates and lie in the same orientation as the existing site's coordinate system.
- C. Subgrade work shall result in a surface suitable for subsequent installation of base liner system, storm water structures, and access roads.

3.02 SUBGRADE SOIL INSTALLATION

- A. CONTRACTOR shall construct the subgrade to elevations as shown on the Drawings. Subgrade soils shall be spread and compacted in loose lifts, not exceeding approximately 12 inches in thickness.

- B. The subgrade shall be excavated or installed to the line and grade, and with a minimum thickness, as shown on the Drawings.
- C. The density of the in-place Subgrade Soils shall not be less than 92 percent of the maximum dry density, as determined by the modified proctor test ASTM D1557, or as approved by CERTIFYING ENGINEER and/or CQA OFFICER.
- D. No materials shall be placed over a lift that has not been tested and accepted by CERTIFYING ENGINEER and/or CQA OFFICER. Areas of installed subgrade that fail testing or are otherwise unacceptable to CERTIFYING ENGINEER and/or CQA OFFICER shall be reworked and retested.
- E. The bonding surface between adjoining lifts shall be moistened and scarified or tracked prior to installing overlying lifts.
- F. Grading of the subgrade layer shall be accomplished via grade stakes set to establish the thickness of the subgrade layer. Grade stakes must be removed once the layer has been completed and before subsequent materials are installed. Grade all surfaces to achieve a uniform grade and consistent surface free of ruts, voids, rills and soft spots.

3.03 CONSTRUCTION TESTING REQUIREMENTS

- A. CQA OFFICER shall conduct construction testing on in-place subgrade as follows:
 - 1. Field density/Moisture content test (ASTM D2922/D3017) shall be performed on all installed subgrade at a minimum frequency of nine tests every acre every 12-inch lift on the base and side slope areas. On containment berms, field density/moisture content testing shall be performed at a minimum frequency of one test every 100 linear feet every 12-inch lift.
- B. Subgrade Soils must pass the specifications as provided in Part 2.01 of this Section.
- C. OWNER and CERTIFYING ENGINEER reserve the right to require additional tests, and more frequent testing, when the materials do not comply with the specifications, at no additional cost to OWNER. CQA OFFICER or third party representative is responsible for collecting the samples and testing.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING INSTALLED MATERIALS AND PREVENTING THEIR DAMAGE.

- B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the satisfaction of OWNER, and at no additional cost to OWNER.

3.05 RECORD DRAWINGS

- A. CONTRACTOR shall submit preliminary “as-built” information after the completion of the Subgrade Layer so CERTIFYING ENGINEER can review and compare “as-built” grades to design grades. The plan shall depict the topographic information, construction grid (refer to 3.01B), and locations where material samples were collected. No work shall begin on low permeability soil layer until OWNER and ENGINEER have approved the Record Drawings.
- B. CONTRACTOR shall submit “as-built” Record Drawings in accordance with Section 01780 - Record Drawings.

END OF SECTION

SECTION 02300
LOW-PERMEABILITY SOIL LINER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to the proper installation of the Low Permeability Soil layer, as specified herein and as indicated on the Drawings. Low Permeability Soil may be available from on-site sources.
- B. Prepare and submit to OWNER a written plan describing Low Permeability Soil screening, wetting, installation, and protection of installed materials. The plan shall include equipment and manpower estimates and a description of construction controls. The plan shall be submitted to OWNER and CERTIFYING ENGINEER at least 2 weeks prior to CONTRACTOR beginning installation of the Low Permeability Soil layer.

1.03 RELATED WORK

- A. Section 02210 – Subgrade
- B. Section 02500 – Geomembrane

1.04 PRE-CONSTRUCTION TESTING REQUIREMENTS

- A. Pre-construction testing is required on all proposed low permeability materials. CQA OFFICER is responsible for collecting all samples and testing. CONTRACTOR will provide labor and equipment as needed for the CQA OFFICER or third party representative to collect samples at source.

- B. CQA OFFICER, or designated representative shall collect sample and conduct a minimum of one grain size/hydrometer (ASTM D422), one moisture content test (ASTM D2216), one Atterberg limit test (ASTM D4318), one modified proctor test (ASTM D1557), one permeability test (ASTM D5084) and one direct shear test (ASTM D3080) on a representative sample of each source of Low Permeability Soil. This testing shall be conducted prior to the delivery of the Low Permeability Soil to the project site. The results of this testing shall be submitted for approval a minimum of 5 days before the delivery of the Low Permeability Soil to the project site.
- C. CQA OFFICER shall conduct testing consisting of interface shear tests (ASTM D5321) on the following interfaces:
 - a. Low permeability soil and Geomembrane.
- D. Direct shear testing (ASTM D3080) and interface shear testing (ASTM D5321) shall determine strength at normal stresses of 500 psf, 5,000 psf, and 10,000 psf. Each shear test shall be performed using the same installation procedures in order to represent actual field conditions. Tests shall be run on fully saturated materials under drained conditions and sheared at a displacement rate of 0.04 in/min to a minimum horizontal displacement of 3 inches. Additional samples shall be collected and tested if the material does not meet specifications as of Part 2.01 of this Section, at no additional cost to OWNER.
- E. CQA OFFICER, before delivering Low Permeability Soil to the project site, shall prepare a Hydraulic Conductivity Curve that documents and defines the soil densities and moisture contents needed to achieve the specified hydraulic conductivity. Several hydraulic conductivity tests shall be performed on samples of each Low Permeability Soil source; the tests shall cover a range of soil densities (85% to 90% of the modified proctor) and moisture contents (optimum to 8% wet of optimum). The results of the hydraulic conductivity tests shall be plotted on the moisture-density curve for the soil. The acceptable range of soil densities and moisture contents shall be those that achieve the hydraulic conductivity specification. As additional test data is developed during the installation of the Low Permeability Soil, CQA OFFICER shall add the data to the Hydraulic Conductivity Curve, as determined by such testing.
- F. CERTIFYING ENGINEER and/or CQA OFFICER reserves the right to require additional tests, and more frequent testing, when there is a change (i.e. source or physical properties) in the material being delivered to the project site, or when the materials do not comply with the specifications, at no additional cost to OWNER. CQA OFFICER or third party representative is responsible for collecting samples and testing.

1.05 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Low Permeability Soil shall be clean, substantially free of contamination, sharp rocks, gypsum, ferrous, limestone based materials or other unsuitable objects as identified by the CERTIFYING ENGINEER and classified as a GM, GC, CL or CH soil by the Unified Soil Classification System.
- B. The low permeability soil material must be free from stones greater than one inch in diameter and stones having an angular surface.
- C. The following gradation requirements serve as a general guideline for selection of material suitable for placement as low permeability soil. Deviation from these guidelines may be allowed at the discretion of the CERTIFYING ENGINEER, provided the material meets the permeability requirements identified below.
1. A minimum of 90 percent of the soil by weight shall pass a #4 sieve as determined by ASTM D422.
 2. A minimum of 40 percent of the soil by weight shall pass a #200 sieve as determined by ASTM D422.
 3. A minimum of 10 percent of the soil by weight shall be less than 0.002 mm “clay” size particles as determined by ASTM D422.
 4. The maximum clod size of soils delivered to the site shall be less than approximately 3 inches. Any clod size over approximately 3 inches in diameter that is developed through the mixing process shall be pulverized or removed prior to compaction.
- D. Low Permeability Soil shall have an in-place hydraulic conductivity equal to or less than 1×10^{-7} centimeters per second as determined by ASTM D5084.
- E. As part of the pre-construction testing (see Part 1.04 of this Section), CQA OFFICER or third party representative will collect sample and perform direct shear testing in accordance with ASTM D3080. The Low Permeability Soil shall have the following minimum internal shear strengths:

Low Permeability Soil (85 percent of the maximum dry density at 5 to 8 percent above optimum moisture content) under saturated conditions:

Shear Strength (at 500 psf) $\geq 25^\circ$

Large Displacement Shear Strength (at 5,000psf and 10,000 psf) $\geq 14^\circ$

- F. As part of the pre-construction testing (see Part 1.04 of this Section), CQA OFFICER shall perform interface shear testing in accordance with ASTM D5321. The Low Permeability Soil shall have the following minimum shear strength:

Low Permeability soil (85 percent of the maximum dry density at 5 to 8 percent above optimum moisture content) and Geomembrane under saturated conditions:

Interface shear strength (at 500 psf) $\geq 23^\circ$

Large Displacement Interface shear strength (at 5,000 psf and 10,000 psf) $\geq 14^\circ$

- G. If peak shear strength at 500 psf does not meet minimum friction angle requirement, ENGINEER may conduct veneer stability analyses that account for anchor trench soil weight and submit calculations in Certification Report confirming adequate factor of safety is obtained during short-term conditions.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Drawings, these Specifications and any pertaining local ordinances.
- B. CONTRACTOR will install a construction control grid. The control grid shall have defined positions every 50 feet across the area of the proposed baseliner. All aspects of construction shall be defined by the control grid including, but not limited to: the floor, tops and toes of slope, anchor trench, berms, and roadways. The construction control grid shall be established in rectangular coordinates and lie in the same orientation as the existing site's coordinate system.

3.02 PREPARATION

- A. CONTRACTOR and CQA OFFICER shall inspect the surface of the subgrade prior to installing the Low Permeability Soil. CONTRACTOR shall remove stones larger than approximately 3 inches in size and any other materials considered unsuitable. CONTRACTOR shall remove ponded water, remove subgrade soils softened by water, and

replace the soils with new subgrade soils. New subgrade soils placed by CONTRACTOR shall be compacted and placed to the lines and grades shown on the Drawings.

- B. CONTRACTOR shall repair erosion rills and irregularities of grade in the subgrade prior to placing the Low Permeability Soil. Repairs shall be such that the lines and grade of the subgrade are as shown on the Drawings.
- C. CONTRACTOR shall proof-roll the subgrade prior to placing the Low Permeability Soil.
- D. Prior to the placement of the Low Permeability Soil, CQA OFFICER shall verify that the subgrade surface is acceptable and that CERTIFYING ENGINEER has verified all lines and grades of the subgrade layer.
- E. The subgrade surface shall be wetted so as to prevent "wicking" of moisture from installed Low Permeability Soil and to ensure a proper bonding between layers.
- F. CONTRACTOR and CQA OFFICER shall visually inspect each truckload of material delivered to the site. The Low Permeability Soil shall be accepted for use once all parties agreed that the quality of the Low Permeability Soil visually satisfied the specifications.

3.03 TEST PAD

- A. CONTRACTOR shall construct a test pad using the same materials that will be used for the Low Permeability Soil layer. The test pad shall be approximately 75 feet wide and approximately 75 feet long, and shall be comprised of a maximum acceptable compacted lift thickness of 8 inches for all areas. The test pad will represent the first (i.e. bottom) lift of the low permeability soil liner. The minimum thickness of the completed Low Permeability Soil layer shall be at least 24 inches after compaction. It shall be constructed in the same manner (i.e. same equipment and effort) that will be used to construct the Low Permeability Soil layer. CONTRACTOR may construct the test pad in the work area. A successful test pad may be incorporated into the Low Permeability Soil layer.
- B. CQA OFFICER shall conduct in-place construction tests described in Part 3.06 to document construction of the test pad. The objective of the test pad is for CONTRACTOR to get familiar with the Low Permeability Soil to be used and to refine their procedures for installing the materials.
- C. CONTRACTOR and CQA OFFICER shall observe the test pad construction and record the work.
- D. If the test results indicate that the test pad construction does not conform to the specifications, CONTRACTOR shall reconstruct and/or rework the test pad until the test

pad conforms to specifications before beginning work on the remaining Low Permeability Soil layer.

