Construction CQA/CQC Plan

Chaffee Facility - Area 7/8 Development

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PRESENTED TO

Waste Management of New York
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REPORT CERTIFICATION

The material and data in this report were prepared under the supervision and direction of the undersigned.

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APPENDICES

1.0 INTRODUCTION

This Quality Control/Quality Assurance plan has been prepared for the construction of the Area 7/8 Development at the Chaffee Facility in Erie County, New York. The plan describes the organizational structure of the Quality Control team. It includes the reporting structure, personnel requirements, laboratory tests and equipment required for field-testing.

The Area 7/8 Development consists of constructing two new cell areas to the south of the existing Western Expansion with minor modification to Cell 1 of the Western Expansion. The development includes additional fill over the Western Expansion. The following procedure indicates the major steps used during the construction of this double composite lined landfill cell:

- Strip topsoil and vegetation from work areas;
- Remove Closed Landfill cap materials and over excavate vertical pipes as required;
- Install and test gas collection pipes;
- Excavate and relocate existing waste materials;
- Proofroll and test subgrade areas that will require fill placement;
- Prepare and test embankment material test pads as required;
- Excavate and fill the subgrade to the design grades;
- Proof roll and test the excavated subgrade areas;
- Replace and test Closed Landfill gas venting geosynthetics;
- Replace and test Closed Landfill cap geomembrane;
- Install and test Closed Landfill cushion geotextile;
- Prepare and test secondary clay material test pads as required;
- Screen clay liner materials for the required lifts of the secondary clay liner and berm caps;
- Place and test lifts of secondary clay liner;
- Install and test secondary geomembrane liner;
- Install and test secondary geocomposite;
- Install and test primary geomembrane liner;
- Install and test cushion geotextile;
- Install and test primary collection pipes;
- Install primary collection stone materials;
- Test the primary and secondary geomembranes using electrical resistivity (only required on floor/bench areas);
- Weld primary to secondary geomembranes along all edges and install berm caps:
- Monitor the secondary collection system flow data for a minimum of 30 days.

Prior to the new construction at the site, Waste Management of New York (WMNY) must submit engineering reports, design drawings, and specifications for all new construction of landfill components described in this Subpart prior to construction. Construction must not commence before written approval is received from the department. A pre-construction meeting must be held prior to commencement of construction. This meeting must include, at a minimum:

- distribution to each involved entity of relevant CQA and CQC documents and supporting information;
- review the role of specific CQA and CQC requirements in demonstrating conformance with design criteria;
- review of established acceptance and rejection criteria as specified in CQA and CQC plan;
- review of methods for documenting and reporting all data;
- review of procedures for storage and protection of landfill construction materials on-site; and
- a site walk-around to identify project site layout and material and equipment storage locations;

The owner or operator must notify the department at least seven days prior to each of the following activities:

- the pre-construction meeting;
- commencement of construction of the soil component of the secondary composite liner;
- commencement of placement of the primary and secondary geomembrane liner, and
- commencement of geomembrane liner integrity testing.

2.0 PROJECT ORGANIZATION

2.1 PERSONNEL

The QA/QC Project Organization Chart is presented on the following page. Lines of authority and communication are shown in solid black and lines of communication are shown in light gray. Qualifications of personnel proposed for QA/QC tasks will be submitted to NYSDEC for review as requested.

2.1.1 Project Engineer

The Project Engineer is responsible for all QA/QC activities including the field technicians, the geotechnical testing laboratory and the QA/QC surveyor. Additionally, the Project Engineer will communicate directly with the NYSDEC, the design engineer, the owner and the contractor. The Project Engineer will be a Licensed Professional Engineer, registered to practice in New York State with at least 10 years experience in the design and construction of landfills meeting the requirements of 6 NYCRR Subpart 360.2. The Project Engineer will have a B.S. degree in Civil Engineering. The Project Engineer will visit the site periodically and as necessary to oversee and manage CQA activities.

The Project Engineer will be on site during all critical phases of construction and testing. It is expected that the Project Engineer will be on site daily during the:

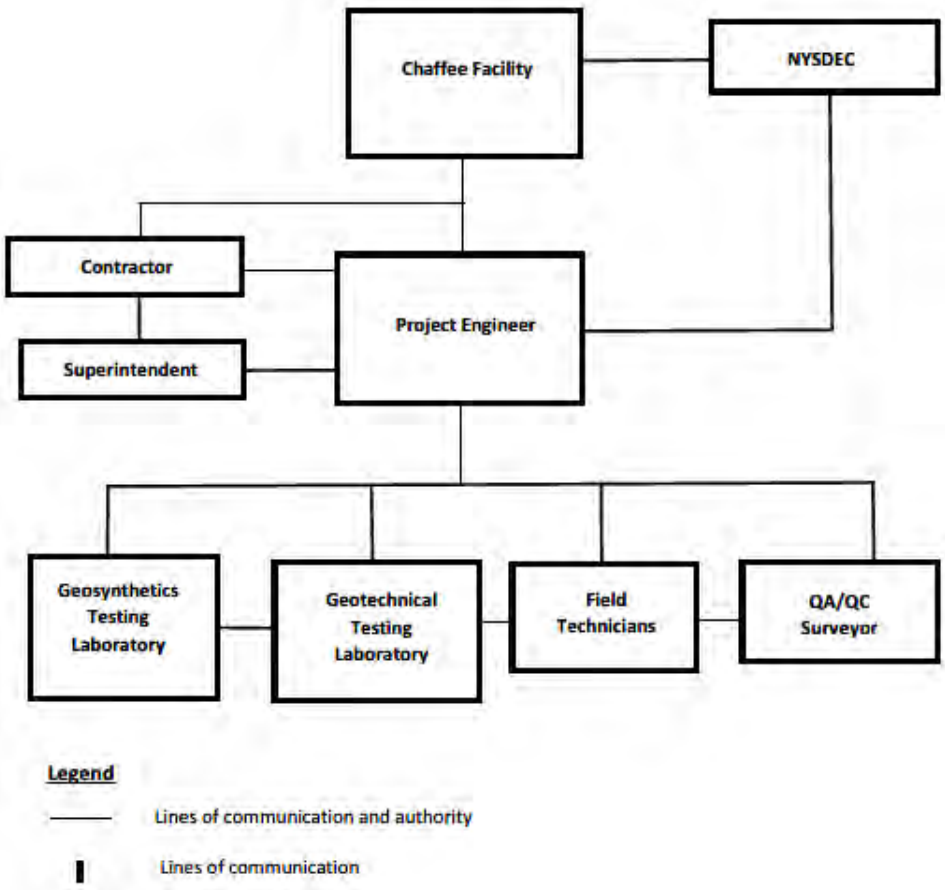
- Subgrade evaluation,
- Embankment fill placement,
- Sump and gas well excavations and modifications,
- Closed Landfill cap removal and waste excavation,
- Closed Landfill cap replacement,
- Clay liner construction,
- Geomembrane placement,
- Geotextile deployment,
- Leachate collection system construction, and
- Stormwater management construction.

The Project Engineer will serve as the primary contact with the contractor.

2.1.2 Field Technicians

A field technician(s) will be assigned to the project to perform field tests and to collect samples as described elsewhere in this plan. The number of technicians assigned to the project will depend on the number of activities on-going concurrently. The field technicians will have experience in the aspects of the construction that they are assigned to monitor. Typically, this individual will have a construction or civil technology degree. Since they will be required to operate a soil nuclear moisture density gauge, they will be required to have completed the certification course for the instrument before construction begins. Field technicians will complete soil sampling, in place density testing and other field-testing and sampling tasks assigned by the QA/QC or the Project Engineer.

Chaffee Facility
QA/QC Project
Organization Chart



2.1.3 QA/QC Surveyor

QA/QC surveyor will measure the constructed dimensions of the facility and check the measurements against the project requirements. The QA/QC surveyor will be licensed in New York State and will seal the record drawings for inclusion in the final report.

2.1.4 Contractor

The contractor's superintendent will be required to demonstrate successful completion of at least two similar landfill construction projects, at least one of which has been completed in the past five years. This must include experience placing low permeability soil liner material. The project superintendent will be required to demonstrate experience supervising construction of a double composite lined landfill of similar magnitude.

The geomembrane contractor and his personnel will be required to demonstrate successful installation of at least 50 acres of geomembrane similar to that required for this project. Additionally, the liner contractor will be required to submit qualifications for individuals involved with supervision and the seaming activities. The geomembrane installation foreman will be required to have supervised the installation of at least 50 acres of geomembrane on at least five projects similar to that required for this project. Personnel involved with geomembrane seaming will be required to demonstrate experience seaming at least 10,000 feet of seams.

2.2 LABORATORIES

A geotechnical testing laboratory and a geosynthetics testing laboratory is required to execute this QA/QC plan. The geotechnical testing laboratory is required to test samples of soil used to construct this facility following ASTM standard methods or other appropriate testing protocols. The geosynthetics testing laboratory will be required to test geomembrane, geotextile and geonet samples. The laboratories shall be managed by an individual with at least five years experience in the testing of soils and at least two years of experience testing geosynthetics following ASTM standards or other industry accepted standards. The laboratory manager is responsible for the results of all tests done in the laboratory and he will report directly to the Project Engineer. Gauges and scales used by the laboratories must be part of a regular calibration program.

2.3 LEAK LOCATION SURVEY FIRM

2.3.1 Qualifications and Experience

Leak Location Contractor shall be an independent third party unrelated by ownership or relation to the general contractor, or geomembrane installation contractor and have qualifications and experience in conducting the survey method, including having tested a minimum of 5,000,000 square feet of geomembrane liner on 5 projects within the previous three years. In addition, the leak location surveys must be supervised by a professional or technician with a minimum of three years and 2,000,000 square feet of geomembrane testing experience on at least 3 projects using the leak location survey method. The leak location supervisor must be on site full-time during the performance of the leak location survey.

2.3.2 Responsibilities

The leak location firm will have the following responsibilities for implementation of the CA/QC Plan:

- Perform leak location surveys on primary and secondary geomembrane systems following placement of soil cover.
- The Leak Location Contractor will identify actions required by the Contractor to prepare the site for a survey, such as:
    - Moving/disconnecting electrical equipment
    - Cleaning/preparing soil surfaces
    - Providing moisture to the soil surface, as directed by the leak location firm representative.
    - Gridding a soil surface
    - Providing electrode access to leaked liquid
    - Removing/marking obstructions to the survey
- Providing electrodes to the Contractor prior to installation of underlying subgrade, as applicable;
- Installation/calibration of a test leak and calibration of system sensitivity;
- Providing daily updates and maintaining direct communication with the Project Engineer regarding status of survey;
- “Fine tuning” potential locations of potential leaks and confirmation of leak after removal of soil cover;
- Leak testing of the repaired geomembrane;
- Providing a final report documenting procedures used and identification of detected leaks (including emplaced holes in the liner system).

2.3.3 Data Recording

The Leak Location Contractor shall furnish equipment for performing the Work that automatically records and stores the leak location survey data in electronic format at the time of data collection (continuous survey data recording) and that can be post-processed for data plotting and analysis. The data must be taken with a density

no less than 3,000 data points per acre to ensure proper data density is achieved to find the smallest damage possible. A “data point” is the electrical reading taken by a single pair of dipole electrodes, spaced a minimum of 36” apart, and a maximum of 44.5” apart. Subsequent lines of data must be taken a maximum of 5 feet apart.