3.04 LOW PERMEABILITY SOIL LAYER INSTALLATION

- A. CONTRACTOR shall place Low Permeability Soils in maximum 8-inch thick lifts (after compaction). The completed Low Permeability Soil layer shall be at least 24 inches thick. Shim lifts will not be allowed. While placing the Low Permeability Soil, laborers shall remove materials that do not conform to the specifications.
- B. No low permeability soil shall be placed over subgrade or low permeability layers that have not been tested and approved by the CERTIFYING ENGINEER and/or CQA OFFICER. Areas that fail testing or are otherwise unacceptable to the CERTIFYING ENGINEER and/or CQA OFFICER shall be reworked and retested as necessary.
- C. Using a bulldozer and a pad-foot vibratory roller (or similar equipment), the Low Permeability Soil shall be mixed and moisture added to achieve uniform particle size and uniform moisture content throughout the material. During the mixing process, laborers shall remove materials that do not conform to the specifications.
- D. The control of moisture is critical to achieving the desired in-place saturated hydraulic conductivity of the Low Permeability Soil layer. Thus, maintaining the moisture content shall be given a high priority by CONTRACTOR. CONTRACTOR shall provide a means for protecting all installed Low Permeability Soil against drying and freezing. If in the opinion of the CQA OFFICER, the soil is too dry to achieve proper compaction or a sufficiently low permeability, a sufficient quantity of clean water shall be added to the soil to attain an acceptable moisture content.
- E. Once the uniform particle size and moisture content are achieved, the Low Permeability Soil shall be compacted using a smooth drum vibratory roller or similar equipment to produce a smooth surface.
- F. Compaction shall be performed until the in-place density and moisture content are within the acceptable range to achieve the hydraulic conductivity specification as established by the Hydraulic Conductivity Curve (see Part 1.04). At no time shall the density be less than 85 percent of the maximum dry density, as determined by the modified Proctor test ASTM D1557.
- G. A new lift of Low Permeability Soil shall not be placed above a previously placed lift of Low Permeability Soil that has not been tested for in-place moisture content and density.
- H. Once the first lift is approved and prior to the second lift placement, the first lift shall be tracked with a bulldozer or pad-foot vibratory roller and wetted to enhance adhesion

between the upper and lower lifts. This procedure shall be followed for the placement of lifts until reaching the required minimum thickness of 24 inches.

- I. The following lifts shall be placed and compacted in the same manner as the first lift. While placing and compacting the subsequent lift of Low Permeability Soil, laborers shall remove any unsuitable materials.
- J. CONTRACTOR may need to utilize the bucket of an excavator, wooden planks attached to the laborers' work boots and/or hand-held tampers to smooth out footprints and minor ridges in the Low Permeability Soil surface.
- K. The CQA Officer or Certifying Engineer will observe the final surface of the low permeability soil layer for contaminants, such as vegetation and other foreign matter, and for rutting, ridges, or other defects that would inhibit direct contact between the low permeability soil and the overlying geomembrane. The CONTRACTOR will remedy areas identified by the CQA Officer or Certifying Engineer prior to geomembrane installation.

3.05 LOW PERMEABILITY SOIL THICKNESS CONTROL

- A. CONTRACTOR shall place Low Permeability Soils in maximum lifts of 8 inches in thickness (after compaction). The completed Low Permeability Soil layer shall be at least 24 inches thick (after compaction). Thus, a number of measures must be implemented to assess the compliance with this requirement.
- B. CONTRACTOR shall provide grade stakes set at specific control points (see Part 3.01) for line and grade controls to guide the installation of the Low Permeability Soil. Once grades are achieved and prior to the geomembrane placement, CONTRACTOR is responsible for removing all grade stakes from the Low Permeability Soil. All penetrations in the Low Permeability Soil layer shall be filled with Low Permeability Soil or bentonite.

3.06 CONSTRUCTION TESTING REQUIREMENTS

- A. CQA OFFICER shall retain the services of a qualified geotechnical laboratory to conduct construction tests on samples of Low Permeability Soil. CQA OFFICER is responsible for collecting samples and testing.
- B. CQA OFFICER shall conduct construction testing on Low Permeability Soil as follows:
 - 1. Atterberg limits tests (ASTM D4318) shall be performed on each source sample as the material is transported on-site at a minimum frequency of one test every 1,000 cubic yards placed.

2. Moisture content tests (ASTM D2216) shall be performed on each source sample as the material is transported on-site at a minimum frequency of one test every 1,000 cubic yards placed.
 3. Grain size/hydrometer test (ASTM D422) shall be performed on each source sample as the material is transported on-site at a minimum frequency of one test every 2,500 cubic yards placed.
 - a. Comparisons of the moisture-density-permeability relation shall be performed on each source sample as the material is transported on-site at a minimum frequency of one test every 5,000 cubic yards placed.
 - b. Permeability tests (ASTM D5084) shall be performed on each source sample as the material is transported on-site at a minimum frequency of one test every 5,000 cubic yards.
- C. CQA OFFICER shall conduct construction testing on in-place Low-Permeability Soil as follows:
1. Permeability tests (ASTM D5084) shall be performed on undisturbed samples of in-place compacted soils at a minimum frequency of one test every acre every 8-inch thick lift.
- D. CQA OFFICER shall conduct construction testing on in-place Low-Permeability Soil as follows:
1. Field density/Moisture content test (ASTM D2922/D3017) shall be performed on all installed Low Permeability Soil at a minimum frequency of nine tests every acre every lift. On containment berms, field density/moisture content testing shall be performed at a minimum frequency of one test every 100 linear feet every lift.
 2. Low Permeability Soil must pass the specifications as provided in Part 2.01 of this Section.
- E. CONTRACTOR shall provide labor and equipment as needed for the CQA OFFICER or third party representative to collect the required samples.
- F. OWNER, CERTIFYING ENGINEER, and/or CQA OFFICER reserves the right to require additional tests, and more frequent testing, when the materials do not comply with the specifications, at no additional cost to OWNER. CQA OFFICER or third party representative is responsible for collecting samples and testing.

3.07 PROTECTION OF INSTALLED MATERIALS

- A. CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of OWNER, and at no additional cost to OWNER.
- C. CONTRACTOR shall re-wet, rework, re-compact and retest any installed Low Permeability Soil that has a moisture content below the acceptable range defined on the Hydraulic Conductivity Curve (see Part 1.04 of this Section).
- D. Any installed Low Permeability Soil that exhibits desiccation or cracking, or has frozen, shall be reworked to attain the desired saturated hydraulic conductivity and retested prior to placing overlying liner materials at the approved of OWNER, CERTIFYING ENGINEER, and/or CQA OFFICER.
- E. To prevent the Low Permeability Soil layer from desiccating, CONTRACTOR may cover the soil layer with a plastic film on a daily basis. The plastic film shall be weighted down with sand bags or other materials to prevent transfer of air between the plastic film and soil. It is CONTRACTOR'S responsibility to maintain the moisture content within the acceptable range as shown on the Hydraulic Conductivity Curve.
- F. The final surface of the Low Permeability Soil layer shall be maintained using water and brooms to keep the surface hydrated and to manage surficial cracks. Any areas not conforming to the specifications shall be reworked and retested prior to deployment of the geomembrane. Granular bentonite may be used to fill in minor, but acceptable, cracks that developed on the surface.
- G. The daily work area shall be no larger than necessary to maintain moist soil conditions and continuous operations. Approved areas shall be covered with the geomembrane as soon as possible to prevent the surface of the low permeability soil from desiccation.
- H. To prevent the Low Permeability Soil layer from freezing, CONTRACTOR may cover the soil layer with frost blankets on a daily basis, as needed.

3.08 RECORD DRAWINGS

- A. CONTRACTOR shall submit "as-built" information within 24 hours after the completion of the Low Permeability Soil layer so CERTIFYING ENGINEER can review and compare "as-built" grades to design grades. The plan shall depict the topographic information, construction grid (refer to 3.01B), and locations where material samples were collected. No work may begin on the geomembrane until the "as-built" information is accepted by OWNER and CERTIFYING ENGINEER.

- B. CONTRACTOR shall submit “as-built” Record Drawings of the Low-Permeability Soil in accordance with Section 01780 – Record Drawings.

END OF SECTION

SECTION 02500
HDPE GEOMEMBRANE

PART 1 - GENERAL

1.05 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.06 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all geomembrane liner materials, tools, supervision, equipment, and labor consisting of but not limited to: supplying quality control certificates from the manufacturer, providing pre-construction testing (Part 1.04) and construction testing (Part 3.04), transportation, unloading and proper storage and handling, layout and placement, patching, seam testing, removal of unsuitable materials, protection of installed materials and all work incidental to the proper installation of the geomembrane liner, as specified herein and as indicated on the Contract Drawings.
- B. Coordinate geomembrane liner installation with the placement of the low permeability soil layer and the placement of the drainage layer materials.
- C. CONTRACTOR shall be responsible for geomembrane material staging areas, unloading, stockpiling, storage, and protection.

1.07 RELATED WORK

- A. Section 02300 – Low Permeability Soil Layer
- B. Section 02550 – Drainage Layer
- C. Section 02595 - Geotextile

1.08 MANUFACTURER’S TESTING REQUIREMENTS

- A. The GEOMEMBRANE MANUFACTURER shall supply the CERTIFYING ENGINEER with quality control certificates on each roll of geomembrane delivered to the site. The certificates shall conform to testing frequencies and parameters as indicated in Part 2.01 of this Section. The certificates shall, at a minimum, indicate manufacturer’s name, type of material, nominal thickness, roll width and length, and date of manufacture.

- B. Extrudate rod shall be manufactured of the same resin type as the geomembrane and shall have the physical properties as indicated in Part 2.01 of this Section.

1.09 PRE-CONSTRUCTION TESTING REQUIREMENTS

- A. OWNER will retain the services of a Geosynthetics Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) certified laboratory for performing pre-construction testing required in this Section. The results of all testing shall be completed before any geomembrane is incorporated into the work.
- B. The GEOMEMBRANE MANUFACTURER shall send samples of the geomembrane taken from rolls that will be delivered to the site to the geotechnical laboratory, as determined by the OWNER, to conduct pre-construction testing. Each sample must be identified with the corresponding roll number.
- C. At the OWNER’S direction, the laboratory shall conduct testing consisting of interface shear tests (ASTM D5321) on the following interfaces:
1. 60-mil textured HDPE Geomembrane and Low Permeability Soil Layer,
 2. 60-mil textured HDPE Geomembrane and Geotextile
- D. Each test shall determine interface strength at normal stresses as specified in the table below. Each interface shear test shall be performed using the same materials and installation procedures in order to represent actual field conditions. Tests shall be run on fully saturated materials under drained conditions and sheared at a displacement rate of 0.04 in/min to a minimum horizontal displacement of 3 inches. Additional samples shall be collected and tested if the material does not meet specifications as of Part 2.01 of this Section, at no additional cost to the OWNER.