2.4 TEST METHODS

The following table summarizes the test methods that will be required to complete the project. The tests will be completed by the manufacturer, supplier, geotechnical or geosynthetics lab, and the contractor’s installation crew or field technicians. The test methods are as follows:

TEST	TEST DESIGNATION
Test Method for Particle Size Distribution of Soils Using Sieve Analysis	ASTM D6913
Test Method for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using a 10 Pound (4.54 kg) Rammer and 18 inch (457 mm) Drop	ASTM D1557
Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table	ASTM D4253
Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density	ASTM D4254
Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	ASTM C88
Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	ASTM C131/C535
Test Method for Insoluble Residue in Carbonate Aggregates	ASTM D3042
Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)	ASTM D6938
Test Method for In-Place Bulk Density of Soil and Soil-Aggregate by a Low-Activity Nuclear Method (Shallow Depth)	ASTM D8167
Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures	ASTM D2216
Test Method for Permeability of Granular Soils (Constant Head)	ASTM D2434
Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils	ASTM D4318
Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter	ASTM D5084
Test Method for Unconsolidated-Undrained Triaxial Compressive Test on Cohesive Soils	ASTM D2850

TEST	TEST DESIGNATION
Test Method for Shear Strength of Soil - Geosynthetic or Geosynthetic - Geosynthetic Interfaces by Direct Shear	ASTM D5321
Test Method for Measuring of Core Thickness of Textured Geomembrane	ASTM D5994
Test Method for Measuring Asperity Height of Textured Geomembranes	ASTM D7466
Test Method for Density of Plastics by the Density-Gradient Technique	ASTM D1505
Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement	ASTM D792
Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer	ASTM D1238
Test Method for Carbon Black Content in Olefin Plastics	ASTM D1603
Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique	ASTM D4218
Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics	ASTM D5596
Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes	ASTM D6693
Test Method for Tear Resistance of Plastic Film and Sheeting	ASTM D1004
Test Method for Index Puncture Resistance of Geomembranes and Related Products	ASTM D4833
Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test	ASTM D5397
Test Method for Oxidative Induction Time of Polyolefins by Differential Scanning Calorimetry	ASTM D3895
Standard Practice for Air-Oven Aging of Polyolefin Geomembranes	ASTM D5721
Test Method for Effect of Exposure of unreinforced Polyolefin Geomembrane using Fluorescent UV Condensation Apparatus	ASTM D7238
Standard Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids	ASTM D5747
Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry	ASTM D5885
Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber	ASTM D5641

TEST	TEST DESIGNATION
Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes	ASTM D5820
Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods	ASTM D6392
Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples	ASTM D4873
Test Method for Measuring Mass per Unit Area of Geotextiles	ASTM D5261
Test Method for Grab Breaking Load and Elongation of Geotextiles	ASTM D4632
Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50 mm Probe	ASTM D6241
Test Method for Trapezoid Tearing Strength of Geotextiles	ASTM D4533
Test Method for Determining Apparent Opening Size of a Geotextile	ASTM D4751
Test Methods for Water Permeability of Geotextiles by Permittivity	ASTM D4491
Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)	ASTM D5035
Test Method for Measuring the Nominal Thickness of Geosynthetics	ASTM D5199
Standard Guide for Determination of the Allowable Flow Rate of a Geosynthetic Drainage Geocomposite	GRI – GC8
Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head	ASTM D4716
Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites	ASTM D7005
Standard Practice for Sampling Freshly Mixed Concrete	ASTM C172
Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete	ASTM C1064
Standard Test Method for Slump of Hydraulic-Cement Concrete	ASTM C143
Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method	ASTM C231
Standard Practice for Making and Curing Concrete Test Specimens in the Field	ASTM C31
Test Method for Compressive Strength of Cylindrical Concrete Specimens	ASTM C39
Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete	ASTM C42

2.5 TESTING EQUIPMENT

The following equipment is required for measuring compliance of earthwork and liner installation activities. Calibration and certification certificates will be required for equipment that is used to test soil and geosynthetics.

2.5.1 Soil Nuclear Moisture Density Gauge

This instrument will be used for measuring the in-place soil moisture content and unit weight. The unit(s) used for this project will have been recently calibrated by factory trained representatives and leak tested. The operator (Field Technician) shall operate the instrument according to manufacturer's recommendations.

2.5.2 Vacuum Box

This instrument will be used to check seams made using the extrusion welding methods for defects. The instrument must be similar to that described in ASTM method D4437. The pressure gauge on the instrument must be clearly visible and calibrated before its use.

2.5.3 Field Pressure Gauges

Pressure gauges used in any field tests such as geomembrane seam testing must have been calibrated before their use will be allowed.

2.5.4 Spark Test Equipment

Spark test equipment shall include a Spy, Model #900-REG-726 detector, manufactured by Pipeline Inspection Company, Inc. or equivalent. This equipment will be used to check seams made using extrusion welding methods that cannot be inspected using the vacuum box. This includes extrusion welds surrounding liner penetrations such as pipe boots. Necessary equipment includes copper wire, a wand for inspecting the weld, a power source capable of supplying the necessary voltage to the wand and copper wire, an earth ground, and an alarm to indicate when a defective weld is encountered with the wand. The instrument must be calibrated before its use. The procedure for performing the spark test is described in Section 6.0 of the QA/QC Plan.

2.5.5 Anemometer

A hand held anemometer will be used to observe the wind speed in the area of geomembrane seaming operations. The instrument must be capable of operating at temperatures between 32 degrees F and 120 degrees F, and measure wind speeds up to 20 mph with an accuracy of +/- 1 mph.

3.0 EMBANKMENT CONSTRUCTION

3.1 BACKGROUND

Construction requires placement of embankment fill described in Section 02200 of the Technical Specifications and as shown on the Engineering Drawings. Embankment material shall be low permeability soil with silty and clayey characteristics and will be placed and compacted to achieve minimum friction angle of 28 degrees.

3.2 PRE-CONSTRUCTION SAMPLING AND TESTING – EMBANKMENT FILL

3.2.1 Field Explorations

Fill for embankment and berm construction will be obtained from subgrade excavations and from approved borrow sources.

Prior to the start of construction, the Project Engineer will coordinate the collection of embankment samples through a test pit program developed for each borrow source. The test pits shall be distributed equally in plan and depth across the borrow areas. Samples shall be collected at the specified frequencies listed in Section 3.2.2. If a borrow source will yield less than 75,000 cubic yards of embankment material a minimum of three remolded unconsolidated undrained triaxial and permeability tests must be performed for development of a moisture-density-permeability relationship.

3.2.2 Laboratory Testing

Samples of Embankment Material will be tested as follows:

Test	Frequency
Particle Size Analysis (ASTM D6913)	1 per 5000 cubic yards
Moisture Content (ASTM D2216)	1 per 5000 cubic yards
Liquid and Plastic Limits (ASTM D4318)	1 per 5000 cubic yards
Moisture-Density Relationship of Soil (ASTM D1557)	1 per 5000 cubic yards
Remolded Unconsolidated Undrained Triaxial (ASTM D2850)	1 per 25,000 cubic yards

Upon receipt of the laboratory test data, the Project Engineer will develop the moisture-density relationship for the specified embankment materials (i.e., the zone of acceptance for construction). The zone of acceptance is defined as the moisture content and dry density combinations that include a dry density greater than or equal to 90% of the modified Proctor maximum dry density (ASTM D1557) and minimum friction angle of 28 degrees within the zone of acceptance. The soil strength parameters must meet those used in the evaluation of the landfill's slope stability analyses. If the required strength cannot be achieved the Project Engineer may re-evaluate the slope stability.

Testing will be completed on single samples. The borrow areas will be sampled and tested before construction of the embankments. However, there may be instances where the soil imported to the construction area appears to differ from that previously used. In these instances, the field technician will collect a sample of this soil type for subsequent laboratory analysis. In the meantime, the soil in question will not be used for construction.

3.3 SUBGRADE SURFACE EVALUATION

For purposes of this QA/QC plan, the subgrade surface is defined as that surface consisting of native or fill soils that exist following excavation and filling for the landfill liner system or construction of embankment fill. Subgrade consisting of fill soils will be tested as described in Section 3.4.

Once the subgrade surface has been either excavated to design grades or prior to placing embankment materials in fill areas, the surface will be proof rolled using a loaded dump truck. These trucks weigh about 30 tons and the tire pressure is about 50 pounds per square inch (psi). An exception to this are areas located over the footprint of the Closed Landfill, subgrade surfaces in those locations will consist of excavated waste or exposed barrier protection soils which will not require proof rolling. These areas shall be visually inspected to identify soft or wet areas that may require remediation.

Proof rolling will be done by driving the truck slowly (about walking speed) over the exposed subgrade surface. The QA/QC representative will walk behind the truck, observing the response of the subgrade to the proof rolling. Soft conditions, (areas that weave under load or that rut more than about 3 inches) will be considered areas requiring remediation. The remediation needed will depend on the cause of the subgrade instability. This could be excessive water or soft soils.

Remediation activities include excavating the soft area and filling it with compacted embankment soil or allowing the area to dry. The areal extent of the remediation will be sufficient to include the entire soft area. The vertical extent of the remediation will be based on testing for density and moisture content, proof rolling the bottom of the excavated area (if the horizontal extent is larger enough), and visual observations. Fill soils to bring the excavated area back to the subgrade elevation will be placed and tested as described in Section 3.4. Upon completing the remediation, the areas will be retested by proof rolling the subgrade surface. Areas that are allowed to dry will be proof rolled after the drying. If soft areas are still detected, the soil will be removed to the depth necessary to result in a firm subgrade during proof rolling. Areas that are over excavated will be proof rolled at the base of the excavation and the fill will be tested for density and moisture content with the nuclear density gauge, as described for embankment fill testing.

Areas that do not dry and release a significant amount of water will be remediated by excavating a trench from the wet area to the subgrade drainage system. If trenching is necessary to remove water from the subgrade, the design of the trench will depend on specific conditions encountered. An estimate of the quantity of water to be carried in the trench will be made and a design detail will be prepared by the Project Engineer. The details of the trench design will be discussed with NYSDEC and if requested, submitted for review prior to installation.

In addition to proof rolling, the subgrade surface will be tested for density and moisture content with a nuclear density gauge at a minimum frequency of 9 tests per acre. Testing in addition to 9 tests per acre will be completed, if necessary. Data from these tests will be reviewed and compared to the laboratory moisture-density relationship. If there are field data showing a low density compared with the other tests, the area with the low-density data will be proof rolled again to check for the presence of a soft area and to define the limits of the soft area if it exists. If the low-density area satisfies the proof rolling criteria, the area will be considered acceptable. An additional exception to the testing will be in those areas located over the footprint of the Closed Landfill, subgrade surfaces in those locations will consist of excavated waste or exposed barrier protection soils which will not require density and moisture content testing.

In addition to the exceptions regarding the proof rolling and testing of the Closed Landfill areas, proof rolling shall not be used in areas where its use could cause damage to underground structures, on compacted fill, in confined areas, etc. In these areas, the nuclear density gauge will be used and the test results will be compared to those collected in areas passing the proof rolling test to assess the suitability of the subgrade.

3.4 EMBANKMENT FILL CONSTRUCTION

The contractor will be required to place embankment material within the specified moisture content and density range. It is expected that major changes to the embankment material moisture content will be made prior to placement.

The field technician will measure the fill moisture and dry density with the nuclear density gauge at a minimum frequency of nine tests per acre per lift. In place density tests will be located relative to the site grid system and in areas that visually appear to be softer. Holes resulting from the density test will be filled with powdered bentonite.

All tests will be required to meet the minimum density criteria and be within the specified moisture content range for the lift to be considered acceptable. The lift must be considered acceptable prior to placement of a new lift. If the moisture content data suggest that the lift is too wet, the contractor will be advised to either scarify the entire depth of the lift, mix the material and allow it to dry or to remove the lift and replace it. If the moisture content data indicate that the lift is too dry, the contractor will be advised to scarify the entire depth of the lift, moisten it, mix the material and recompact it before retesting it. If the density test data are low, the contractor will be advised that additional compactive effort is required.

If corrective measures are required for a soil lift, the lift must be retested following the corrective measures. Retests of failed in place density tests will be made within two feet of the original failure location.

After the results of all in place density and moisture content tests meet the project specifications, the surface of the lift will be scarified to enhance bonding with the subsequent lift. The lift surface will be scarified using equipment necessary to adequately scarify the lift surface, which may include bulldozer tracks or the pad roller.

Areas of the embankment fill where desiccation is observed will be scarified and recompacted to remove the desiccation cracks and meet the project requirements for density and moisture content before the next lift is placed.

At the completion of each shift and on weekends, the embankment and berm surfaces will be sloped to drain surface water. Additionally, the surface will be rolled with a smooth drum roller to enhance its ability to shed water.

It might be necessary to prepare areas of embankment fill placement for winter shutdown. If winter shutdown is required a “shutdown/startup” plan will be prepared and submitted to NYSDEC for approval. The plan might include placing a sacrificial layer of fill over the embankments and berms. Following winter shutdown, the sacrificial layer (if any) would be removed and the embankment and berm surfaces would be evaluated. In place density tests would be performed at approximately two locations per acre. The test results would be compared with measurements made prior to winter shutdown, to assess the depth of embankment fill impacted by the winter conditions. The embankment fill would then be reworked and recompacted to the depth necessary so that the results of in place density tests meet the project requirements.