Material	Normal Stresses for Interface Testing (psf)
60-Mil Textured HDPE Geomembrane	500 psf, 5,000 psf, 10,000 psf

1.010 LINE AND GRADE CONTROL

- A. The EARTHWORK and GEOMEMBRANE CONTRACTORS are responsible for line and grade control for all aspects of the work in this Section in accordance with the Contract Drawings and these Specifications.

1.011 SUBMITTALS

- A. The GEOMEMBRANE MANUFACTURER shall submit to the CERTIFYING ENGINEER quality control certificates on each roll of the geomembrane. Such test results must document compliance with the specifications in Part 2.01 of this Section.
- B. The GEOMEMBRANE MANUFACTURER shall submit representative samples of the geomembrane (that will be delivered to the site) to a geotechnical laboratory for pre-construction testing and samples to a Geosynthetics Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) certified laboratory for construction testing. Such test results must document compliance with the specifications in Part 2.01 of this Section.
- C. The GEOMEMBRANE CONTRACTOR shall submit geomembrane panel layout drawings to the OWNER at least 10 days prior to beginning the installation of the geomembrane. The panel layout drawings shall be prepared at scale not less than 1" = 50'. Each drawing shall show the location of geomembrane panels, seam locations, destructive sample locations, pipe penetrations and anchor trench.
- D. GEOMEMBRANE CONTRACTOR shall submit acceptable verification of installer's qualifications and experience.

1.012 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Handle and store geomembrane rolls and associated materials in such a manner as to ensure a sound, undamaged condition. Procedures shall be in conformance with manufacturer's recommendations.
- B. Rolls will be stored at the job site away from high-traffic areas but sufficiently close to the active work area to minimize handling. The designated storage area should be flat, dry and stable.
- C. Only undamaged geomembrane shall be included within this Work.
- D. The OWNER shall replace geomembrane material found to be damaged, as necessary. If such damage occurs after the commencement of Work, as determined by the OWNER and/or CQA OFFICER, the CONTRACTOR will be responsible for reimbursing the OWNER's cost of providing replacement geomembrane material, including laboratory testing, freight, and taxes. The CONTRACTOR will not be granted extensions to the completion dates as a result of the manufacturing lead-time or delivery times required for the OWNER to replace damaged geomembrane material, unless otherwise approved in writing by the OWNER.

1.013 QUALIFICATIONS

- A. The GEOMEMBRANE MANUFACTURER must have at least five years' experience in the manufacture of the specified geomembrane material. In addition, the geomembrane manufacturer shall have produced at least 10 million square feet of similar material within the last three years.
- B. The GEOMEMBRANE CONTRACTOR must have at least five years' experience in the installation of the specified geomembrane material. In addition, the geomembrane installer must have installed at least five projects involving a total of 50 acres of similar material within the last three years.
- C. The GEOMEMBRANE CONTRACTOR's supervisor must be on-site and be in responsible charge for the full duration of the geomembrane installation. The supervisor must have supervised the installation of at least 50 acres of geomembrane on a minimum of five separate projects.
- D. The GEOMEMBRANE CONTRACTOR must establish a Quality Control (QC) representative who must be responsible in the field for the quality and integrity of the geomembrane installation, including all testing, inspections, documentation and interaction with the CQA OFFICER. The QC representative must have performed these duties on at least 50 acres of geomembrane on a minimum of five separate projects.
- E. The GEOMEMBRANE CONTRACTOR is responsible for all means, methods, techniques, sequences, and procedures related to the installation of the geomembrane materials.
- F. The GEOMEMBRANE CONTRACTOR's welding personnel must be certified to operate the welder by a certification program acceptable to the New York State Department of Environmental Conservation.

PART 2 - PRODUCTS

2.01 GEOMEMBRANE

- A. The geomembrane shall be 60-mil textured high-density polyethylene (HDPE), as shown on the Contract Drawings. The texturing shall be evenly distributed on both sides of the membrane.
- B. Geomembrane materials shall be delivered to the site in rolls and shall be manufactured by GSE Lining Technologies, Inc. or approved equal.

- C. The geomembrane material shall be tested to the frequencies and physical properties as follows:

60-Mil HDPE Geomembrane Testing Frequency and Test Methods¹		
Test	Frequency	Value
Thickness (ASTM D5994)	Each roll	57 mil (min. avg.) 8 out of 10 values ² = 54 mil (min.) 10 out of 10 values ³ = 51 mil (min.)
Asperity Height (ASTM D7466)	Every second roll	16 mil (min. avg.)
Density (ASTM D1505/792)	200,000 lbs.	0.940 g/cc (min. avg.)
Tensile Properties (ASTM D6693 – Type IV)	20,000 lbs.	Yield strength: 126 psi Break Strength: 90 psi Yield elongation: 12% Break elongation: 100%
Tear Resistance (ASTM D1004)	45,000 lbs.	42 lbs. (min. avg.)
Puncture Resistance (ASTM D4833)	45,000 lbs.	90 lbs. (min. avg.)
Stress Crack Resistance (ASTM D5397) ⁴	per GRI GM10	500 hr
Carbon Black Content (ASTM D4218)	20,000 lbs.	2%-3%

Carbon Black Dispersion (ASTM D5596)	45,000 lbs.	9 values: Category 1 or 2 1 value: Category 3
Oxidative Induction Time (OIT) (e) Standard OIT (ASTM D3895) — or — (f) High Pressure OIT (ASTM D5885)	200,000 lbs.	100 (min. avg.) 400 (min. avg.)
Oven Aging at 85°C (ASTM D5721) (a) Standard OIT - % ret. after 90 days (ASTM D3895) — or — (b) High Pressure OIT - % ret. after 90 days (ASTM D5885)	per formulation	55% (min. avg.) 80% (min. avg.)
UV Resistance (GM11) (a) Standard OIT (ASTM D3895) — or — (b) High Pressure OIT -% ret. after 1600 hrs. (ASTM D5885)	per formulation	N.R. ⁵ 50% (min. avg.)

Notes: 1. Properties presented in this table are based on GRI GM13, Test Methods, Test Properties and Testing

Frequency for HDPE Smooth and Textured Geomembranes, Revision 12, dated 11/14/2014.

2. Lowest individual for 8 out of 10 values.
3. Lowest individual for any of the 10 values.
4. See note #4 in table 2(a) of GRI GM13.
5. See note #10 in table 2(a) of GRI GM13.

Geomembrane and extrudate rod shall be manufactured with the same resin type. Each batch of resin used to produce the geomembrane and extrudate rod shall have the physical properties as follows:

GEOMEMBRANE RESIN PROPERTIES AND QUALITY CONTROL TESTING REQUIREMENTS		
Test	Standard	HDPE Value
Density	ASTM D1505	0.932 g/cc (min.)
Melt Flow Index	ASTM D1238	1.0 g / 10 minutes (max)

- D. As part of the pre-construction testing (see Part 1.05 of this Section), CQA OFFICER shall conduct interface shear testing to be performed on each interface of the baseliner system in accordance with ASTM D5321. The geomembrane interfaces shall have the following minimum secant friction angles:

60-mil Textured HDPE Geomembrane and Low Permeability Soil Layer under saturated conditions:

Interface shear strength (at 500 psf) $\geq 23^\circ$

Large Displacement Interface shear strength (at 5,000 psf and 10,000 psf) $\geq 14^\circ$

60-mil Textured HDPE Geomembrane and Geotextile under saturated conditions:

Interface shear strength (at 500 psf) $\geq 25^\circ$

Large Displacement Interface shear strength (at 5,000 psf and 10,000 psf) $\geq 14^\circ$

- E. If peak shear strength at 500 psf does not meet minimum friction angle requirement, ENGINEER may conduct veneer stability analyses that account for anchor trench soil weight and submit calculations in Certification Report confirming adequate factor of safety is obtained during short-term conditions.

PART 3 – EXECUTION

3.01 GENERAL

All work shall be performed in accordance with the Contract Drawings, these Specifications and any pertaining local ordinances.

3.02 PREPARATION

- A. The GEOMEMBRANE CONTRACTOR shall conduct all work necessary to ensure that the surfaces on which the geomembrane is to be placed are free of irregularities, erosion rills, protrusions, loose soil, changes in grade, stones, rocks, sticks, roots, sharp objects, or debris of any kind that may damage the geomembrane. No areas with standing water, or which are excessively softened by high water content, shall be allowed.
- B. The low permeability soil layer must be reviewed and approved by the CQA OFFICER before placing the geomembrane.

3.03 GEOMEMBRANE BARRIER INSTALLATION

- C. Panel placement should commence at the upgradient limit of work and progress in a downhill fashion. The panels may be placed by manually unrolling the geomembrane into position or by using heavy equipment provided the chosen method does not create ruts or other damage in the underlying materials or damage the geomembrane. A smooth geomembrane rub sheet may be used.
- D. Vehicles used for geomembrane deployment shall conform to the following requirements:
 - 1. Vehicles to be used shall be approved by the CERTIFYING ENGINEER prior to use on the geosynthetics.
 - 2. Tire pressure shall not exceed five (5) psi unless otherwise approved by the CERTIFYING ENGINEER, and shall adhere to minimum ground pressure requirements.
 - 3. No sharp turns, sudden stops or quick starts shall be allowed.
 - 4. Vehicles shall be used in a controlled manner at all times and for the use of geosynthetic deployment only. Abuse or misuse of the vehicles will result in termination of such vehicles for use in geosynthetic deployment.
 - 5. No equipment other than LGP vehicles shall be used over any the low permeability soil layer.

6. Rub sheets acceptable to the CQA OFFICER must be placed underneath all tools, generators, welding equipment, etc. while on the geomembrane.
- C. The geomembrane panels must be oriented parallel to the line of maximum slope, (i.e., oriented up and down, not across, the side slope). No horizontal seams shall be within five feet of the toe of the slope or any anchor trench. No horizontal seams shall be allowed on slopes unless otherwise approved by CQA OFFICER.
- D. Adjacent panels for end of panels shall be overlapped a minimum of 12 inches. All over laps shall be such that the upslope panel is placed over the down slope panel. Horizontal end of roll seams shall be staggered every other panel upslope and downslope by a minimum of 15 feet.
- E. After the geomembrane is completely unrolled, it must be positioned. If the panel is being installed overlapping a previously placed panel, as recommended by the geomembrane manufacturer, care must be taken to align the sheets for seaming. When positioned, wrinkles shall be worked out of the geomembrane, prior to seaming.
- F. All deployed panels must be provided with ballast to prevent their movement. Ballast shall be provided, as needed, to prevent the movement of deployed geomembrane. At a minimum, sand in burlap bags should be placed every 1 to 2 feet along a seam.

3.04 GEOMEMBRANE SEAMING

- A. All geomembrane seam welding shall be by the hot-wedge (fusion) weld method. The welding equipment shall form a double-track fusion weld seam with an air channel in between. Extrusion welding is allowed but shall be limited to detail work and patching, and shall not be used as a general method of seaming unless otherwise approved by CQA OFFICER. The welding process shall be in accordance with the geomembrane manufacturer's recommendations.
- B. Prior to field seaming, the geomembrane surface shall be free of dust, silt and debris. Furthermore, the welding surface must be dry and at the proper temperature as recommended by the geomembrane manufacturer. The installer should be equipped with an ample supply of clean rags to dry and remove dust from the welding surface. A means for preheating the seam prior to welding may be necessary in cold weather.
- C. Seaming shall only be performed under proper weather conditions. The highest and lowest allowable ambient temperatures for welding are based on conditions such as ambient temperature, wind, subgrade conditions, exposure to sunlight, material type, and material thickness. Welding in such temperatures may be performed by increasing or decreasing the welding speeds and/or wedge temperature. Seaming shall not be

- performed during periods of precipitation, or when winds are in excess of 20 miles/hour. Unless otherwise approved, field seaming is prohibited when the ambient temperature is below 32°F and above 120°F as measured six inches above the geomembrane surface, or when the sheet temperature exceeds 158 °F. CQA OFFICER at its discretion may request cessation of seaming due to unacceptable weather conditions or may require an increase in the number of trial welds and/or supplemental destructive seam testing.
- D. All seams shall extend the full length of the panels being joined. Repairs shall be placed at all panel intersections. When seaming adjacent panels along an anchor trench, the seam shall extend completely through the anchor trench. Plywood or other flat surfaces shall be used to bridge the trench while welding the seam.
- E. All "fish-mouths" and wrinkles on a seam shall be removed by cutting the geomembrane and installing an overlapping patch.
- F. The CONTRACTOR shall not conduct any seaming operations without prior notification of CQA OFFICER.

3.05 PATCHING

- E. Once the geomembrane has been deployed, the panels must be examined for flaws, holes, defects and tears. Each location requiring a repair shall be repaired using the following procedures:
1. Patching - A patch shall be used to repair defects in the geomembrane that are 1/8-inch or larger.
 2. Abrading and Re-welding - This procedure may be used to repair seam sections that are less than 10 feet in length
 3. Spot Welding - Spot welding may be used to repair small tears, pinholes and/or other small defects.
 4. Capping – Capping shall be used to repair failed seams that are greater than 10 feet in length.
- F. Patches or caps shall extend at least six inches beyond the edge of the defect. The edges of the patch or cap shall be extrusion welded to the in place geomembrane after both the liners are abraded to remove the surface sheen of the geomembrane and to provide a surface that is more conducive to accepting the weld. Welding of the repair patch or cap shall be completed by extrusion welding the geomembrane. The repairs shall be non-destructive tested using the vacuum-box method as described in this Section.

- G. The CONTRACTOR shall not conduct repairs without prior notification of CQA OFFICER.

3.06 GEOMEMBRANE TESTING

H. TRIAL WELD TESTS

1. The CONTRACTOR shall perform trial welds for each piece of welding equipment to be used as follows: at the beginning of each seaming period, at least once every four (4) hours, when the person running the welding equipment has changed, when the welding equipment has been shut-off or has been unused for a period for one hour or longer, and if there has been a 20°F rise or drop in ambient temperature since the last passing trial weld. CQA OFFICER may require more frequent trial welds when the ambient air temperature is less than 40°F or CQA OFFICER's observations of seam conditions warrant additional trails welds.
2. Trial welds shall be performed on fragment pieces of geomembrane, varying in length between three-feet (extrusion welds) to ten-feet (double-track welds) long and one (1) foot wide. Once completed, the weld shall be visually inspected for deficiencies before taking a minimum of seven, one-inch wide random specimens from the trial weld. The seven specimens shall be tested by the CONTRACTOR for peel and shear strength (five in peel, two in shear) using a field tensiometer with the results being properly recorded by the CONTRACTOR and CQA OFFICER. When peel testing is performed, both welds of double fusion welds shall be tested to provide an indication of the quality of the weld. All trial weld specimens shall exhibit a film tear bond (FTB) and shall meet or exceed the minimum seam strength requirements in Section C part f of this specification section. Only those pieces of equipment that provide passing test results shall be used for seaming or repair work
3. Additional trial welds shall be performed for failed samples. This retesting procedure includes adjusting the temperature of the double-track hot-wedge (or extrusion welding gun) and/or the speed at which the double-track hot-wedge weld is performing. Once adjustments have been made, additional trial welds shall be made and tested. If the specimen fails the retest, the seaming apparatus and procedures will not be accepted and shall not be used for seaming until the deficiencies are corrected and a minimum of two consecutive successful trial welds are achieved.
4. The CONTRACTOR shall not conduct trial welds without prior notification of CQA OFFICER.

I. NON-DESTRUCTIVE TESTS

1. The CONTRACTOR shall perform non-destructive tests on all welds during the seaming process to establish seam continuity. All seams constructed in the field shall be subjected to non-destructive testing along their entire lengths (including seams that pass through the anchor trench).
2. The CONTRACTOR shall verify the continuity of the entire length of hot wedge welded field seams by performing an air pressure test.
3. The air pressure test shall be performed on all double-track hot-wedge welds. This test method involves the application of air pressure (27 to 30 psi for 60-mil HDPE) to the channel between the parallel welds and observing the stability of the pressure for the duration of the test. After a two-minute (minimum) relaxation period to stabilize the air pressure in the channel, the pressure shall be at least 27 psi for 60-mil HDPE before beginning the test. The test shall be at least 5 minutes in length. If a pressure loss exceeding 3 psi is observed, the seam shall be considered discontinuous (unacceptable) and repairs shall be made.
4. At the conclusion of a passing seam channel test, the end of the seam channel opposite the pressure test gauge must be cut to relieve the pressure. If the pressure gauge does not detect a drop in pressure, it must be assumed that the seam channel is blocked. In this case, the location of the blockage must be identified and the seam retested in segments for continuity.
5. The CONTRACTOR shall verify all field seams constructed by the extrusion welding method by performing the vacuum box test.
 - a) The vacuum box test shall be used on seams that cannot be tested by air pressurization. After a generous amount of soapy solution has been applied to the seam length to be tested, the vacuum box test apparatus shall be placed over the seam and a vacuum of at least 2 psi shall be applied to the seam or until the tested area has risen off the ground due to the applied vacuum. During the test, the response of the soapy solution shall be observed and noted. Bubbling of the solution indicates the presence of a hole or discontinuity. The location of holes and discontinuities shall be marked and repaired.
 - b) The CONTRACTOR shall not conduct any non-destructive seam tests without prior notification to CQA OFFICER.

J. DESTRUCTIVE TESTS

1. The CONTRACTOR shall verify that all seam welds are fully integrated with each other and evaluate seam strength by collecting seam samples for destructive testing. At a minimum, one seam sample shall be taken, at random, every 1,000 feet of seam length, per seaming machine operating, per day. The locations of seam samples shall be determined by CQA OFFICER. If field conditions warrant, or the CQA OFFICER suspects a seam may not have been constructed properly, samples may be collected at a greater frequency.
2. Each destructive sample, measuring twelve (12) inches wide and fifty (50) inches long, shall be cut from the seam by the CONTRACTOR. Seven 1-inch wide by 12-inch long specimens shall be cut from each sample by the CONTRACTOR. Each specimen shall be tested in the field by the CONTRACTOR for peel and shear strength (five in peel, two in shear) using a field tensiometer with the results being properly recorded by the CONTRACTOR and CQA OFFICER. When peel testing is performed, both welds of double fusion welds shall be tested to provide an indication of the quality of the weld. All specimens shall exhibit a film tear bond (FTB). The peel strength of four out of five specimens in peel shall meet or exceed the minimum seam strength requirements. The fifth specimen must meet or exceed 80% of the minimum seam strength requirements. If the sample passes the field peel and shear tests, the remaining sections shall be cut and distributed as follows
 - a. one 12 inch by 12 inch section for OWNER's archives,
 - b. one 12 inch by 12 inch section for the CONTRACTOR, and
 - c. one 12 inch by 18 inch section for shear and peel testing by CQA OFFICER'S independent laboratory.
3. Each of the 12-inch by 18-inch samples for laboratory testing shall provide 10 specimens: five for shear and five for peel. When peel testing is performed, both welds of double fusion welds shall be tested to provide an indication of the quality of the weld. All specimens shall exhibit a film tear bond (FTB). The peel (shear) strength of four out of five specimens in peel (shear) shall meet or exceed the minimum seam strength requirements. The fifth specimen must meet or exceed 80% of the minimum seam strength requirements.
4. If the sample fails the peel and shear tests by CQA OFFICER'S laboratory, then the CONTRACTOR has the following options to reconstruct the seam between the failed location and any passed test section, which include:

- a. cap stripping of the seam, or
 - b. replacing the failed seam with a new two foot wide panel that is double-track welded to the adjacent panels, or
 - c. retrace the failed seam in both directions, by taking additional samples for destructive testing and conducting field peel and shear tests, until the length of the poor quality seam is established. Additional destructive samples shall be collected at minimum intervals of ten (10) feet from the location of the failed sample. Upon attaining passing results from the destructive samples, the seam shall be reconstructed between the passing location and the original failed location.
5. All passing seams shall be bound by two locations from which passing laboratory destructive tests have been taken. Reconstructed seams of over 50 feet or more in length must have a sample taken from the reconstructed seam in order to pass the destructive testing.
6. Testing of the geomembrane seams shall be performed in accordance with ASTM D6392, in conjunction with GRI-GM19. All seams shall meet the requirements in the following table:

Material	Peel Strength		Peel Separation	Shear Strength
	Extrusion Weld	Hot Wedge Weld		
60 mil textured HDPE	78 ppi	91 ppi	25%	120 ppi

K. PIPE PENETRATIONS

1. The Contractor shall furnish all liner penetration boots and other appropriate material required to complete the installation of the geomembrane. All geomembrane boots shall be of the same sheet density and at least as thick as the liner to which they are being welded.
2. Geomembrane penetrations are to be minimized. The CONTRACTOR is cautioned that no deviation in the quantity or configuration of geomembrane penetrations will be accepted without the advance written approval of CQA OFFICER.

3. In attaching the geomembrane liner penetration boot in the field, no field seams or welds will be allowed in locations or configurations that do not allow for quality control testing. Visual observation is not considered a sole acceptable method for in-field quality control.
4. Where field non-destructive testing cannot be performed, attachments shall be field spark tested by standard leak detectors. Spark testing shall be done in areas where both air pressure testing and vacuum testing is not possible.
5. Where clamps, fasteners, gaskets, seals or sealants are used, the Contractor shall use only materials that are compatible with the geomembrane material and the proposed material to be contained.
6. The CONTRACTOR shall provide suitable documentation to indicate that the clamps or fasteners will maintain their seal through adverse temperature cycles.

L. CONSTRUCTION TESTING

1. Owner will retain the services of a GAI-LAP certified laboratory for performing construction testing on samples of the geomembrane liner.
2. The GEOMEMBRANE MANUFACTURER shall send a sample of the geomembrane every 100,000 square feet to an independent laboratory, as determined by OWNER, to conduct construction testing. The samples shall be a minimum of three feet long by the entire roll width and shall not include the first five feet of roll length. These samples shall be analyzed for the parameters listed below.
 - a. Thickness (ASTM D5994)
 1. Asperity Height (ASTM D7466)
 2. Density (ASTM D1505)
 3. Tensile Properties (ASTM D638)
 4. Tear Resistance (ASTM D1004)
 5. Puncture Resistance (ASTM D4833)
 6. Carbon Black Content (ASTM D1603)
 7. Carbon Black Dispersion (ASTM D5596)

3. Geomembrane must pass the specifications as provided in Part 2.01 of this Section.
4. OWNER, CERTIFYING ENGINEER, and/or CQA OFFICER reserves the right to require additional tests, and more frequent testing, when the materials do not comply with the specifications.