3.5 REPORTING

Each field technician will report their observations and the results of their testing and sampling to the Project Engineer. The Project Engineer will assemble the individual reports and will complete a field report for each day that construction occurs. The report will describe the contractor’s activities on that day and will present the results of the field tests made that day and a list of any samples collected for laboratory analysis. The Project Engineer will submit the daily field reports to the Project Engineer.

The Project Engineer is responsible for photographic documentation, which will serve as a pictorial record of work progress, problems, and mitigation activities.

4.0 CLAY LINERS

4.1 BACKGROUND

A double composite liner system will be constructed beneath Cells 7 and 8, as well as the modified Cell 1. The secondary composite liner consists of a leachate collection layer underlain by a geomembrane and compacted clay liner. The secondary compacted clay liner is twenty-four inches thick and is constructed on top of the prepared subgrade/embankment surfaces. Note that a portion of the secondary clay liner will be constructed over reconstructed Closed Landfill cap materials. The primary composite liner consists of a leachate collection layer underlain by a cushion geotextile, geomembrane and geosynthetic clay liner where shown.

The clay liner is designed with the following features:

- A permeability less than or equal to 1x10-7 centimeters per second (cm/sec) for Type I, II and III secondary clay liner (Items 02211, 02212 and 02214),
- A maximum particle size of 3 inches for secondary clay liner, Type I (Item 02211) and 1-inch for secondary clay liner, Type II and III (Item 02212 and 02214),
- For the secondary clay liner soils, Type I and II, the maximum compacted lift thickness is 6 inches unless other wise noted on the Engineering Drawings, and
- For berm cap soils, Type III, the maximum compacted lift thickness is 12 inches.

Material for the compacted clay liner will be obtained from the Borrow Area C, the South Borrow Area or other approved source. The Borrow Area C and the South Borrow Area soil are well graded glacial till having gravel, sand, silt and clay sized particle which has successfully been used at the site for liner material.

4.2 PRE-CONSTRUCTION SAMPLING, TESTING AND MEASUREMENTS

Soil for clay liner materials, Type I, II and III, (Items 02211, 02212 and 02214) will be obtained from the borrow areas or other approved source. Soil for clay liner materials, Type II (Item 02212) will be screened from soils obtained from the excavations to meet the 1-inch maximum particle size required in the specifications.

Prior to the start of construction, the Project Engineer will coordinate the collection of clay liner samples through a test pit program developed for the borrow source. The test pits shall be distributed equally in plan and depth across the borrow areas. Samples shall be collected at the specified frequencies listed in Section 4.2.1. If a borrow source will yield less than 15,000 cubic yards of clay liner material a minimum of three Remolded Permeability tests must be performed for development of a moisture-density-permeability relationship.

Clay liner samples for Type II will be collected from the screened stockpiles at a rate of at least one sample for every 1000 cubic yards of screened material. The sampling frequency will be such that laboratory tests can be done at the frequency described in Section 4.2.1.

4.2.1 Laboratory Testing

Samples collected in the exploration program will be delivered to the soils laboratory for testing. The minimum testing frequency for clay liner soils (Type I, II and III) follows:

Test	Frequency
Moisture Content (ASTM D2216)	1 per 1000 cubic yards
Liquid and Plastic Limits (ASTM D4318)	1 per 1000 cubic yards
Particle Size Analysis (ASTM D6913)	1 per 2500 cubic yards

Test	Frequency
Moisture-Density Relationship of Soil (ASTM D1557)	1 per 5000 cubic yards
Remolded Permeability (Items 02211 and 02212) (ASTM D5084)	1 per 5000 cubic yards

Upon receipt of the laboratory test data, the Project Engineer will develop the moisture-density-permeability relationship (i.e., the zone of acceptance for construction) for the clay liner soils. The zone of acceptance is defined as the moisture content and dry density combinations that produce a soil permeability of 1x10-7 cm/sec or less and acceptable strength and compressibility characteristics, if applicable. The samples chosen to test the moisture-density-permeability relationship will be representative of the range of plasticity index and particle size distributions observed. These samples will include those with a lower plasticity index and higher sand and gravel content to represent material that will require a greater density to achieve the specified permeability. The moisture content and dry density selected for field control will be based on a Proctor test having nearly the highest dry density value. The field technicians will use this information for acceptance of field dry density and moisture content measurements.

4.2.2 Test Pad Construction

The clay liner contractor will build a test pad using the clay liner soil (Item 02211) to:

1) Assess the capability of the proposed compaction equipment to achieve the required soil compaction and permeability results, destroy clay clods and knead the clay mass together,
2) Measure the loose lift thickness that results in an 8-inch thick compacted lift, and
3) Measure the loose lift thickness that can be compacted with the proposed equipment and number of passes required to achieve the specified soil density.

The contractor will be required to use both pad foot and smooth drum rollers for this project and both roller types will be needed for the test pad construction.

The Project Engineer will first develop the zone of acceptance and establish compaction criteria for the clay liner. The contractor will place soil for the test pad within the specified range of moisture content.

The Project Engineer will select an area that covers a 3 horizontal: 1 vertical slope, which will be about 100 feet by 20 feet for construction of the test pad. The contractor will place a lift of clay liner material along one edge of the designated area next to grade stakes spaced about 20 feet apart. The lift should have a uniform loose thickness of about 8 to 10 inches and be at least 75 feet long and 12 feet wide.

Prior to placement of clay liner soil, four control points will be established near the center of the test pad to allow measurement of loose and compacted lift thickness. The subgrade elevation and the insitu moisture and dry density will be measured at each control point.

After the clay liner material is placed with the bulldozer, the locations of four control points referenced to the stakes placed along the edge of the test pad will be re-established. Field technicians will measure the soil moisture content and dry density at the four control point locations using the nuclear density gauge to obtain the uncompacted dry density. The nuclear density gauge probe length must be less than the lift thickness with the gauge operated in the direct transmission mode. If the measured moisture contents are outside the zone of acceptance, the soil will be considered unsuitable and new soil will be imported and spread.

Elevations of the lift at the four control point locations will be measured. These elevations will be compared to the subgrade elevation measurements to calculate the loose lift thickness.

The contractor should make six passes (three forward and three in reverse) over the test pad with the proposed rollers. The rollers should be operated at the proposed operating speed.

The field technician will measure the elevation of each control point. These elevations will be compared to the subgrade elevation data to calculate the compacted lift thickness. Next, field technicians will measure the soil density and moisture content at the four control point locations with the nuclear density gauge. For density measurements, the nuclear moisture-density gauge probe should extend to near the bottom of the lift, but not through it. Following each test, the field technicians will fill the hole left by the probe with bentonite powder tamped into the hole.

The QA/QC or project engineer will compare the soil dry density and moisture content data to the proposed zone of acceptance data. If the required dry density has not been reached at all four test locations, the contractor will make four additional passes with the compaction equipment. If the moisture content data suggest that the lift is too wet, the contractor will be advised to either scarify the entire depth of the lift, mix the material and allow it to dry or to remove the lift and replace it. If the moisture content data indicate that the lift is too dry, the contractor will be advised to scarify the entire depth of the lift, moisten it, mix the material and recompact it before retesting it.

Following the additional passes (making a total of ten), field technicians will measure the soil dry density, moisture content and ground surface elevation at the control points. Again, the QA/QC or project engineer will compare the in place density data to the proposed zone of acceptance. If all dry density data do not satisfy the minimum dry density criteria, the contractor will make four additional passes with the compaction equipment. The process of making four passes, measuring the soil dry density and moisture content and ground surface elevation should be continued until the dry density measurements at all four control point locations satisfy the minimum dry density (and moisture content) criteria. Two Shelby tube samples will then be collected for permeability testing.

Upon completion of the test pad for the first lift, clay liner soil will be placed for the second lift. The second lift will be placed about 8 to 10 inches thick (loose). The procedures described above for the first lift will be followed for the second lift.

The results of the test pad construction and testing will be submitted to NYSDEC prior to constructing the clay liner.

If several borrow sources are utilized in the clay liner construction, a test pad will be required for each designated source based on preconstruction testing acceptance.

4.3 TESTS DURING CONSTRUCTION

4.3.1 Survey Measurement

The QA/QC Surveyor will use appropriate survey measurements to determine the thickness of the liner and leachate collection system as described in Section 5.0.

The contractor will be required to control the loose lift thickness to no greater than that determined from the test pad construction. The contractor can use grade stakes marked at the loose lift thickness or laser equipment attached to the bulldozer blade. If grade stakes are used, the Contractor will fill holes left by the grade stakes with bentonite when the stakes are removed.

4.3.2 Field Testing and Sampling

a) In-Place Density Tests

Field technicians will estimate the area of each completed clay liner using the survey control on site and calculate the number of in-place density tests required to provide a frequency of at least nine tests per acre per lift of soil material placed. Additional tests will be done when, based on observations of the Project Engineer or Field Technician, they are warranted. The test locations will be proportionally distributed to reflect the areal extent of

side slope versus bottom area of the landfill and established so that they do not coincide with the test locations on the immediately underlying lift.

Field technicians will measure the in-place dry density and moisture content of the compacted clay liner using a nuclear moisture-density gauge in general accordance with ASTM D6938. The nuclear density gauge probe will typically extend to the full depth of the lift.

In-place moisture density test results for the compacted clay liner must satisfy the established moisture and density criteria before the next lift is placed. The QA/QC or project engineer will advise the contractor of the test data. If the in-place moisture content is acceptable but the dry density is too low, the contractor will make more passes with the compactor until all in-place test results are satisfactory. If the in-place moisture content is too high to achieve the required compaction, the contractor will scarify the clay to the full lift depth and allow it to dry. If weather conditions are not favorable for drying, the contractor may elect to remove the entire lift and replace it with drier liner soil. Scarification to the full lift depth, water addition and recompaction must be done if the in-place moisture content is too low. This process is acceptable only for minor moisture content adjustments. Major moisture content adjustments should be made at the borrow pit (or stockpile) before moving the soil to the working area.

The compacted clay liner must be retested for moisture content and dry density following any remediation efforts. Tests following remediation should be within two feet of the original tests.

b) Observations

Once all field in-place density tests show satisfactory results, the Field Technician will evaluate the condition of the lift to determine its acceptability before the contractor places the overlying lift. The lift will be checked for wet and dry zones. Saturated areas must be removed. Dried areas will be checked for desiccation cracks. Lifts having desiccation cracks exceeding 1/4 inch in depth will need to be remediated. The contractor will either remove the unacceptable zones in the lift or remediate the areas by scarifying and moisturizing. The remediated areas will be tested as though they are a new lift (see above).

c) Shelby Tube Sampling

After all in-place moisture-density test results have satisfied the established criteria, field technicians will collect thin-walled tube (Shelby tube) samples at the rate of one location per acre from each lift of clay liner placed. No Shelby tube samples are required for Type III or Type IV clay liner soils. Shelby tube sampling locations will be selected such that they differ from underlying lifts. Two Shelby tube samples will be collected at each location by using the blade of a bulldozer to push the Shelby tube into the soil. Shelby tubes will be pushed about 6 inches, as the compacted thickness of each lift is limited to 8 inches.

The secondary clay liner materials are a till that contains sand, gravel, silt and clay. The sand and gravel fraction introduces difficulty in collecting samples with Shelby tubes. For that reason, two tubes will be collected from each location so that if the first sample is disturbed, the second can be opened and tested. More details are provided in Section 4.3.3. Tube samples, which visually appear to be disturbed, will be rejected. If both tube samples from a location appear disturbed, then two additional tube samples will be collected. If both of these additional samples are disturbed, then a tube sample will be remolded to the dry density measured in the field at the moisture content of the tube sample and tested.

The field technician will measure the location of thin walled tube samples relative to the established field survey control system. The geotechnical testing laboratory will extrude and test the sample for permeability as described in Section 4.3.3. The geotechnical testing laboratory will report the test results to the Project Engineer.

All permeability test data will be required to be 1x10-7 cm/sec or less to be considered acceptable. The Project Engineer will explore the causes for all thin-walled tube samples that have a permeability greater than 1x10-7 cm/sec.

The Project Engineer will request that the contractor excavate an area surrounding the location of a Shelby tube sample with failing permeability test results to the lift with the failing result. (It is assumed that the contractor will continue construction of compacted clay liner lifts after all in-place density tests satisfy the established criteria. It is impractical to wait until all Shelby tube sample test data are available before continuing construction of the clay liners because testing of Shelby tube samples requires several days.) The excavation area must be of sufficient size to allow for density testing and remediation of the lifts following excavation and retesting.