3.07 ELECTRICAL RESISTIVITY LEAK LOCATION

- A. After placement of the soil drainage layer, an electrical resistivity leak location evaluation and/or other geomembrane liner integrity evaluation must be conducted on the geomembrane in areas with slopes of 10 percent or less. The testing must be conducted by a person independent of the liner installer.
- B. Electrical resistivity leak location evaluation must be performed in accordance with standards of ASTM D8265 - Standard Practices for Electrical Methods for Mapping Leaks in Installed Geomembranes.
- C. Prior to the commencement of the electrical leak location survey, the electrical leak location consultant shall submit a Work Plan to CQA Officer. The Work Plan shall include qualifications of the proposed electrical leak location consultant including square footage and number of projects of successful application of leak location methods performed, description of the proposed survey method, procedures, site preparations, estimated duration of survey, and quality control and field calibration procedures.
- D. Geomembrane leak location survey using electrical methods requires the conductive media above and below the geomembrane to be electrically isolated from each other. A continuous electrically conducting pathway through the material above the geomembrane, through the leaks, and through the low permeability soil under the geomembrane is required. CONTRACTOR shall install necessary electrodes, wires, etc. as required in the electrical leak location Work Plan.

3.08 PROTECTION OF INSTALLED MATERIALS

- A. The CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. The geomembrane shall be properly secured and/or ballasted so as to prevent uplift by wind or landfill gases.

- C. Damaged geomembrane and scrap material are the property of the CONTRACTOR and shall be removed from the site and disposed of at a disposal location approved by the OWNER at the CONTRACTOR'S expense. The CONTRACTOR shall retain all ownership and responsibility for the geomembrane until final acceptance of the entire project by OWNER.
- D. In the event of damage to prior work or work completed as specified in this Section, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of OWNER, and at no additional cost to OWNER.

3.09 RECORD DRAWINGS

- A. CONTRACTOR shall submit "as-built" Record Drawings in accordance with Section 01780 - Record Drawings.

3.10 WARRANTY

- A. The manufacturer shall warrant that the geomembrane liners be free from manufacturing defects and that the geomembrane, when properly installed and maintained, shall not suffer significant deterioration due to normal weather aging.
- B. The CONTRACTOR shall guarantee the geomembrane installation against defects in the installation and workmanship for one year commencing with the date of final acceptance.

END OF SECTION

SECTION 02550
DRAINAGE LAYER

PART 1 - GENERAL

1.014 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.015 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to the proper installation of the drainage layer, as specified herein and as indicated on the Contract Drawings. Drainage Layer materials will be available from an on-site stockpile.

1.016 PRE-CONSTRUCTION TESTING REQUIREMENTS

- A. Pre-construction testing is required on all proposed materials for use in the drainage layer. CQA OFFICER is responsible for collecting all samples and testing. CONTRACTOR will provide labor and equipment as needed for the CQA OFFICER or third party representative to collect samples at material source for testing.
- B. CQA OFFICER shall conduct a minimum of one grain size test (ASTM D422), one soil classification (ASTM D2487), one permeability test (ASTM D2434), one carbonate content (ASTM D4373) using a solution with a pH representative of landfill leachate, and one direct shear test (ASTM D3080) on a representative sample of each source of drainage layer materials. This testing shall be conducted prior to the delivery of drainage layer materials to the project site. The results of this testing shall be submitted to the CERTIFYING ENGINEER a minimum of 5 days before the delivery of drainage layer materials to the project site.
- C. CQA OFFICER shall conduct testing consisting of interface shear tests (ASTM D5321) on the following interfaces:
- a. Geotextile vs. Drainage Layer Material
- D. Direct shear testing (ASTM D3080) and interface shear testing (ASTM D5321) shall determine strength at normal stresses of 500 psf, 5,000 psf, and 10,000 psf. Each shear

test shall be performed using the same installation procedures in order to represent actual field conditions. Tests shall be run on fully saturated materials under drained conditions and sheared at a displacement rate of 0.04 in/min to a minimum horizontal displacement of 3 inches. Additional samples shall be collected and tested if the material does not meet specifications as of Part 2.01 of this Section, at no additional cost to OWNER.

- E. OWNER, CERTIFYING ENGINEER and/or CQA OFFICER reserve the right to require additional tests, and more frequent testing, when there is a change (i.e. source or physical properties) in the material being delivered to the project site, or when the materials do not comply with the specifications, at no additional cost to OWNER. CQA OFFICER or third party representative is responsible for collecting samples and testing.

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Contract Drawings and these Specifications.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Drainage layer materials shall be clean, free of contamination, sharp rocks, debris of any kind, organic matter, vegetation, gypsum, ferrous, limestone based materials or any other unsuitable objects.
- B. Drainage layer materials must have less than 5 percent by weight pass the No. 200 sieve.
- C. Drainage layer materials must have no more than 15 percent calcium carbonate equivalent and be tested using a solution with a pH representative of landfill leachate.

- D. Drainage layer materials must meet filter criteria below:

$$\frac{D_{15} \text{ (Drainage Material)}}{D_{85} \text{ (Crushed Stone)}} = <5$$

$$\frac{D_{15} \text{ (Crushed Stone)}}{D_{15} \text{ (Drainage Material)}} = >4 \text{ and } <20$$

$$\frac{D_{50} \text{ (Drainage Material)}}{D_{50} \text{ (Crushed Stone)}} = <25$$

- E. Drainage layer material placed on slopes less than or equal to 10 percent shall have a minimum hydraulic conductivity of 1.0 centimeters per second, as determined by ASTM D2434.
- F. Drainage layer material placed on slopes greater than 10 percent shall have a minimum hydraulic conductivity of 0.1 centimeters per second, as determined by ASTM D2434.
- G. As part of the pre-construction testing (see Part 1.03 of this Section), the CQA OFFICER shall perform direct shear testing in accordance with ASTM D3080. The drainage layer materials shall have the following minimum secant friction angles:

Drainage layer material (at dry density required to meet minimum permeability):

$$\text{Shear Strength (at 500 psf)} \geq 25^\circ$$

$$\text{Large Displacement Shear Strength (at 5,000 psf and 10,000 psf)} \geq 14^\circ$$

- H. As part of the pre-construction testing (see Part 1.04 of this Section), CQA OFFICER shall perform interface shear testing in accordance with ASTM D5321. Drainage layer materials shall have the following minimum strengths:

Drainage layer materials (at maximum dry density required to achieve minimum permeability) vs. Geotextile:

$$\text{Interface shear strength (at 500 psf)} \geq 25^\circ$$

$$\text{Large Displacement Interface shear strength (at 5,000 psf and 10,000 psf)} \geq 14^\circ$$

- I. If peak shear strength at 500 psf does not meet minimum friction angle requirement, ENGINEER may conduct veneer stability analyses that account for anchor trench soil weight and submit calculations in Certification Report confirming adequate factor of safety is obtained during short-term conditions.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Contract Drawings, these Specifications and any pertaining local ordinances.
- B. CONTRACTOR will install a construction control grid. The control grid shall have defined positions every 50 feet across the area of the proposed baseliner. All aspects of construction shall be defined by the control grid including, but not limited to, the floor, tops and toes of slope, anchor trench, berms, and roadways. The construction control grid shall be established in rectangular coordinates and lie in the same orientation as the existing site's coordinate system.

3.02 PREPARATION

- A. The CONTRACTOR shall ensure that the surface of the geomembrane shall be free of scraps of the liner, wastes, loose soil, stones, rocks, sticks, roots, sharp objects, or debris of any kind that may damage the geomembrane during placement of the drainage layer material.
- B. All geomembrane testing shall be completed and passed before placing the drainage layer material.

3.03 DRAINAGE LAYER MATERIALS INSTALLATION

- A. Drainage layer materials shall be spread directly on top of the geotextile surface. The drainage layer materials shall have a minimum thickness, after compaction, of approximately 24 inches as shown on the Contract Drawings.
- B. Placement of the material should be performed using a low ground pressure bulldozer. The tracked equipment shall operate only over previously placed drainage layer materials. The CONTRACTOR shall not operate equipment directly on the geotextile surface.
- C. The equipment used to spread the drainage layer material shall not exert ground pressures exceeding the following:

Allowable Equipment Ground Pressure (psi)	Thickness of Drainage Layer Above Geomembrane (in.)
< 5	12
< 10	18
< 20	24
> 20	36

- D. No equipment, including LGP equipment, will be allowed to travel over geomembrane layers with less than 12 inches of drainage layer materials.
- E. When traveling on drainage layer materials spread over the geomembrane and geotextile layers, vehicle speeds and turning shall be minimized to the satisfaction of the CERTIFYING ENGINEER and/or CQA OFFICER to avoid rutting, bouncing, and other stresses on the underlying geosynthetics.
- F. Spreading of drainage layer materials shall be done so as to avoid stretching, wrinkling or creasing of the geosynthetics.
- G. Drainage layer materials shall be spread from the bottom of the slopes to the top, unless otherwise approved by the OWNER and the CQA OFFICER.
- H. CONTRACTOR shall post one spotter at each piece of equipment spreading drainage layer materials over the geosynthetics at all times of active material spreading. At a minimum, the spotter shall walk out wrinkles, inspect for unacceptable objects within the drainage layer materials, and ensure lifts of adequate depth. The presence of the OWNER, CERTIFYING ENGINEER, or CQA OFFICER shall not relieve the CONTRACTOR from the responsibility to post a spotter.

3.04 CONSTRUCTION TESTING REQUIREMENTS

- A. The CQA OFFICER shall retain the services of a qualified geotechnical laboratory to conduct construction tests on samples of drainage layer materials. All collection of samples and testing is the responsibility of the CQA OFFICER.
- B. The CQA OFFICER shall conduct construction testing on the drainage layer materials as the soils are delivered to the site as follows:

1. Grain size test (ASTM D422) shall be performed at a minimum frequency of one test every 1,000 cubic yards.
 2. Permeability test (ASTM D2434) shall be performed at a minimum frequency of one test every 2,500 cubic yards.
- C. The CQA OFFICER shall conduct construction testing on the drainage layer materials in-place as follows:
1. Permeability test (ASTM D2434) shall be performed at a minimum frequency of one test in-place every 2,500 cubic yards.
- D. CONTRACTOR shall provide labor and equipment as needed for the CQA OFFICER or third party representative to collect the required samples.
- E. Drainage layer materials must pass the specifications as provided in Part 2.01 of this Section.
- F. OWNER, CERTIFYING ENGINEER, and CQA OFFICER reserves the right to require additional tests, and more frequent testing, when the materials do not comply with the specifications, at no additional cost to the OWNER. CQA OFFICER or third party representative is responsible for collecting samples and testing.

3.05 PROTECTION OF INSTALLED MATERIALS

- A. The CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the OWNER, and at no additional cost to the OWNER.

3.06 RECORD DRAWINGS

- A. The CONTRACTOR shall submit “as-built” information to the OWNER within five (5) days after the completion of the drainage layer so the CERTIFYING ENGINEER can review and compare “as-built” grades to design grades. The plan shall depict the topographic information, construction grid (refer to 3.01B), and locations where material samples were collected.
- B. CONTRACTOR shall submit “as-built” Record Drawings in accordance with Section 01780 – Record Drawings.