In-place density tests will be made around the location of the failing tube to verify that either the soil satisfies the required moisture-density criteria or to estimate the extent of the area that does not comply with the project requirements. Field technicians will measure the in-place dry density and moisture content of the clay in four orthogonal directions approximately 4 feet from the Shelby tube location and compare the results to the dry density and moisture content of the Shelby tube sample and to the project requirements for dry density and moisture content. The limits of the area excavated will be extended until the measured in-place dry density and moisture content meet the project requirements to assess the extent of the failed tube area.

If the in-place density test results indicate that the soil satisfies the required moisture density criteria, two Shelby tube samples will be collected from the area and tested for permeability as described in Section 4.3.3. The excavated area will then be reconstructed and tested as described in Section 4.1 and 4.3.

The area surrounding the location of the Shelby tube with the failing permeability test result will be remediated. The remediation method will depend on the field data. When the field test data meet the project requirements, two Shelby tube samples will be collected from the remediated area and tested for permeability as described in Section 4.3.3.

All holes (Shelby tube or those made for in-place density tests) made in the clay liners will be filled by placing and tamping bentonite powder/soil mixture.

4.3.3 Laboratory Tests During Construction

The geotechnical testing laboratory will measure the weight and dimensions of the Shelby tube samples collected in the field and calculate the total unit weight of the samples. The first sample from a given location will be extruded and its condition will be observed for defects. The geotechnical testing laboratory will report the presence of any hydraulic defects to the Project Engineer and will determine the origin of those defects, sampling or construction. If the defects are due to construction methods, then the sample will not be tested and the area represented by the Shelby tube will be remediated.

If the sample is free from sampling defects (which often occur when sampling in soils containing gravel), it will be trimmed and the portion of the sample from the lower part of the lift being tested will be placed in a flexible wall permeameter. The sample will be tested for permeability using the falling head permeability test method and in general accordance with the procedures described by ASTM D5084. The dry density and moisture content of the sample will also be measured.

If sampling defects exist within the first sample from a given location, the sample will be saved and the second sample will be extruded and observed. If this sample is free of sampling defects, its permeability will be measured.

If both samples contain sampling defects, soil from the first sample will be remolded at the moisture content of the Shelby tube sample and the dry density measured at the nearest in-place density location. This sample's permeability will be measured in the flexible wall permeameter, as described above.

Samples having defective zones that are representative of construction (e.g., poor bonding between lifts, desiccation cracks) will be identified to the Project Engineer who will attempt to identify the extent of this condition for the contractor to remediate. This might include excavation of test pits to observe bonding between lifts,

desiccation cracks, etc. in addition to the testing described in Section 4.3.2. The contractor will implement the remediation procedure described in Section 4.3.2.

4.3.4 Winter Shutdown

It might be necessary to prepare areas of clay liner placement for winter shutdown. If winter shutdown is required, a “shutdown/startup” plan will be prepared and submitted to NYSDEC for approval. The plan will include the following general approach.

Prior to the winter shutdown, the clay liner surface will be sloped to drain surface water and rolled with a smooth drum roller to enhance its ability to shed water. A topographic survey will be completed upon completion of grading activities. Additionally, a sacrificial layer of fill will be placed over the clay liner. This lift will be compacted to a firm condition but will not be tested.

At the start of construction in the following spring, the sacrificial layer will be removed and the clay liner surface evaluated. In place density tests will be made on the clay liner surface. The test results will be compared to results of tests made prior to winter shutdown, to assess the effect of winter conditions on the clay liner. If test data indicate the clay liner has been affected, the contractor will be instructed to remove the uppermost lift and the in place density test routine described above will be repeated. This evaluation process will continue for each lift until the test data indicate that the winter effects no longer exist at that depth.

The clay liner will then be reworked and recompacted to the depth necessary so that results of in place density tests meet the project requirements.

4.4 REPORTING

The Project Engineer will assemble the individual reports and will complete a field report for each day that construction occurs. The report will describe the contractor’s activities on that day and will present the results of field tests made that day and a list of samples collected for laboratory analysis. Plan drawings that show the approximate locations of acceptable in-place moisture and density tests for each lift of compacted clay liner placed will be included in the report. The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems, and mitigation activities.

5.0 SURVEY MEASUREMENTS

5.1 BACKGROUND

This section describes the survey measurements required for implementing various parts of the QA/QC plan. The QA/QC Surveyor will provide control points for the contractor to use when constructing the liner subgrade, exterior berms, drainage structures, leachate and gas transfer piping. The QA/QC Surveyor will use survey measurements to determine the thickness of the various liner components, the locations of the leachate system piping and permanent stormwater controls.

The QA/QC surveyor will develop a grid pattern spaced at 50-foot intervals to define elevation measurement locations. Thickness measurements will be made at the same horizontal coordinates for each layer. The design elevations plus the tolerances stated in the specifications will be used as the baseline for the thickness measurements for each layer. A portion of the construction occurs over the Closed Landfill and will require collection of a direct measurement of material thickness. Each layer of the liner system will be checked including:

a) A survey of existing conditions in the proposed work area;
b) The final prepared surface of the top of the subgrade;
c) Extent and location of all Closed Landfill cap replacement geosynthetics;
d) The top of the secondary clay liner, including thickness;
e) Extent of the geomembrane liner and geomembrane flaps;
f) The extent of the secondary leachate collection system geocomposite;
g) Top and toe of the berms;
h) Middle of both the secondary and primary geomembrane liner anchor trenches
i) The top of the primary leachate collection drainage stone, including thickness;
j) At 50-foot intervals along each pipe and other drainage structures, including any fittings, bends and valves.

Measurements also will be made at changes in slope, such as the toe of containment berms, and at the edges of the liner system. Measurements made at the toe of slope will be made at the toe of each layer.

Construction of subsequent layers of the liner system will not be allowed until all of the survey data for a given layer are within specified tolerances.

5.2 CONTROL

The QA/QC surveyor will set horizontal and vertical control for the project using the existing control at the site. The contractor will lay out work in the cell area with wood stakes driven into the ground. Field technicians will use this control as a reference for test and sampling locations.

5.3 LAYER THICKNESS

The QA/QC Surveyor will establish the grid in the field and make elevation measurements at the grid locations. The first set of elevations will be made prior to construction activities at the site. The second set will be made on the prepared subgrade surface, before construction of the liner system begins. Subgrade locations that are not within the specified tolerance will be regraded until they are within tolerance.

The QA/QC Surveyor will make elevation measurements at the grid locations following construction of the clay liner. These data will be compared to the design elevations and checked to see if the construction is within the specified tolerances. As previously stated, a portion of the construction occurs over the Closed Landfill and will

require collection of a direct measurement of material thickness. If the liner elevations indicate the thicknesses are within the specified tolerance, construction can begin on the geomembrane then on the leachate collection system. If not, the contractor must adjust the elevations (either cut or filled) and the QA/QC surveyor will repeat the measurements on the repaired area before deployment of the geomembrane.

Following construction of the leachate collection system layer, the QA/QC Surveyor will re-establish the grid pattern on the leachate collection system surface and will make elevation measurements to determine whether the elevations are within tolerance at each location. As previously stated, a portion of the construction occurs over the Closed Landfill and will require collection of a direct measurement of material thickness. Areas not within the specified tolerance will be repaired and additional measurements will be made.

Elevation measurements will be made following the placement of all pipes and drainage structures including ditches. The elevations will be checked to determine if they conform to the specified tolerances. The Project Engineer will identify areas that are not within the specified tolerance for the contractor to repair.

5.4 REPORTING

The QA/QC surveyor will report his/her observations to the Project Engineer. Following the survey, the Project Engineer will discuss any areas that require remediation with the contractor. The QA/QC surveyor will provide the final survey measurements to the Project Engineer who will submit them to the Project Engineer for approval.

The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems, and mitigation activities.

6.0 GEOMEMBRANES

6.1 BACKGROUND

Two geomembranes liners are incorporated into the double composite liner that function as containment at the base of the landfill. The geomembrane shall be manufactured from HDPE into textured sheets having a thickness of 60 mils and an average asperity height of 16 mils. HDPE geomembranes are delivered to the site in rolls and do not contain any factory seams. Seams must be made such that they can be tested.

A geomembrane cap is utilized in the final cover of the Closed Landfill and in the final cover of the Area 7/8 Development and will require partial removal and replacement as part of the construction. The geomembrane cap shall be manufactured from LLDPE into textured sheets having a thickness of 40 mils and an average asperity height of 16 mils. LLDPE geomembranes are delivered to the site in rolls and do not contain any factory seams. Seams must be made such that they can be tested.

Geomembrane sheets shall be joined in the field by seaming. The hot wedge seaming method using a “split” wedge is the preferred method of joining geomembranes. The air channel, which is formed, can be used to evaluate seam continuity. Extrusion fillet seams shall be used for geomembrane patches, and in areas with poor accessibility such as around appurtenances and corners.

The QA/QC plan described below specifies the methods used to check the quality of the geomembrane delivered to the site compared to the design requirements and specifications, and the field seams used to join the geomembrane sheets. In what follows, procedures that encompass QA/QC throughout the project including manufacturing, delivery, storage, and installation of the geomembrane sheets are described.

6.2 PRE-CONSTRUCTION SAMPLING, TESTING AND DOCUMENTATION

6.2.1 Supplier Requirements

The geomembrane supplier must provide the following information to the Project Engineer prior to installation of the liner. Information and test results are needed for one sample from each lot of raw materials used to manufacture the geomembranes and for the manufactured sheets.

Raw Materials. The geomembrane supplier must provide the Project Engineer with copies of quality control certificates issued by the producer of the geomembrane raw materials to verify the material quality. Quality control certificates must describe results from the following tests; polymer density (ASTM D1505) and melt flow index (ASTM D1238).

Quality control certificates issued by the producer of the geomembrane raw materials must verify the material quality according to resin lot number. The geomembrane supplier will also be required to provide documentation to the Project Engineer that shows correlation between the resin lot number and the respective liner rolls.

The geomembrane installer must provide a certification letter to the Project Engineer indicating the welding rods used for extrusion seaming, and the sheet are the same compound. If not, the welding raw material shall be certified by the manufacturer.

Manufactured Sheets. The supplier of the geomembrane must certify to the Project Engineer through the manufacturer’s quality control documents that during manufacture, the geomembrane was continuously inspected for uniformity, damage, imperfections, holes, cracks, thin spots and foreign materials. Additionally, the geomembrane must have been inspected for tears, punctures and blisters.

The geomembrane supplier must also provide to the Project Engineer reports of tests taken to verify the integrity of the manufactured geomembrane. Results from the following tests must be submitted prior to installation of the liner.

Required HDPE Geomembrane Property Values

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Standard Sheet Properties				
Thickness	Minimum average value Lowest individual for any of the ten values	mils	57 51	ASTM D5994
Asperity Height	Minimum average value	mils	16	ASTM D7466 See Notes 1 and 2
Density (includes 2% to 3% Carbon Black Content)	Minimum	g/cm^3	0.94	ASTM D1505/D792 Method A
Carbon Black Content	Range	%	2-3	ASTM D1603/D4218
Carbon Black Dispersion	N/A	none	9 of 10 in Cat. 1 or 2 1 in Cat. 3	ASTM D5596
Tensile Properties				
Tensile Strength at Yield	Minimum (each direction)	lb./in	126	ASTM D6693
Tensile Strength at Break	Minimum (each direction)	lb./in	90	ASTM D6693
Elongation at yield	Minimum (each direction)	%	12	ASTM D6693
Elongation at break	Minimum (each direction)	%	100	ASTM D6693
Tear Resistance	Minimum	lb.	42	ASTM D1004
Puncture Resistance	Minimum	lb.	90	ASTM D4833
Miscellaneous Sheet Properties				
Single Point Stress Crack Resistance	Minimum	hours	500	ASTM D5397 Appendix
Water Vapor Transmission Rate	Maximum	$gr/m^2/day$	0.03	ASTM E96
Oxidative Induction Time (Standard OIT)	Minimum average value	minutes	100	ASTM D3895
Oven Aging at 85°C (Standard OIT)	Minimum average value	% retained after 90 days	55	ASTM D5721
UV Resistance (High Pressure OIT)	Minimum average value	% retained after 1600 hours	50	ASTM D7238

Note 1: Asperity height requirements shall be modified based on direct shear test requirements listed in Section 6.0 of the QA/QC Plan.

Note 2: Asperity height measurements shall be taken at uniform intervals across the entire roll width.

Required LLDPE Geomembrane Property Values

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Standard Sheet Properties				
Thickness	Minimum average value Lowest individual for any of the ten values	mils	38 34	ASTM D5994
Asperity Height	Minimum average value	mils	16	ASTM D7466 See Notes 1 and 2
Density (includes 2% to 3% Carbon Black Content)	Maximum	g/cm^3	0.939	ASTM D1505/D792 Method A
Carbon Black Content	Range	%	2-3	ASTM D1603/D4218
Carbon Black Dispersion	N/A	none	9 of 10 in Cat. 1 or 2 1 in Cat. 3	ASTM D5596
Tensile Properties				
Tensile – Break Strength	Minimum (each direction)	lb./in	60	ASTM D6693
Tensile – break elongation	Minimum (each direction)	%	250	ASTM D6693
Miscellaneous Sheet Properties				
Oxidative Induction Time (Standard OIT)	Minimum average value	minutes	100	ASTM D3895
Oven Aging at 85^{o}C (Standard OIT)	Minimum average value	% retained after 90 days	35	ASTM D3895
UV Resistance (High Pressure OIT)	Minimum average value	% retained after 1600 hours	35	ASTM D5885
2% Modulus	Maximum	lb/in	2400	ASTM D 5323
Axi-Symmetric Break Resistance Strain	Minimum	%	30	ASTM D 5617
Tear Resistance	Minimum average value	lb.	22	ASTM D1004
Puncture Resistance	Minimum average value	lb.	44	ASTM D4833

Note 1: Asperity height requirements shall be modified based on direct shear test requirements listed in Section 6.0 of the QA/QC Plan.

Note 2: Asperity height measurements shall be taken at uniform intervals across the entire roll width.

Testing should also be completed to demonstrate chemical compatibility with representative leachate based on results from ASTM D5747 or EPA 90/90 as described in Section 2400 of the Technical Specifications. This test is only required if the materials used in the construction of the Area 7/8 Development vary from those used in the previous Cells (1, 2, 3, 4, 5, 6 or Overliner Cells 1 and 2 Phase 1).

The supplier will sample and test the geomembrane material for the properties listed above at a frequency of at least once for every 50,000 square feet of manufactured geomembrane, and at least once after each change in source of raw materials (e.g., resin). A quantity of material shall be taken from each roll sampled to satisfy the requirements for testing as described in each of the above referenced testing standards. The miscellaneous sheet properties need not be tested at the frequency of at least once for every 50,000 square feet of manufactured geomembrane. The Manufacturer must certify for this project, however, that these tests have been run on geomembrane sheets made from the particular resin and provide the test results.

Conformance testing shall be performed at the indicated frequencies on material and rolls specifically designated for use on this project. Conformance test results supplied for rolls, which are not to be used on this project, will be considered if they are bounding rolls to those used on this project. Furthermore, sampling intervals shall be distributed throughout the rolls, every 50,000 square feet.

Samples not satisfying the specifications shall result in the rejection of the applicable rolls and additional testing of individual rolls will be performed to more closely identify the non-complying rolls.

The supplier must submit all documentation required by this section to the Project Engineer before the geomembrane may be deployed in the landfill.

6.2.2 Project Engineer Requirements

Project Engineer requirements include those for interface direct shear testing, archive sampling and conformance testing and sampling.

Interface Direct Shear Testing: This testing is only required if the products used in the construction of the Area 7/8 Development vary from those used in the previous Cells (1, 2, 3, 4, 5, 6 or Overliner Cells 1 and 2). If testing is required, the following procedure shall be used.

Prior to delivery of the geomembrane liner, the geomembrane supplier shall provide the Project Engineer with six samples of the geomembrane liner designated for delivery to this project for direct shear testing as described by ASTM D5321. Each sample must be 18 inches long by 18 inches wide. The supplier will clearly mark the machine direction on each of the samples.

Prior to performing the direct shear test, the geosynthetics laboratory shall measure the asperity height of each sample. The reported value will be based on the average of 10 measurements taken from each sample, at a minimum the average and lowest value shall meet the required standard sheet properties. The Project Engineer will decide which of these samples should then be used for direct shear testing. Upon completing the direct shear test, the Project Engineer shall compare the results to the required values listed below and either approve or reject the geomembrane. If the geomembrane is acceptable, the reported average asperity height for that sample will now be used as the required standard sheet property with the lowest value for any single measurement not less than 16 mils.

The Project Engineer will obtain samples of clay liner material and deliver the geomembrane and clay liner samples to the geosynthetics laboratory for testing. The Project Engineer will specify the compaction requirements of the clay liner material using the highest moisture content acceptable during the clay liner placement, and the calculated normal stresses that the interfaces will be subjected to. The testing shall be performed by using normal stresses above and below the actual stress, so as to define the failure relationship. Prior to performing the test, the interfaces shall be inundated with water and allowed to consolidate. The geosynthetics laboratory will then test the shear strength of the geomembrane/compacted clay liner interface by

the direct shear method described in ASTM D5321. This test is used to verify clay liner/geomembrane interface shear strength parameters used in the liner stability analysis.

Interface shear testing will also be completed for the primary geomembrane/cushion geotextile interface, secondary or primary geomembrane/geocomposite interface, as was described above. If the configuration of the liner system changes, additional interface testing may be required to identify potential failure zones.

The following geomembrane cap interfaces will also be tested, geomembrane/gas venting geotextile interface, geomembrane/cushion geotextile interface and secondary clay/cushion geotextile interface, as was described above. If the configuration of the cap replacement system changes, additional interface testing may be required to identify potential failure zones.

Upon completion of the direct shear testing, the remaining samples shall be returned to the Project Engineer. These samples will then be used during geomembrane deployment to visually inspect that the geomembrane matches the material that was tested.

The geosynthetics testing laboratory will report the results of direct shear testing to the Project Engineer. Acceptance criteria for test results are as follows. A minimum peak friction angle of 15 degrees for the baseliner interfaces. A minimum peak friction angle of 24 degrees for the sideslope liner interfaces after construction and prior to waste placement (i.e., low normal stresses). A minimum residual friction angle of 19 degrees for the sideslope liner interfaces after waste placement (at the applicable normal stresses). If the required strengths are not met, the Project Engineer may re-evaluate the stability of the landfill with the tested values and submit the analysis to the NYSDEC for approval or select another material for testing.

Conformance Testing and Archive Samples: The geomembrane rolls will be sampled at a rate of 1 per 100,000 square feet of material proposed for use in the liner before the geomembrane is delivered. Sample collection will be observed and documented by the Project Engineer. At least one representative roll must be sampled for each source of raw materials used in the manufacture of geomembrane. Sample rolls will be selected at the geomembrane manufacturer's facility prior to delivery to the site, additional samples will be taken for possible future fingerprinting and quality assurance testing as described below.

Archive Samples

A set of samples will be taken at the geomembrane manufacturer's facility for possible future fingerprinting at a rate of one sample per 100,000 square foot of installed geomembrane and at least one per resin lot. Sample collection will be observed and documented by the Project Engineer. Samples for possible future fingerprinting will consist of 4 sheets having dimensions of 8.5 inches by 11.0 inches. Sample sheets will be removed from a length of geomembrane taken from the roll with none taken closer than 12 inches from the edge of the roll. Sample sheets shall not be cut from the inner or outer wraps of a geomembrane roll. The owner will archive the samples for possible future fingerprinting in a light free environment maintained at room temperature. The Project Engineer will observe the archive location.

Conformance Testing

The laboratory test samples will be taken at the geomembrane manufacturer's facility at a rate of one sample per 100,000 square foot of installed geomembrane and at least one per resin lot for conformance testing. The sample will be a full width, two-foot long swatch of material from each roll sampled. Material shall not be taken from the inner or outer wraps of a roll. Sample collection will be observed and documented by the Project Engineer. The Project Engineer will then deliver the samples to the geosynthetics testing laboratory. The geosynthetics laboratory will perform the following tests on specimens cut from the samples delivered. Preparation of test specimens and performance of the tests will be in accordance with the appropriate specifications.

Required HDPE Geomembrane Property Values

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Standard Sheet Properties				
Thickness	Minimum average value Lowest individual for any of the ten values	mils	57 51	ASTM D5994
Asperity Height	Minimum average value	mils	16	ASTM D7466 See Notes 1 and 2
Density (includes 2% to 3% Carbon Black Content)	Minimum	g/cm^3	0.94	ASTM D1505/D792 Method A
Carbon Black Content	Range	%	2-3	ASTM D1603/D4218
Carbon Black Dispersion	N/A	none	9 of 10 in Cat. 1 or 2 1 in Cat. 3	ASTM D5596
Tensile Properties				
Tensile Strength at Yield	Minimum (each direction)	lb./in	126	ASTM D6693
Tensile Strength at Break	Minimum (each direction)	lb./in	90	ASTM D6693
Elongation at yield	Minimum (each direction)	%	12	ASTM D6693
Elongation at break	Minimum (each direction)	%	100	ASTM D6693

Note 1: Asperity height requirements shall be modified based on direct shear test requirements listed in Section 6.0 of the QA/QC Plan.

Note 2: Asperity height measurements shall be taken at uniform intervals across the entire roll width.

Required LLDPE Geomembrane Property Values

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Standard Sheet Properties				
Thickness	Minimum average value Lowest individual for any of the ten values	mils	38 34	ASTM D5994
Asperity Height	Minimum average value	mils	16	ASTM D7466 See Notes 1 and 2
Density (includes 2% to 3% Carbon Black Content)	Maximum	g/cm^3	0.939	ASTM D1505/D792 Method A
Carbon Black Content	Range	%	2-3	ASTM D1603/D4218
Carbon Black Dispersion	N/A	none	9 of 10 in Cat. 1 or 2 1 in Cat. 3	ASTM D5596
Tensile Properties				
Tensile – Break Strength	Minimum (each direction)	lb./in	60	ASTM D6693
Tensile – break elongation	Minimum (each direction)	%	250	ASTM D6693
Miscellaneous Sheet Properties				
Tear Resistance	Minimum average value	lb.	22	ASTM D1004
Puncture Resistance	Minimum average value	lb.	44	ASTM D4833

Note 1: Asperity height requirements shall be modified based on direct shear test requirements listed in Section 6.0 of the QA/QC Plan.

Note 2: Asperity height measurements shall be taken at uniform intervals across the entire roll width.

The geosynthetics testing laboratory will report the test results to the Project Engineer. If the laboratory samples do not meet specifications, two additional rolls will be sampled for testing. The sample roll, which failed initial testing, will not be included in the domain for resampling. An additional sample will only be taken from a roll having the same source of raw materials as the roll with the failed sample and bounding the failed roll in construction sequence. If the additional laboratory samples fail to meet specifications, the Project Engineer shall instruct the installer to remove the geomembrane represented by the failed sample from the site. Sampling and testing will continue until the first passing roll is identified, therefore all of the rolls between that first failing test and that with the first passing test data shall be removed from the site.

6.3 CONSTRUCTION PHASE OF QA/QC ACTIVITIES

6.3.1 Surface Inspection

The geomembrane installer will observe the condition of the clay liner, GCL surface or the Closed Landfill subgrade (the surface on which the geomembrane liner will be deployed) for smoothness and protrusions before deploying the geomembrane as described in Section 2400 of the Technical Specifications. The strength of the clay liner surface or Closed Landfill subgrade must be sufficient to support the equipment that will be used for deploying the liner without experiencing permanent deformations such as ruts. When the surface is acceptable, the geomembrane installer will submit a written notice to the Project Engineer stating that the surface satisfies the installer's requirements.

6.3.2 Deployment of Geomembrane

The geomembrane shall remain rolled and dry until ready to use. The material shall not be unrolled if the material temperatures are lower than 32 degrees F due to the possibility of cracking. Additionally, geomembranes shall not be unrolled during any precipitation, in the presence of excessive moisture, in an area of ponded water, or in the presence of winds in excess of 20 miles per hour. The two geomembrane sheets to be joined must be properly positioned such that a minimum of 3 inches of overlap exists for extrusion welds and 4 inches of overlap exists for fusion welds. No vehicles will be allowed directly on the geomembrane during or after deployment. The geomembrane sheets will be deployed on the landfill floor to create a "shingle effect," i.e., the upslope sheet shall overlap the downslope sheet. After the geomembrane has been unrolled, the installer and the Project Engineer shall visually observe its condition for uniformity, damage, and imperfections which may include tears, punctures or blisters. Any geomembrane containing imperfections shall be discarded at the discretion of the Project Engineer.