END OF SECTION

SECTION 02595
GEOTEXTILES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limiting to: hauling, unloading, storing, and placing the woven and non-woven geotextile, protection of installed materials, and all work incidental to the proper installation of the geotextiles, as specified herein and as indicated on the Contract Drawings.

1.03 RELATED WORK

- A. Not Used.

1.04 PRE-CONSTRUCTION TESTING REQUIREMENTS

- A. OWNER will retain the services of a Geosynthetics Accreditation Institute – Laboratory Accreditation Program (GAI-LAP) certified laboratory for performing pre-construction testing required in this Section. The results of all testing shall be completed before any geomembrane is incorporated into the work.
- B. The GEOTEXTILE MANUFACTURER shall send samples of the geotextile taken from rolls that will be delivered to the site to the certified laboratory, as determined by the OWNER, to conduct pre-construction testing. Each sample must be identified with the corresponding roll number.
- C. At the OWNER’S direction, the laboratory shall conduct testing consisting of interface shear tests (ASTM D5321) on the following interfaces:
- a. Geotextile and 60-mil textured HDPE Geomembrane
 - b. Geotextile and the Drainage Layer
- D. Each test shall determine interface strength at normal stresses of 500 psf, 5,000 psf, and 10,000 psf. Each interface shear test shall be performed using the same materials and

installation procedures in order to represent actual field conditions. Tests shall be run on fully saturated materials under drained conditions and sheared at a displacement rate of 0.04 in/min to a minimum horizontal displacement of 3 inches. Additional samples shall be collected and tested if the material does not meet specifications as of Part 2.01 of this Section, at no additional cost to the OWNER.

- E. OWNER, CERTIFYING ENGINEER and/or CQA OFFICER reserve the right to require additional tests, and more frequent testing, when there is a change (i.e. source or physical properties) in the material being delivered to the project site, or when the materials do not comply with the specifications, at no additional cost to OWNER. CQA OFFICER or third party representative is responsible for collecting samples and testing.

1.05 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Contract Drawings and these Specifications.

1.06 SUBMITTALS

- A. The GEOTEXTILE MANUFACTURER shall submit to the CERTIFYING ENGINEER quality control certificates on each roll of the geotextile. Such test results must document compliance with the specifications in Part 2.01 of this Section.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Handle and store geotextile rolls and associated materials in such a manner as to ensure a sound, undamaged condition. Procedures shall be in conformance with manufacturer's recommendations.
- B. Rolls will be stored at the job site away from high-traffic areas but sufficiently close to the active work area to minimize handling. The designated storage area should be flat, dry and stable.
- C. Geotextile will be rejected if it is found to have defects, rips, holes, flaws, deterioration or other damage.

PART 2 – PRODUCTS**2.01 16 OZ. NON-WOVEN GEOTEXTILE**

- D. The 16-ounce non-woven needle-punched polypropylene geotextile shall be manufactured by LINQ Industrial Fabrics, Inc. or approved equal.
- E. The non-woven geotextile shall meet the following requirements.

Property	Test Method	Minimum Requirements
Mass per Unit Area	ASTM D5261	16 oz./SY
Grab Tensile Strength	ASTM D4632	370 lbs.
Grab Elongation	ASTM D4632	50%
Puncture Strength	ASTM D4833	170 lbs.
Trapezoidal Tear Strength	ASTM D4533	145 lbs.

- F. As part of the pre-construction testing (see Part 1.04 of this Section), CQA OFFICER shall conduct interface shear testing to be performed on each interface of the baseliner system in accordance with ASTM D5321. The geotextile interfaces shall have the following minimum secant friction angles:

Geotextile and 60-mil Textured HDPE Geomembrane and Geotextile and Drainage Layer under saturated conditions:

Interface shear strength (at 500 psf) $\geq 25^\circ$

Large Displacement Interface shear strength (at 5,000 psf and 10,000 psf) $\geq 14^\circ$

- G. If peak shear strength at 500 psf does not meet minimum friction angle requirement, ENGINEER may conduct veneer stability analyses that account for anchor trench soil weight and submit calculations in Certification Report confirming adequate factor of safety is obtained during short-term conditions.

PART 3 - EXECUTION**3.01 GENERAL**

- A. All work shall be performed in accordance with the Contract Drawings, these Specifications and any pertaining local ordinances.

3.02 PREPARATION

- A. The base surface shall be cleared of sharp objects, boulders, stumps, or any materials that may contribute to fabric punctures, shearing, rupturing or tearing. The subgrade shall be inspected for unstable areas or soft spots, before the fabric is placed and additional fill shall be placed and compacted to eliminate those unstable areas.

3.03 INSTALLATION

- A. When placing the geotextile, sections placed on slopes shall be placed so that the upper strip of geotextile overlaps the next lower strip by six inches. Fabric shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.
- B. Bulldozer blades or buckets shall not be in direct contact with the geotextile. If geotextile should be damaged, a piece of geotextile material shall be cut and placed over the damaged area and overlap the undamaged material a minimum of 3 feet in each direction.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. The CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the OWNER, and at no additional cost to the OWNER.

END OF SECTION

SECTION 02800
ACCESS ROADS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division -1 General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to proper installation of the access roads, as specified herein and on the Contract Drawings.

1.03 RELATED WORK

- A. Section 02810 – Stones
B. Section 02595 – Geotextile

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. NYSDOT #2 Crushed Stone (703-0201) shall be used as the top course for the proposed gravel access roads, as shown on the Contract Drawings.
1. NYSDOT #2 Crushed Stone (703-0201) shall conform to the specifications of Section 02810, Stone.
- B. NYSDOT #5 Screened Gravel (703-0203) shall be used as the base course for the proposed gravel access roads, as shown on the Contract Drawings.

1. NYSDOT #5 Screened Gravel (703-0203) shall conform to the specifications of Section 02810, Stone.
- C. Woven geotextile shall be used beneath the base course of the proposed gravel access roads, as shown on the Contract Drawings.
1. Geotextile shall conform to the specifications of Section 02950, Geotextile.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Contract Drawings, these Specifications and any pertaining local ordinances.

3.02 PREPARATION

- A. Before placing material on the access road, CONTRACTOR shall ensure that the subgrade layer is at the line and grade required by the Drawings.

3.03 ACCESS ROAD CONSTRUCTION

- A. Width of each access road shall be constructed as shown on the Contract Drawings.
- B. Contractor shall construct the access road by placing a woven geotextile above the existing subgrade soils and fill the respective base course and top course stones to the specified minimum thicknesses as shown on the Contract Drawings. The material shall be compacted via several passes of a roller.
- C. Loam and seed shall be placed on exterior berm slopes at the locations shown on the Contract Drawings.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. The CONTRACTOR shall be responsible for maintaining installed materials and prevent their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the OWNER, and at no additional cost to the OWNER.

3.05 RECORD DRAWINGS

- A. The CONTRACTOR shall submit “as-built” information to the OWNER within five (5) days after the completion of the access roads so the CERTIFYING ENGINEER can review and compare “as-built” grades to design grades.
- B. CONTRACTOR shall submit “as-built” Record Drawings in accordance with Section 01780 – Record Drawings.

END OF SECTION

SECTION 02810
STONE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 SCOPE OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to the proper installation of each respective stone, as specified herein and on the Contract Drawings.
- B. The CONTRACTOR is responsible for conducting pre-construction testing (see Part 1.03 of this Section) and construction testing (see Part 3.03 of this Section) on a representative sample of each size and source of each stone material.

1.03 RELATED WORK

- A. Section 02800 – Access Roads
- B. Section 02850 – Stormwater Controls

1.04 PRE-CONSTRUCTION TESTING REQUIREMENTS

- A. CONTRACTOR shall retain the services of a qualified geotechnical laboratory to conduct pre-construction tests on samples of each stone material.
- B. CONTRACTOR shall conduct a minimum of one grain size test (ASTM D422) on a representative sample of size and source of each stone material. This testing shall be conducted prior to the delivery of stone to the project site. The results of this testing shall be submitted to the CERTIFYING ENGINEER a minimum of 5 days before the delivery of stone to the project site.
- C. CONTRACTOR shall conduct a minimum of one standard test for insoluble residue in carbonate aggregates (ASTM D-3042) on a representative sample of each stone material to be used as leachate collection stone. Stone shall exhibit a maximum acid solubility of 15 percent. This testing shall be conducted prior to the delivery of stone to the project

site. The results of this testing shall be submitted to the CERTIFYING ENGINEER a minimum of 5 days before the delivery of stone to the site.

- D. OWNER, CERTIFYING ENGINEER, and/or CQA OFFICER reserves the right to require additional tests, and more frequent testing, by CONTRACTOR when there is a change (i.e. source or physical properties) in the material being delivered to the project site, or when the materials do not comply with the specifications, at no additional cost to the OWNER.

1.05 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Contract Drawings and these Specifications.

1.06 SUBMITTALS

- A. The CONTRACTOR shall submit to the OWNER representative samples of each source of stone prior to delivery of the materials to the project site. OWNER may elect to conduct tests on said sample.
- B. The CONTRACTOR shall submit to the CERTIFYING ENGINEER testing results of pre-construction tests conducted on representative samples of each stone material. The results of this testing shall be submitted to the CERTIFYING ENGINEER a minimum of 5 days after the tests are completed. Such test results must document compliance with the specifications in Part 2.01.

PART 2 - PRODUCTS

2.01 NYSDOT #2 CRUSHED STONE (703-0201)

- A. The NYSDOT #2 crushed stone (703-0201) shall be used as the top course for the proposed gravel access roads and as leachate collection pipe stone, as shown on the Contract Drawings.
- B. The crushed stone shall consist of clean, durable, sharp-angled fragments of rock of uniform quality.
- C. The crushed stone used as aggregate for all items shall be obtained from sources conforming to the requirements of the Department as to sampling, testing methods, Quarry Reports, and any other required procedures.

2.02 NYSDOT #4 CRUSHED STONE (703-0204)

- A. The NYSDOT #4 crushed stone (703-020) shall be used as leachate collection pipe stone, as shown on the Contract Drawings.
- B. The crushed stone shall consist of clean, durable, sharp-angled fragments of rock of uniform quality.
- C. The crushed stone used as aggregate for all items shall be obtained from sources conforming to the requirements of the Department as to sampling, testing methods, Quarry Reports, and any other required procedures.

2.03 NYSDOT #5 SCREENED GRAVEL (703-0203)

- A. The NYSDOT #5 screened gravel (703-0203) shall be used as the base course for the proposed gravel access roads, as shown on the Contract Drawings.
- B. The screened gravel shall consist of clean, durable gravel free from coatings. Screened gravel may consist of all uncrushed particles and shall be obtained from sources conforming to the requirements for crushed gravel.