6.3.3 Observations During Geomembrane Seaming

The Project Engineer shall record ambient conditions during seaming including air temperature, clouds and wind velocity. The Project Engineer shall measure the wind velocity at the location of the geomembrane with an anemometer. Field seaming is prohibited when the ambient air temperature, is below 32 degrees F, or above 120 degrees F, during precipitation, when winds are in excess of 20 miles per hour or when the underlying compacted clay liner is frozen. Also, the Project Engineer will measure and record the temperature of the geomembrane sheet within five minutes prior to seaming. Sheet temperatures for seaming shall be above 32°F or below 158 degrees F. At air temperatures between 32 degrees F and 40 degrees F, seaming shall be allowed if the geomembrane is preheated either by the sun or a hot air device, and if there is no excessive cooling from the wind. For hot wedge seams, the Project Engineer shall record the temperature of the hot wedge seaming device and the rate of seaming. The temperature of the hot wedge seaming device shall be between 600 degrees F and 800 degrees F.

Prior to extrusion seaming, the Project Engineer must inspect all extrudate material to ensure that it is kept dry and free of dirt, debris and foreign matter. During seaming, the Project Engineer shall record the temperature of the extrudate.

6.3.4 Preparation of Seam Test Strips

The geomembrane installer will check its seaming performance by making test seams at:

1) Each start of work for each seaming crew,
2) After every four hours of continuous seaming,
3) Every time seaming equipment is changed,
4) At least once each day for each seamer/machine combination, and
5) When significant changes in ambient conditions or geomembrane temperature are observed.

Seaming crews shall prepare test strips at least 3 feet long by 1 foot wide with the seam centered lengthwise. Equipment, environmental conditions and materials for preparing test strips must be identical to those used subsequently to produce liner seams in the field. The installer shall cut six adjoining specimens each 1.0-inch wide. The seams shall be allowed to cool in ambient conditions at least 5 to 10 minutes before testing. Three specimens shall be tested in peel and three specimens shall be tested in shear, as described in ASTM D6392, using a field tensiometer. The field tensiometer shall provide quantitative test results and be properly calibrated. The seaming crew shall perform peel and shear tests, and the Project Engineer shall document that the testing was performed and the type of failure for each specimen tested. The Project Engineer will approve the test strip only if the specimens tested meet the same criteria for field welds stated in Section 6.3.6. If a specimen fails, the entire operation shall be repeated. If the additional specimen fails, the seaming apparatus or seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful

trial welds are achieved as witnessed by the Project Engineer. After completion of the above described tests, the remaining portion of the trial seam sample shall be discarded.

6.3.5 Nondestructive Field Tests for Continuity

The geomembrane installer and the Project Engineer shall visually check all liner seams for uniformity of width and surface continuity. The geomembrane installer shall check all field seams for continuity using nondestructive test methods. For dual hot wedge seams, the installer will evaluate the seams continuity using the Pressurized Air Channel Test. Extrusion fillet welds will be observed with a vacuum box as described in ASTM D5641. Extrusion welds that are not accessible for vacuum testing will be tested by spark testing following the procedure described at the end of this section. Continual testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. All non-destructive testing must be witnessed by the Project Engineer. The Project Engineer will record the location, date, test unit number, installer name and results for all nondestructive tests.

Necessary equipment and the procedure for performing the Pressurized Air Channel Test are described in ASTM Test Method D5820. The air pump must inflate the sealed channel to a pressure between 27 and 30 pounds per square inch. After the pressure within the sealed channel has stabilized, the pump is disconnected and a dwell time of five minutes must be observed. The Project Engineer will monitor the test and mark the time and pressure at the beginning and end of the test on the geomembrane. The maximum allowable pressure drops over the five-minute dwell time shall be 3 pounds per square inch. If the pressure does not drop below this value, the air channel shall be checked for blockage. The seam length will be considered satisfactory when the pressure between the ends of the seam and/or any blockages is maintained within the prescribed limits and dwell time. If the air pressure cannot be maintained within the prescribed limits and dwell time, the seals at the ends of the air channel are checked for leakage. If the end seals are not found to be leaking, a leak within the dual seam is indicated and corrective actions are required. Upon completion of the test, the far end of the pressurized seam (away from the pressure gauge) will be punctured to document a pressure loss at the gauge. This will identify that there were no blockages in the seam, and that the entire seam was tested.

Corrective actions include additional inspection along the length of the failed seam to pinpoint leaking areas. Fusion welded seams will be divided into isolated sections and each subjected to air channel testing. Sections of the seam, which do not pass air channel testing, must be repaired and reinspected.

Alternatively, the installer may search for leaks along the outer track of the dual seam. The installer shall cut away the loose flap on the upper geomembrane and perform the Vacuum Box Test as described in ASTM D5641. If no leaks are detected along the outer seam, then the leak is along the inner track of the dual seam and has no impact on the liner integrity. In this case, the outer seam is accepted and further corrective action is not required. Areas where leaks are detected along the outer seam must be repaired and reinspected.

Extrusion welds that are not accessible for vacuum testing will be tested by spark testing. The installer will provide equipment for spark testing that meets the approval of the Project Engineer. Necessary equipment includes copper wire, a wand for inspecting the weld, a power source capable of supplying the necessary voltage to the wand and copper wire, an earth ground, and an alarm to indicate when a defective weld is encountered with the wand. The installer will perform spark testing according to the following procedure:

1) After the upper geomembrane sheet has been beveled at a 45 degrees angle, use a Leister hot air device to heat tack the upper geomembrane to the lower geomembrane.
2) Use a grinding disk to abrade the surface of the geomembrane approximately 3/4 inch on each side of the overlapped sheets.
3) Place a single strand of 24-gauge copper wire at the edge of the top sheet of the overlapped and heat tacked geomembrane and cover the wire with molten extrudate. The tip of a screwdriver or similar device may be used to keep the copper wire centered in the overlap ahead of the extrusion gun placing extrudate. The copper wire must be continuous through the extrusion weld.

4) At the end of each extrusion seam, one end of the copper wire must extend out of the weld approximately 2 to 3 inches for connection to the spark test electrode. As the test wand, used in step 6, nears the exposed end of the copper wire, an electrical arc will occur making this a difficult area to test. If space permits, the extrusion bead with the buried wire shall be extended at a right angle from the actual seam approximately 3 inches. Thus, the exposed wire is away from the actual seam allowing full testing of the seam area.
5) Connect the alligator clip of the spark test unit electrode to the exposed end of the copper wire.
6) Slowly pass the brass bristled brush (test wand) of the test unit over the entire length of the seam. Any flaw in the weld must be indicated by an audible signal and a visible electrical arc at the leak location.
7) Mark the location of any possible flaws. Grind the area, cover with an extrusion bead and retest.
8) At the conclusion of spark testing, cut the exposed length of the copper wire as close to the weld as possible. Re-grind this area and place an extrusion bead over the wire location.

The Project Engineer will monitor all nondestructive testing and record the location, date, test unit number, name of tester, and results of all testing. Based on results from nondestructive testing, the Project Engineer will inform the installer of necessary corrective actions. Seams that leak and are repaired will be retested.

The installer shall repair the defective seam areas with a geomembrane patch, which extends at least 6 inches beyond the unbonded area on all sides. The installer shall seam the patch along the edges by extrusion fillet seaming.

6.3.6 Sampling of Liner Seam and Destructive Testing

Destructive test samples shall be marked and cut out randomly at a minimum average frequency of one test location for every 1,000 feet of seam length. However, samples must be taken at least once for each seamer/seaming machine combination operating on a given day. The Project Engineer shall mark and document sample locations along seams fabricated in the field. Test locations may be prompted by suspicion of excess crystallinity, contamination, offset welds, or any other potential cause of imperfect welding. The Project Engineer reserves the right to increase the sampling frequency in accordance with results of samples taken at no additional cost to the owner. The installer shall cut out 4-foot long sections of fabricated seam from each sample location marked on the liner. The cutout section shall be wide enough such that there is at least 4 inches of sheet material on either side of the sampled seam. The installer shall identify each sample with a number and include the sample number and location on the panel layout drawing. The area from which the liner seam sample was taken shall be patched and then subjected to nondestructive testing as described in Section 6.3.5.

A 1-inch wide strip shall be cut from each end of the sample. The installer will test these two specimens in shear and peel, respectively, using a field tensiometer. The field tensiometer shall provide quantitative test results and be properly calibrated. The Project Engineer shall document each test including the type of failure. The Project Engineer will only approve field cut samples for which both specimens fail by film tearing. Any field cut sample not approved by the Project Engineer will be considered a destructive test failure.

Additionally, the Project Engineer shall visually inspect each sample in cross section. All welded areas, including areas on both sides of the air cavity for fusion welds shall appear as a single piece of material with no air bubbles, cracking or visible line at the point of joining of the two sheets. The Project Engineer will not approve field cut samples not passing visual inspection.

The installer shall divide the remaining liner seam sample into two parts. Each part must be at least 2 feet long. The installer will provide one part to the owner and one to the Project Engineer. The owner shall archive its sample for possible future testing. The archive shall be stored in a light free environment maintained at room temperature. The archive location shall be inspected and approved by the Project Engineer. The Project Engineer shall deliver the remaining sample to the geosynthetics testing laboratory for peel and shear testing as described in ASTM D6392. The testing laboratory will cut ten test specimens from the laboratory sample. The geosynthetics laboratory will test five specimens for peel strength and five specimens for shear strength. For dual track hot

wedge welds, only the outer, or visible weld need be tested. The geosynthetics testing laboratory shall report results of shear and peel testing to the Project Engineer. The laboratory shall provide test results no more than 24 hours after they receive the samples.

The Project Engineer shall determine acceptance of the laboratory sample according to the following criteria:

Shear: All seam samples (5 out of 5) must fail by film tear bond (FTB) at a strength equal to or greater than 120 lb/in for HDPE and 60 lb/in for LLDPE.

Peel: All seam samples (5 out of 5) must fail by film tear bond (FTB) at a strength equal to or greater than 78 lb/in for HDPE and 44 lb/in for LLDPE on extrusion welds and 91 lb/in for HDPE and 50 lb/in for LLDPE on fusion welds.

Seam strength testing shall be done as the seaming work progresses, not at the completion of all field seaming.

Remediation is required when the laboratory sample does not meet the criteria stated above or when the cut sample is not approved by the Project Engineer. The installer will be required to: (1) patch the seam in each direction between the failed sample location and the location of the next acceptable sample, or (2) collect and destructive test an additional sample from each side of the failed sample location to identify the limits of the defective seam. These sample locations must be at least 10 feet away from the original failed sample location. A patch would then be placed over the seam between the two passing seam locations. All patch seams will undergo nondestructive testing as described in Section 6.3.5. Large patches covering more than 50 feet of seam will be of sufficient extent to require destructive test sampling.

6.4 POST-CONSTRUCTION QUALITY ASSURANCE/CONTROL

For primary and secondary geomembrane used on the bottom slope of landfill liner systems, an electrical leak location survey will be performed following placement of overlying soil drainage media in order to identify significant construction-related damage. The electrical leak location survey is performed to identify geomembrane defects associated with installation of the geosynthetics as well as the leachate system. The primary purpose of the electrical leak location survey is to identify construction-related defects. However, the sensitivity of the method employed in general allows for the location of much smaller defects generally associated with installation damage or defects (e.g., knife slits, poor seams). Leak location surveys will be performed by a qualified leak location survey firm in accordance with the requirements provided in Section 2410, Geomembrane Leak Location Testing.

6.5 REPORTING

The Project Engineer shall complete a field report for each day that describes the contractor's activities on that day, environmental conditions during liner installation, the condition of the geomembrane sheets, results of all required testing, and locations of liner seam samples taken for destructive testing. The report shall contain documentation of any failed test results, descriptions of any necessary remedial activities, and all necessary reinspection and testing performed.

The geomembrane installer shall provide the Project Engineer with a record of the installation. The record shall include a plan view of the installed liner showing the panel dimensions, panel and seam identification numbers, panel locations, as well as the locations of destructive tests samples, and necessary repairs.

The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems, and mitigation activities.

7.0 GEOTEXTILES

7.1 BACKGROUND

Geotextiles are used in a number of different locations throughout the construction. The cap replacement system utilizes a gas venting and cushion geotextile. The liner system utilizes geotextiles as a protective cushion for geomembranes. Geotextiles are also utilized in the liner system as separation between stone and soil layers. The following table is a summary of the different geotextiles used at the Chaffee Facility, and the associated function.

SYSTEM	LOCATION	FUNCTION
Cap	Below the cap geomembrane	Gas venting
Cap	On top of the cap geomembrane	Cushion and protection
Liner	On top of the primary geomembrane	Cushion and protection
Liner	Used to separate stone and soil at various locations in the secondary and primary collection systems	Separation
Surface Drainage and Misc.	Beneath the rip-rap stone in drainage channels, etc.	Separation
Haul Roads	Beneath subbase stone in haul roads	Separation and stabilization

7.2 PRE-CONSTRUCTION SAMPLING AND TESTING REQUIREMENTS

7.2.1 Supplier Requirements

The geotextile supplier will provide the Project Engineer with a certificate that indicates the fiber type, manufacturing process, and that the geotextile material meets or exceeds the specified physical requirements. It shall have also been continuously inspected for uniformity, damage, imperfections, holes, cracks, thin spots and foreign materials (i.e. needles). Each manufactured roll must be labeled according to ASTM D4873 to indicate the manufacturer, style number and roll number.

Interface direct shear testing is only required if the products used in the construction of the Overliner area vary from those used in the previous Cells (1, 2, 3, 4, 5, 6 or Overliner Cells 1 and 2). If testing is required, the following procedure shall be used. Prior to delivery of the cushion and protection geotextile, the geotextile supplier shall provide the Project Engineer with six samples of the geotextile designated for delivery to this project for direct shear testing as described by ASTM D5321. Each sample must be 18 inches long by 18 inches wide. The supplier will clearly mark the machine direction on each of the samples.

Interface shear testing will be completed as described in Section 6.0 of this plan. If the configuration of the liner or cap system changes, additional interface testing may be required to identify potential failure zones.

The supplier will provide manufacturer's quality control/quality assurance test reports to the Project Engineer for the sampling frequency stated in the following table. Required manufacturer's quality control/quality assurance tests shall be conducted in accordance with applicable test standards as shown in the following table. The required sampling frequency is also indicated in the table.

TEST	SPECIFICATION	SAMPLING FREQUENCY
Mass/Unit Area	ASTM D5261	once per 100,000 square
Grab Strength	ASTM D4632	feet of geotextile produced
CBR Puncture Strength	ASTM D6241	once per 400,000 square feet of geotextile produced
Trapezoidal Tear	ASTM D4533	
Apparent Opening Size[1]	ASTM D4751	once per production lot

[1] not required for geotextile used for cushion and protection

All documentation required of the supplier must be provided to the Project Engineer prior to using the geotextile on site.

7.2.2 Project Engineer Requirements

Sample rolls will be selected at the manufacturer's facility prior to delivery to the site. The Project Engineer will sample geotextile rolls from each type of geotextile delivered for use as 1) geomembrane protection, 2) gas venting and 3) separation for drainage stone in the collection systems. Conformance samples will be collected at a rate of 1 sample per 100,000 square feet of geotextile.

The Project Engineer will cut a full width, one-foot long conformance sample from each roll sampled. Each conformance sample will be clearly identified with the style number, roll number, and manufacturers' name. Conformance samples will be tested for mass per unit area according to the procedures described in ASTM D5261. The Project Engineer will compare the measured value to the specifications. If a conformance sample does not meet the required specifications, each roll in the shipment will be sampled, and all rolls not meeting specifications will be returned.

The Project Engineer will observe the storage of geotextile rolls delivered to the site and the procedures used to shelter them from sunlight, storm water and construction traffic.

7.3 CONSTRUCTION REQUIREMENTS

All geotextiles will be protected from dirt and dust until they are installed. The field technician will observe the deployment of each geotextile roll and will advise the installer of any defects, punctures and tears so that repairs can be made, inspection for foreign materials (i.e. needles) will also be made by the installer. The field technician will observe the overlaps and will check them against specifications. Defective overlaps and patches will be identified to the installer so that repairs can be made before covering. The maximum exposure time for geotextiles is 14 days.

7.4 REPORTING

The Project Engineer will assemble the individual reports and will complete a field report for each day that construction occurs. The report will describe the contractor's activities on that day and will present the results of field tests made that day and a list of samples collected for laboratory analysis. Plan drawings that show the approximate locations of geotextile placement and the locations of any repairs will be included in the report. The Project Engineer will submit the daily field reports to the Project Engineer.

The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems, and mitigation activities.

8.0 GEOSYNTHETIC CLAY LINER

8.1 BACKGROUND

A geosynthetic clay liner (GCL) is incorporated into the composite liner that functions as the upper 6-inch portion of the primary clay liner as well as the plateau areas of the cap. The location of the GCL is depicted on the Engineering Drawings.

The QA/QC plan described below specifies the methods used to check the quality of the GCL delivered to the site compared to the design requirements and specifications, and the field seams used to join the GCL sheets.

8.2 PRE-CONSTRUCTION SAMPLING, TESTING AND DOCUMENTATION

8.2.1 Supplier Requirements

The GCL supplier must provide the following information to the Project Engineer prior to installation of the liner.

Manufactured Sheets: The supplier of the GCL must certify to the Project Engineer through the manufacturer's quality control documents that during manufacture, the GCL was continuously inspected for uniformity, damage, imperfections, holes, cracks, thin spots and foreign materials (i.e. needles). Additionally, the GCL must have been inspected for tears and punctures. Documentation must demonstrate that all imperfections found were repaired and reinspected at the manufacturing facility.

The GCL supplier must also provide to the Project Engineer reports of tests taken to verify the integrity of the manufactured GCL. Results from the following tests must be submitted prior to installation of the liner.

Component	Test	Frequency
Sheet	Permeability ASTM D5887	once every 270,000 square feet
	Bentonite mass/area ASTM D5993 (Bentonite at 0% moisture content)	once every 45,000 square feet
Geotextile	Mass per unit area ASTM D5261	once every 225,000 square feet
Bentonite	Fluid Loss ASTM D5891	once for every 50,000 tons of raw material
	Swell Index ASTM D5890	once for every 50,000 tons of raw material

The supplier will sample and test the GCL material for the properties and at the frequencies listed above.

Samples not satisfying the specifications shall result in the rejection of the applicable rolls. At the Project Engineer's discretion, additional testing of individual rolls may be performed to more closely identify the non-complying rolls.

The supplier must submit all documentation required by this section to the Project Engineer before the GCL may be deployed in the landfill.

8.2.2 Project Engineer Requirements

Project Engineer requirements include those for interface direct shear testing, and conformance testing and sampling.

Interface Direct Shear Testing: This testing is only required if the products used in the construction of Overliner Cells 1 and 2 vary from those used in the previous Cells (1, 2, 3, 4, 5 or 6). If testing is required, the following procedure shall be used.

Prior to delivery of the GCL, the GCL supplier shall provide the Project Engineer with six samples of the GCL designated for delivery to this project for direct shear testing as described by ASTM D5321. Each sample must be 18 inches long by 18 inches wide. The supplier will clearly mark the machine direction on each of the samples.

Interface shear testing will be completed for the geomembrane/GCL interface as described in Section 6.0 of this plan. If the configuration of the liner system changes, additional interface testing may be required to identify potential failure zones.

In addition to the GCL interface testing, the geosynthetics laboratory will test the internal shear strength of the GCL as described in ASTM D6243. This test will be used to verify that the GCL has a higher internal shear strength than the weakest interface of the liner system in which it is being used.

The geosynthetics testing laboratory will report the results of direct shear testing to the Project Engineer. Acceptance criteria for test results are as follows. A minimum peak friction angle of 15 degrees for the baseliner interfaces. A minimum peak friction angle of 24 degrees for the sideslope liner interfaces after construction and prior to waste placement (i.e., low normal stresses). A minimum residual friction angle of 19 degrees for the sideslope liner interfaces after waste placement (at the applicable normal stresses). If the required strengths are not met, the Project Engineer may re-evaluate the stability of the landfill with the tested values and submit the analysis to the NYSDEC for approval or select another material for testing.

Conformance Testing: Sample rolls will be selected at the manufacturer's facility prior to delivery to the site. The sample will be a full width, 2-foot long swatch of material from GCL rolls at a rate of 1 per 100,000 square feet of material proposed for use in the barrier. Material shall not be taken from the inner or outer wraps of a roll. Sample collection will be observed and documented by the Project Engineer. The Project Engineer will then deliver the samples to the geosynthetics testing laboratory. The GCL sheet will be tested for bentonite mass per area according to the procedure described in ASTM D5993 and the geotextile portion of the conformance sample will be tested for mass per unit area according to the procedures described in ASTM D5261. At least one sample delivered to the site will be tested for permeability according to the procedures described in ASTM D5887. The Project Engineer will compare the measured values to the specifications. If a conformance sample does not meet the required specifications, each roll in the shipment will be sampled and all rolls not meeting specifications will be returned.

If the laboratory samples do not meet specifications, the roll will be rejected and additional rolls adjacent to the rejected roll in the manufacturing sequence will be sampled and tested.

8.3 CONSTRUCTION PHASE OF QA/QC ACTIVITIES

8.3.1 Surface Inspection

The GCL installer will observe the condition of the primary structural fill layer (the surface on which the GCL liner will be deployed) for smoothness and protrusions before deploying the GCL. The strength of the primary structural fill layer must be sufficient to support the equipment that will be used for deploying the liner without experiencing permanent deformations such as ruts. When the surface is acceptable, the GCL installer will submit a written notice to the Project Engineer stating that the surface satisfies the installer's requirements.

8.3.2 Deployment of GCL

The GCL shall remain rolled and dry until ready to use. Deployment requirements are described in the project specifications.

8.3.3 Observations During GCL Seaming

The Project Engineer shall record ambient conditions during seaming including air temperature, clouds and wind velocity. The panels shall be observed for uniform bentonite distribution. Panels, which appear to lack sufficient bentonite, shall be replaced.

Seams shall be observed for proper orientation and overlap. Bentonite placed along seams shall be observed for proper thickness, width and continuity.

8.4 REPORTING

The Project Engineer shall complete a field report for each day that describes the contractor's activities on that day, environmental conditions during liner installation and the condition of the GCL sheets.

The GCL installer shall provide the Project Engineer with a record of the installation. The record shall include a plan view of the installed liner showing the panel dimensions, panel and seam identification numbers, panel locations and the locations of necessary repairs.

The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems, and mitigation activities.

9.0 LEACHATE COLLECTION SYSTEM

9.1 BACKGROUND

The leachate collection system within the Cell consists of two layers, the first is located on top of the secondary composite liner system and the second is located on top of the primary composite liner system. The secondary collection system consists of a geocomposite sloped to drain to previously constructed sump areas that can be pumped. This layer acts as a leak detection and collects any liquid above the secondary composite liner. The primary collection system consists of a cushion geotextile covering the primary geomembrane, followed by a layer of porous drainage media. This layer is used to collect liquid that collects below the waste and above the primary composite liner. Granular drainage materials for the secondary and primary systems will be imported from an off-site supplier.

The leachate transfer system for the overliner cells consists of pumps installed into riser pipes that discharge into a gravity main that runs along the north, west and south sides of the Western Expansion Landfill. This main ultimately discharges the collected leachate into the on site storage tanks. The leachate transfer pipes are installed within a double containment system. The leachate transfer system pumps, sump pipes, and dual contained transfer pipes have already been installed during previous construction.

This section describes the testing requirements for the drainage layer materials. Testing requirements for the geotextiles in the leachate collection system are described in Section 7.0 of the QA/QC Plan.

9.2 PRE-CONSTRUCTION

9.2.1 Primary Drainage Layer Material

Two samples of drainage layer materials will be collected from selected suppliers. The supplier will provide the Project Engineer with certification that indicates the material meets or exceeds the specifications for coarse drainage stone Item 02501 and drainage stone Item 02502. The certification will include results from tests, which document that the materials meet NYSDOT requirements for quality and soundness and also the calcium carbonate equivalent. Additionally, the supplier shall submit gradation test results that demonstrate that the material meets the specified gradation.

The samples will be tested for gradation according to ASTM D6913 to check for compliance with the project specifications. If the gradation data do not meet the project requirements, the Project Engineer may test one or both of the samples for permeability using the constant head method, ASTM D2434. If the gradation data fail to meet specified values but the permeability data demonstrate that the materials are acceptable, the Project Engineer may elect to use the material.

Samples of the drainage material will be collected from the on-site stockpiles periodically during delivery. Gradation samples will be collected at a rate of about one sample for every 3000 cubic yards. In addition, permeability samples will be collected from the stockpile at a rate of one sample for every 2500 cubic yards delivered to the site.