2.04 NYSDOT “FINE” STONE FILLING

- A. The NYSDOT “fine” stone filling shall be used as backfill around the proposed stormwater diffuser, as shown on the Contract Drawings.
- B. The NYSDOT “fine” stone filling shall be clean, free of contamination, debris of any kind, organic matter, vegetation, limestone based materials or any other unsuitable objects.
- C. NYSDOT “fine” stone filling shall be within the following limits:

Stone Filling Item	Stone Size	Percent of Total By Weight
Fine	Smaller than 200 mm	90-100
	Larger than 75 mm	50-100
	Smaller than 2.0 mm	0-10

NOTES:

1. Stone sizes, other than weights, refer to the average of the maximum and minimum dimensions of a stone particle as estimated by the engineer.
2. Materials shall contain less than 20 percent of stones with a ratio of maximum to minimum dimension greater than three.

3. Air-cooled blast furnace slag, cobbles, or gravel having at least one fractured face per particle are acceptable substitutes for stone under these items, provided that the soundness and gradation requirements are met.
4. Materials shall contain a sufficient amount of stones smaller than the average stone size to fill in the spaces between the larger stones.

2.05 STONE RIP-RAP

- A. The stone rip-rap stone shall be clean, free of contamination, debris of any kind, organic matter, vegetation, limestone based materials or any other unsuitable objects.
- B. Stone rip-rap shall consist of a well-graded rip-rap, consisting of a D_{50} of 6 inches and within the following limits:

Sieve Size	Percent Finer
12"	100
4" – 6"	30 – 60
2" – 4"	30 – 40
1" – 2"	10 – 20
Less than 1"	0 – 10

- C. The breadth or thickness of a single stone shall not be less than 1/3 its length.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Contract Drawings, these Specifications and any pertaining local ordinances.

3.02 STONE INSTALLATION

- A. The NYSDOT #2 crushed stone (703-0201) shall be installed as the top course for the proposed gravel access roads, to the depths and widths as shown on the Contract Drawings.
- B. The NYSDOT #5 screened gravel (703-0203) shall be installed as the base course for the proposed gravel access roads, to the depths and widths as shown on the Contract Drawings.
- C. The NYSDOT "fine" stone filling shall be placed as backfill around the proposed stormwater diffuser, to the depths and widths as shown on the Contract Drawings.

- D. Stone rip-rap shall be placed at the proposed apron outlet locations, to the depths and widths as shown on the Contract Drawings.

3.03 CONSTRUCTION TESTING REQUIREMENTS

- A. The CQA OFFICER shall retain the services of a qualified geotechnical laboratory to conduct construction tests on each sample of Stone.
- B. The CQA OFFICER shall conduct construction testing on each type of Stone as the stone is delivered to the site as follows:
 - 1. Grain size test (ASTM D422) shall be performed at a minimum frequency of one test every 500 cubic yards.
- C. The stone must pass the specifications as provided in Part 2 of this Section.
- D. CONTRACTOR shall facilitate the CQA OFFICER in obtaining the required samples.
- E. OWNER, CERTIFYING ENGINEER, and CQA OFFICER reserves the right to require additional tests, and more frequent testing, when the materials do not comply with the specifications, at no additional cost to the OWNER.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. The CONTRACTOR shall be responsible for maintaining installed materials and preventing their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the OWNER CERTIFYING ENGINEER, and/or CQA OFFICER and at no additional cost to the OWNER.

END OF SECTION

SECTION 02820
HDPE PIPES & FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limiting to all work incidental to the proper installation and testing of the high-density polyethylene (HDPE) piping, as specified herein and as indicated on the Drawings.
- B. Solid and perforated HDPE pipe shall be used in the leachate collection and removal system.

1.03 RELATED WORK

- A. Section 01669 – Testing Pipe Systems
- B. Section 02150 – Excavation & Trenching

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

1.05 REFERENCES

- A. American Society for Testing and Materials (ASTM):
1. ASTM D-638-95 - Test Method for Tensile Properties of Plastics.
 2. ASTM D-790-86 - Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 3. ASTM D-1238-88 - Test Method for Flow Rates of Thermoplastic by Extrusion Plastometer.

4. ASTM D-1248-84 - Specification for Polyethylene Plastics Molding and Extrusion Materials.
5. ASTM D-1505-85 - Test Method for Density of Plastics by Density-Gradient Technique.
6. ASTM D-1693-70 - Test Method for Environmental Stress - Cracking of Ethylene Plastics.
7. ASTM D-2122-88 - Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings.
8. ASTM D-2513-95(c) - Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
9. ASTM D-2837-88 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
10. ASTM D-3261-88 - Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
11. ASTM D-3350-84 - Polyethylene Plastic Pipe and Fittings Material.
12. ASTM F-1055-95 - Electrofusion Type Polyethylene Fittings.

1.06 SUBMITTALS

- A. CONTRACTOR shall submit shop drawings detailing the dimensioning and technical specifications for all pipe, culvert, and fittings.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Pipe Storage:
 1. Store or stack pipe to prevent damage from marring, crushing or puncture. Limit maximum stacking height to 6 feet or manufacturer's maximum recommended height, whichever is less.
 2. Store in accordance with manufacturer's recommendations.
- B. Pipe handling:
 1. Protect pipe from excessive heat or harmful chemicals.

PART 2 - PRODUCTS**2.01 PHYSICAL PROPERTIES OF HDPE PIPE RESIN**

- A. Density: ASTM D-1505, not less than 0.941 – 0.955 gm/cu cm.
- B. Melt Flow: ASTM D-1238 - Condition E, not greater than 0.15.
- C. Flexural Modulus: ASTM D-790, 110,000 to less than 160,000 psi.
- D. Tensile Strength at Yield: ASTM D-638, 3,000 to less than 3,500 psi.
- E. Environmental Stress Crack Resistance (ESCR): ASTM D-1693 - Condition C, shall be in excess of 5,000 hrs with zero failure.
- F. Hydrostatic Design Basis: ASTM D-2837, 1600 psi at 23°C.

2.02 HDPE PIPE

- A. High performance, high molecular weight, high density polyethylene pipe (type PE 4710 resin).
- B. ASTM D-1248 (Type III, Class C, Category 5, P34).
- C. ASTM D-3350, minimum cell classification value 345434C.
- D. Standard dimension ratio: See Drawings.
- E. Marking: Intervals of 5 ft or less.
 - 1. Manufacturer's name or trademark.
 - 2. Nominal pipe size.
 - 3. Type of plastic resin (i.e., PE 3408).
 - 4. Standard dimension ratio (i.e., SDR-17)
 - 5. ASTM D-2413.
 - 6. Extrusion date, period of manufacture or lot, or batch number.
- F. Dimensions:
 - 1. Conform to standard dimensions and tolerances of ASTM D-2513.

2.03 HDPE FITTINGS

- A. Fittings from polyethylene compound having cell classification equal to or exceeding compound used in pipe to insure compatibility of polyethylene resins.
- B. Polyethylene fittings shall be molded for sizes 6-inch and smaller and shall be fabricated from polyethylene pipe for sizes 8-inch and larger by means of thermal butt-fusion. Extrusion welds on fittings will not be allowed. The ends of the fabricated fittings shall not be trimmed to match the pipe section to which they are going to be joined. All polyethylene fittings shall have the same or higher pressure rating as the pipe when installed in accordance with the latest technical specifications.
- C. Joints.
 - 1. Joints shall be thermal butt-fusion, except where connecting to unions, valves, and equipment with connections that may require future disassembly.
 - 2. No mechanical couplings shall be used unless shown on the Drawings.
 - 3. Extrusion welds will not be allowed.
- D. Flange Connections:
 - 1. 150-lb carbon steel or convoluted epoxy coated ductile iron backup rings for flanged connections as recommended by manufacturer.
 - 2. Type 316 stainless steel, zinc plated hex head nuts and bolts, and accompanying flat washers.
 - 3. Viton full-face flange gaskets.
 - 4. Flanges and bolt patterns consistent with ANSI B16.5/AWWA C207/ASTM A536, as recommended by manufacturer.
- E. Dimensions of fittings conform to standard dimensions and tolerances according to ASTM D-3261.
- F. Markings:
 - 1. Manufacturer's name or trademark.
 - 2. Nominal size.
 - 3. Type of plastic resin (i.e. PE 4710).

4. Standard dimension ratio (i.e., SDR-17).
 5. ASTM D-2513.
 6. Extrusion date, lot number, or batch number.
- G. Pressure rating of fittings shall be equal to or greater than pressure rating of pipe.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Pipe may be rejected for failure to conform to Specifications, or for:
1. Fractures or cracks passing through pipe wall, except a single crack not exceeding two (2) inches in length at either end of pipe that could be cut off and discarded. Pipes within one shipment will be rejected if defects exist in more than 5% of shipment or delivery.
 2. Cracks sufficient to impair strength, durability, or serviceability of pipe.
 3. Defects indicating improper proportioning, mixing, and molding.
 4. Damaged ends, where such damage would prevent making satisfactory joints.
- B. Acceptance of fittings, stubs, or other specifically fabricated pipe sections shall be based on visual observation by the OWNER or ENGINEER at the Project site and documentation that they conform to these Specifications.

3.02 INSTALLATION

- A. General:
1. Perform trenching, backfilling, and compaction in accordance with Sections 02150.
 2. Pipes and fittings shall be carefully lowered into trench to limit stress to pipes, fittings, and joints.
 3. Pipe and fittings shall be installed so that there will be no deviation at the joints and so that inverts present a smooth surface. Pipe and fittings that do not fit together to form a tight fitting joint are not permitted.
 4. Pipes shall be installed at the locations and to the required lines and grades shown in the Construction Drawings and provided in these Specifications,

using an approved method of control. The CQA OFFICER has the authority to order the removal or relaying of pipe laid contrary to the specifications, her/his instructions, or during her/his absence.

5. Excavations shall be maintained free of water during the progress of the work. No pipes shall be laid in water nor shall there be any joints made up in water. All slides or cave-ins of the trenches or cuts shall be remedied to the satisfaction of the CQA OFFICER.
6. Cleanliness of installed pipe and fitting interiors shall be maintained throughout the Work. Cap pipe sections longer than single joint (usually 40 feet) on both ends during placement, except during fusing operations.
7. All adjustments to the line and grade of pipe laid on earth foundation shall be done by scraping away or placing compacted fill under the barrel of the pipe, and not by blocking or wedging the pipe. Wherever the excavation has been over excavated to a depth in excess of six (6) inches, the CQA OFFICER may order crushed stone or gravel fill be placed in the excavation to provide the proper grade. In all cases, the trench under the joint shall be excavated to permit an even bearing surface for the barrel of the pipe.
8. When unsuitable materials and/or conditions are encountered, the CQA OFFICER may direct the excavation to continue below grade and the trench filled with gravel or crushed stone foundation, or the CQA OFFICER may order other corrective measures.
9. Fittings shall be installed as required and in accordance with the Construction Drawings and Specifications. The installation of fittings after the pipeline has been laid will not be permitted without written approval from the CQA OFFICER. In such cases, complete details pertaining to the proposed type of fittings and the installation procedure shall be submitted by the CONTRACTOR to the CQA OFFICER for review before approval will be considered.
10. Approval by the CQA OFFICER is required prior to changing the location of any of the Work due to field conditions. Changes in pipe sizes are prohibited without a written consent from the CQA OFFICER.
11. All installed pipe shall form completely connected systems, including connections to valves and appurtenances specified in other sections, to result in a satisfactorily operating installation.

B. Heat Fusion of HDPE Piping:

1. HDPE pipe shall be joined by butt-fusion methods, having a uniform and monolithic pipe interior according to the fusion joining procedures as instructed by the manufacturer, except within the structures, as shown in the Construction Drawings.
2. Each individual performing fusion joining shall have at least one (1) year of experience in the use of the fusion procedure.
3. Join pipe sections at ground level to a maximum length of 400 feet, or a length recommended by the manufacturer such that maximum allowable stress, when pulling the pipe into position alongside the trench, is not exceeded. Use appropriate materials and equipment, as recommended by the HDPE pipe manufacturer, when pulling butt-fused pipe sections alongside the trench to prevent pipe damage.
4. For summertime installations, it may be necessary to provide a slightly longer length of HDPE pipe when connections are to be made between two fixed points or structures to compensate for contraction of the pipe in a cooler trench bottom. The additional pipe length requirements shall be in accordance with the HDPE pipe manufacturer's instructions.
5. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.
6. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade.
7. Do not subject pipe to strains that will overstress or buckle pipe or impose excessive stress on joints.
8. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment will be of the size to facilitate saddle fusion within the trench.
9. Before butt fusing pipe, each length shall be observed for presence of dirt, sand, mud, shavings, and other debris or animals. Remove all materials from the inside of the pipe.
10. At end of each working day, cover open ends of fused pipe. Cap to prevent entry by animals or debris.

11. Use compatible fusion techniques when polyethylene pipes of different melt indexes are fused together. Refer to manufacturer's specifications for compatible fusion.
 12. Interior pipe joints shall be de-beaded to provide a smooth interior surface. De-beading shall be performed using manufacturer recommended tools and equipment.
- C. Flange Joining:
1. Use on flanged pipe connection sections.
 2. Connect slip-on backup flanges with nuts and bolts.
 3. Butt fuse flange adapters to pipe.
 4. Observe the following precautions when connecting flanged joints.
 - a. Align flanges or flange/valve connections to provide a tight seal. Viton full-face gaskets are required for flange/valve connections.
 - b. Place U.S. Standard round washers as may be required on some flanges per manufacturer's recommendations. Bolts shall be lubricated in accordance with manufacturer's recommendations.
 - c. Tighten flange bolts in sequence and in accordance with manufacturer's recommendations. CAUTION: Do not over-torque the bolts. CONTRACTOR shall be required to use a torque wrench to secure flanged connections.
 - d. Pull bolt down by degrees to uniform torque in accordance with manufacturer's recommendations.
- D. Pipe Placement
1. Grade control equipment shall accurately maintain design grades and slopes during installation of pipe.
 2. Maximum lengths of fused pipe to be handled as one section shall be placed according to manufacturer's recommendations as to pipe size, pipe SDR, and topography so as to not cause excessive gouging or surface abrasion; but not to exceed 400 feet.
 3. Notify CQA OFFICER prior to installing pipe into trench and allow time for CQA OFFICER'S observation.
 4. Correct irregularities found during inspection.

5. Complete connections within trench whenever possible to prevent overstressed connections.
6. Complete flanged branch saddle connections within trench.
7. Allow pipe sufficient time to adjust to trench temperature prior to any testing, segment connections, or backfilling activity.
8. Install reducers adjacent to laterals or tees.
9. To reduce branch saddle stress, saddles shall be installed at slope equal to and continuous with lateral piping.
10. Place in trench by allowing at least 12 inches/100 feet for thermal contraction and expansion.
11. Coordinate construction of header lines near access roads with OWNER to limit interruptions to normal landfill operations.

3.03 PIPE TESTING

- A. Test pipe sections in accordance with Section 01669, Testing Pipe Systems.
- B. Pig all pipe sections to clean pipe shavings prior to placing the leachate collection and removal system in operation.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. All installed materials shall be maintained so as to assure compliance with materials and installation specifications.
- B. In the event of damage to prior work or work completed as specified in this Section, CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of OWNER, CERTIFYING ENGINEER, and CQA OFFICER and at no additional cost to OWNER.

3.05 RECORD DRAWINGS

- A. CONTRACTOR shall submit “as-built” Record Drawings of all pipe locations and elevations in accordance with Section 01780 - Record Drawings.

END OF SECTION

SECTION 02850
STORMWATER CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all materials, tools, supervision, equipment, and labor consisting of but not limited to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to installation and maintenance of storm water controls, as specified herein and on the Contract Drawings.

1.03 RELATED WORK

- A. Section 02880 – Loam/Seeding/Erosion Mat
B. Section 02150 – Excavation & Trenching

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Contract Drawings and these Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Drainage Swales
1. The drainage swale shall consist of the following:
 - Loam and seed shall be in accordance to specification Section 02880.
 - Erosion control mat shall be in accordance to specification Section 02880.

PART 3 - EXECUTION**3.01 GENERAL**

- A. All work shall be performed in accordance with the Contract Drawings, these Specifications and any pertaining local ordinances.

3.02 STORM WATER CONTROL INSTALLATION

- A. Drainage Swale
1. The drainage swale shall be installed at the dimensions and locations as indicated on the Contract Drawings.

3.03 PROTECTION OF INSTALLED MATERIALS

- A. The CONTRACTOR shall be responsible for maintaining installed materials and prevent their damage.
- B. In the event of damage to prior work or work completed as specified in this Section, the CONTRACTOR shall immediately make all repairs and replacements necessary, to the approval of the OWNER, and at no additional cost to the OWNER.

3.04 RECORD DRAWINGS

- A. CONTRACTOR shall submit “as-built” Record Drawings of all pipe and structure locations and all associated stormwater control elevations in accordance with Section 01780 - Record Drawings.

END OF SECTION

SECTION 02880
LOAM/SEEDING/EROSION MAT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Division 1 – General Specification sections, apply to the work of this Section.

1.02 DESCRIPTION OF WORK

- A. The work in this Section includes the furnishing of all tools, supervision, equipment, and labor consisting of but not limiting to: hauling, grading, drying, removal of storm water, removal of unsuitable materials, protection of installed materials and all work incidental to the proper installation of the loam/seedling/erosion mat, as specified herein and as indicated on the Drawings.

1.03 RELATED WORK

Not Applicable.

1.04 LINE AND GRADE CONTROL

- A. CONTRACTOR is responsible for line and grade control for all aspects of the work in this Section in accordance with the Drawings and these Specifications.

1.05 SUBMITTALS

- A. Contractor shall submit shop drawings detailing the dimensioning and technical specifications for the erosion mat.
- B. Contractor shall submit the seed vendor's certified statement for each grass seed mixture and other data substantiating that materials comply with specified requirements.

PART 2 - PRODUCTS**2.01 MATERIALS****A. LOAM**

1. Native topsoil, which has been stripped and stockpiled on site by the CONTRACTOR, may be utilized, where approved by the OWNER and/or CERTIFYING ENGINEER.
2. The material shall be original loam of rich, uniform grade, without admixture of subsoil and shall be free from hard clods, stiff clay, hard pan, sods, large stones, lime, cement, bricks, coal ashes, cinders, slags, concrete, tar or its residue, boards, sticks, or other deleterious matter.
3. The loam material shall be graded within the following limits:

Sieve Size	Percent Finer
1-inch	100%
¼-inch	100 – 97%
#200 sieve	20 – 65%

4. The loam shall contain not less than 5% or more than 20% organic matter in that portion of any sample that passes a ¼-inch sieve, when determined by the wet combustion method of a sample dried at 105° C.

B. SEEDING

1. Loam shall be a mixture of vegetative species comprised of one of the following recommended seed mixtures, or an approved equal.

Common Name	Seeding Rate (lbs/acre)	Seeding Rate (lbs/1,000 ft ²)
Empire Birdsfoot Trefoil OR Common White Clover	8 lbs/acre	0.2 lbs/ ft ²
Tall Fescue	20 lbs/acre	0.45 lbs/ ft ²
Redtop OR Perennial Ryegrass	2 lbs/acre (Redtop) 5 lbs/acre (Ryegrass)	0.05 lbs/ ft ² 0.10 lbs/ ft ²

2. Fertilizer: Available nutrients, percent by total weight.
 - a. 10% nitrogen.
 - b. 10% phosphorus.
 - c. 10% potassium.
3. Hard, caked material will not be acceptable.
4. Limestone: Ground limestone with a minimum total neutralizing value of 88% calcium carbonate equivalence; minimum 90% passing the 20 mesh sieve and minimum 60% passing the 100 mesh sieve; and hard, caked material will not be accepted.
5. Starter fertilizer shall be applied to the loam layer areas at a rate as determined by the manufacturer of the material.

C. EROSION CONTROL MAT

1. The erosion control mat used within the proposed drainage swales shall be VMax[®] P550[®] Turf Reinforcement Mat, as manufactured by North American Green, or approved equal. The selection of an erosion mat is subject to the approval of the CERTIFYING ENGINEER.
2. The erosion control mat used for slope stabilization shall be ECP-3[™] Polypropylene Turf Reinforcement Mat, as manufactured by East Coast Erosion Blankets, LLC, or approved equal. The selection of an erosion mat is subject to the approval of the CERTIFYING ENGINEER.

PART 3 - EXECUTION

3.01 GENERAL

- A. All work shall be performed in accordance with the Drawings, these Specifications and any pertaining local ordinances.

3.02 PREPARATION

- A. Contractor shall ensure that the surfaces where loam is to be placed shall be graded to a uniform slope.
- B. Surfaces with loam that are ready for the placement of seed shall be prepared by tracking the seedbed perpendicular to the slope or raking the slope.

- C. Any erosion rills in the seedbed must be repaired before seeding.

3.03 INSTALLATION

- A. Loam shall be spread in the drainage swales, exterior slope of the berms, and all vegetated areas disturbed by construction. The loam shall have a minimum thickness, after compaction, of 4 inches, as shown on the Drawings.
- B. Grading of the loam material may be accomplished via depth markers, or other approved method, to establish the thickness of the loam material layer. Depth markers shall be removed once the material has been installed.
- C. Seed may be spread by a broadcast spreader or using hydro-seeding methods. CONTRACTOR shall be responsible for re-seeding in areas of poor germination.
- D. A minimum of 150 lbs. of seed mixture must be applied per acre.
- E. Contractor shall submit the testing data from an approved soils laboratory, which provides recommendations for the application rates for fertilizer and lime appropriate for the soil to be used. Contractor will provide such test information for each new source of soil.
- F. Hay, straw mulch, or erosion control matting shall be applied, as necessary, to areas that have been seeded.
- G. The proposed erosion control mat shall be installed within the perimeter drainage swales, as shown on the Contract Drawings.

3.04 PROTECTION OF INSTALLED MATERIALS

- A. Contractor shall be responsible for maintaining installed materials in conformance with the requirements of this Section. CONTRACTOR will be responsible for vegetation growth 1 year from final date of seeding. A satisfactory stand of growth will be defined as a section of grass of 10,000 square feet or larger that has:
 - 1. No bare spots larger than three (3) square feet.
 - 2. No more than ten percent (10%) of total area with bare spots larger than one (1) square foot.
 - 3. No more than fifteen percent (15%) of total area with bare spots larger than 6-inches square.
 - 4. The observations by the ENGINEER or OWNER will determine whether maintenance shall continue in any area found deficient.

- B. In the event of damage to prior work or work completed as specified in this Section, Contractor shall immediately make all repairs and replacements necessary, to the approval of Owner and CQA OFFICER and at no additional cost to Owner.

END OF SECTION