The samples will be delivered to the geotechnical laboratory where they will be analyzed for particle size distribution (ASTM D6913) and permeability using the constant head method, (ASTM D2434). The Project Engineer will compare these test data to assess the variability of the material and to demonstrate that the materials meet the specifications.

If the data indicate that the source of the drainage material provides satisfactory materials, it will be considered an approved source. If not, the contractor will be advised to select another source.

9.2.2 Secondary Geocomposite

The geocomposite placed for the secondary leachate collection will be a geonet sandwiched between two geotextiles. The QA/QC plan addresses the specifications and design requirements of the individual components and of the composite.

Manufacturer's Testing: The supplier of the geocomposite will provide the Project Engineer with certification describing the source of the geotextiles and geonet used, and that the materials meet or exceed the specified physical requirements. Certification must indicate the fiber type, and manufacturing process for geotextiles and the polymer type and density for the geonet. Each manufactured roll of geocomposite must be labeled according to ASTM D4873 to indicate the manufacturer, style number and roll number.

Interface direct shear testing is only required if the materials used in the construction of the Overliner area vary from those used in the previous Cells (1, 2, 3, 4, 5, 6 and Overliner Cells 1 and 2). If testing is required, the following procedure shall be used. Prior to delivery of the geocomposite, the gecomposite supplier shall provide the Project Engineer with six samples of the geocomposite designated for delivery to this project for direct shear testing as described by ASTM D5321. Each sample must be 18 inches long by 18 inches wide. The supplier will clearly mark the machine direction on each of the samples.

Interface shear testing will be completed as described in Section 6.0 of this plan. If the configuration of the liner system changes, additional interface testing may be required to identify potential failure zones.

The supplier of the geocomposite will provide manufacturers' quality control/quality assurance test reports to the Project Engineer for the geotextile and geonet components. Required manufacturers' quality control/quality assurance tests shall be conducted in accordance with applicable test standards as shown in the following tables. The required sampling frequency is also indicated in the tables.

GEOTEXTILE TESTS

TEST	SPECIFICATION	SAMPLING FREQUENCY
Mass/unit area	ASTM D5261	once per 100,000 ft^2 of geotextile produced
Grab Strength	ASTM D4632	
Puncture Strength	ASTM D6241	
Trapezoidal Tear Strength	ASTM D4533	once for every 540,000 ft^2 of geotextile produced
Apparent Opening Size	ASTM D4751	
Permittivity	ASTM D4491	

GEONET CORE TESTS

TESTS	SPECIFICATION	SAMPLING FREQUENCY
Resin Polymer Density	ASTM D1505	once for each lot produced
Melt Flow Index	ASTM D1238	
Tensile Strength	ASTM D5035	once for every 100,000 ft^2 of geonet produced
Geonet Thickness	ASTM D5199	
Carbon Black	ASTM D1603	

GEOCOMPOSITE DRAINAGE LAYER TESTS

TESTS	SPECIFICATION	SAMPLING FREQUENCY
Geocomposite Ply Adhesion	ASTM D7005	once for every 100,000 ft^2 of geonet produced

Conformance Testing Sample rolls will be selected at the manufacturer's facility prior to delivery to the site. The Project Engineer will sample the geocomposite at a rate of 1 sample per 100,000 square feet. The Project Engineer will cut a full width, one-foot long conformance sample from each roll sampled. The conformance sample will be clearly identified with the style number, roll number, and manufacturer's name.

One of the geocomposite conformance samples will be cut into a 12-inch by 24-inch sample, which will be tested for hydraulic transmissivity as described by ASTM D4716 and GRI-GC8. The Project Engineer will obtain samples of geomembrane and deliver the geocomposite and geomembrane samples to the geosynthetics laboratory for testing. The testing will be completed such that the geocomposite is placed between two geomembranes so as to replicate secondary collection field conditions. The geosynthetics laboratory will test the hydraulic transmissivity of the geocomposite by the method described in ASTM D4716 and GRI-GC8. The transmissivity test will be made at a confining pressure of 13,000 psf, hydraulic gradient of 0.1 and a minimum seating period of 100 hours. The geosynthetics testing laboratory will report the results of transmissivity testing to the Project Engineer.

The geotextile portion of the conformance sample will be tested for mass per unit area according to the procedures described in ASTM D5261 and the geonet portion will be tested for thickness according to the procedure described in ASTM D5199. At least one sample delivered to the site will have the geotextile portion tested for Apparent Opening Size according to the procedures described in ASTM D4751. The Project Engineer will compare the measured value to the specifications. If a conformance sample does not meet the required specifications, each roll in the shipment will be sampled and all rolls not meeting specifications will be returned.

The Project Engineer will observe the storage of geocomposite rolls delivered to the site and the procedures used to shelter them from sunlight, storm water and construction traffic.

9.2.3 Pipes and Drainage System Components

The supplier of the HDPE pipes and fittings will be required to submit delivery slips with the shipment planned for use in the leachate transfer systems. The field technician will compare the information contained on the delivery slips to that required for the project and will reject deliveries not meeting the project requirements. The manufacturer will submit certificates stating that the pipes and fittings delivered satisfy the minimum requirements.

9.3 TESTS DURING CONSTRUCTION

9.3.1 Primary Drainage Material

A particle size analysis of the soil drainage layer material must be submitted to the project engineer for approval for each borrow source prior to installation. A laboratory constant-head permeability test (ASTM D2434) for a soil drainage layer sample must be submitted to the project engineer for approval for each borrow source prior to installation Samples collected during this phase will be selected for permeability testing based on the results of the gradation testing. Permeability tests using the constant head method, ASTM D2434 will be done at a frequency of once per every 2500 cubic yards of drainage layer material.

The field technician will collect samples of the drainage material following placement in the landfill for particle size analysis. The number of samples collected will be 1 for every 1000 cubic yards of drainage material used. The purpose of collecting samples from the placed drainage layer is to assess the amount of the particle breakdown

resulting from delivery and placement by testing for Particle Size Analysis according to ASTM D6913. At least one sample will be collected from areas beneath access roads that are expected to have greater particle breakdown.

Samples collected during this phase will be selected for permeability testing based on the results of the gradation testing. Permeability tests using the constant head method, ASTM D2434 will be done at a frequency of once per every 2500 cubic yards of drainage layer material as the material is delivered and at a frequency of once per every 2500 cubic yards of drainage layer material placed.

If the gradation data fail to meet specified values but the permeability data demonstrate that the materials are acceptable, the Project Engineer may accept the material. The Project Engineer will approve the quality control testing results of soil drainage materials and ensure that the materials meet the placement, hydraulic conductivity, and thickness requirements of section 363-6.6.

9.3.2 Secondary Geocomposite

All seams shall be made according to the manufacturer's specifications. Seaming procedures shall be submitted for approval before beginning deployment of the geocomposite material. For long seams this includes overlapping the lower geotextile 4 inches, overlapping the geonets 6-inches with plastic ties installed at 5-foot intervals on the floor, 1-foot intervals on the sideslopes and overlapping the upper geotextile 4-inches and sewing. For butt seams, the geocomposite shall be overlapped 12 inches with plastic ties installed at 6-inch intervals and the upper geotextiles shall be capped with an 18-inch wide strip of geotextile. The upper geotextile on the lower geocomposite and the lower geotextile on the upper geocomposite shall be removed to allow the geonet portions of the geocomposites to be in direct contact as shown in the Engineering Drawings. All geotextile will be protected from dirt and dust until they are installed. The field technician will observe the deployment and will advise the installer of any defects, punctures and tears so that repairs can be made. The field technician will observe the overlaps and will check them against specifications. Defective overlaps and patches will be identified to the installer so that repairs can be made before covering. The maximum exposure time for geotextiles is 30 days.

9.3.3 Pipe Installation

The Contractor will be required to submit its proposed procedures, equipment (including a relationship between hydraulic carriage pressure and fusion pressure) and names of individuals who will be performing the fusion welding, prior to welding. HDPE Pipe welding procedures will be developed from an on-site test performed in the presence of the Project Engineer, to establish appropriate procedures for butt fusion welding of joints using the Contractor's proposed equipment. Documents such as "Qualification Procedures for making PE 3408 Polyethylene Heat Fusion Joints" by Plexco or "Heat Fusion Qualification Guide" by Driscopipe shall be consulted to develop the butt fusion procedure.

The Project Engineer shall observe all pipe welding and placement of the pipes. If pipe is welded a distance from the actual placement location, any possible damage to the pipe including scratches and gouges shall be documented by the Project Engineer. Damages exceeding 10 percent of the wall thickness will require removal and replacement. In addition, the Project Engineer reserves the right to reject or independently test welded pipe joints if in their opinion manufacturer recommendations or welding procedures are not being followed.

The Project Engineer will observe pipe backfilling activities and reserves the right to request additional compactive effort when placing backfill materials or the need to expose pipes that are believed to have been damaged during backfill placement.

9.3.4 Survey Measurements

The QA/QC Surveyor will use survey measurements to estimate the thickness of the drainage layer as described in Section 5.0. These measurements will be reported to the Project Engineer.

The QA/QC Surveyor and or the Contractor will measure the location and elevation of the leachate pipes at 50-foot intervals and compare these to the design locations and elevations. The QA/QC Surveyor and the Contractor will measure the location and elevations of control points for all other leachate collection system components.

9.4 REPORTING

Each field technician will report their observations and the results of their testing and sampling to the Project Engineer. The Project Engineer will assemble the individual reports and will complete a field report for each day that construction occurs. The report will describe the contractor's activities on that day and will present the list of samples collected for laboratory analysis. The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems and mitigation activities.

10.0 GAS COLLECTION SYSTEM

10.1 BACKGROUND

The gas collection system construction work consists of modifying the existing collection system located on and within the cap system of the Closed Landfill. This work consists of over drilling existing gas wells and abandoning existing extraction wells, installing perforated and solid piping and backfilling the trenches with drainage stone (Item 02502) or pipe bedding material (Item 02203) as shown on the Engineering Drawings.

Also included are installation of gas venting geosynthetics beneath the portions of the Closed Landfill cap geomembrane that is being removed and replaced. The required geosynthetics consist of gas vent strips spaced across the work area and a gas venting geotextile as shown on the Engineering Drawings. Manufacturer and construction QA/QC requirements for the gas venting geosynthetics are included in the Technical specifications and Section 8.0 of this plan.

This section describes the testing requirements for the pipes, fittings and backfill.

10.2 PRE-CONSTRUCTION

10.2.1 Pipes and System Components

The supplier of the pipes and fittings will be required to submit delivery slips with the shipment planned for use in the gas collection systems. The field technician will compare the information contained on the delivery slips to that required for the project and will reject deliveries not meeting the project requirements. The manufacturer will submit certificates stating that the pipes, and fittings delivered satisfy the minimum requirements.

10.2.2 Pipe Backfill Materials

Drainage stone used for backfilling overdrilled gas wells, abandoned extraction wells and around perforated gas collection pipes shall conform to material properties for Item 02502. As described in Section 9.2.1 of this plan, pre-construction sampling and testing shall be performed by the supplier and QA/QC Engineer.

Prior to delivery of the pipe bedding material (Item 02203) to the site, the material supplier shall provide a particle size analysis (ASTM D422) for the material to the Project Engineer. The Project Engineer will then determine whether the materials meet the specifications. If the material is suitable, the material supplier will provide a sample of material to the Project Engineer for testing each 5000 cy of supplied material. The geotechnical testing laboratory will perform a particle size analysis (ASTM D422) for each 5000 cy of supplied material.

10.3 TESTS DURING CONSTRUCTION

10.3.1 Pipe Installation

The Contractor will be required to submit its proposed procedures, equipment (including a relationship between hydraulic carriage pressure and fusion pressure) and names of individuals who will be performing the fusion welding, prior to welding. HDPE Pipe welding procedures will be developed from an on-site test performed in the presence of the Project Engineer, to establish appropriate procedures for butt fusion welding of joints using the Contractor's proposed equipment. Documents such as "Qualification Procedures for making PE 3408 Polyethylene Heat Fusion Joints" by Plexco or "Heat Fusion Qualification Guide" by Driscopipe shall be consulted to develop the butt fusion procedure.

The Project Engineer shall observe all pipe welding and placement of the pipes. If pipe is welded a distance from the actual placement location, any possible damage to the pipe including scratches and gouges shall be documented by the Project Engineer. Damages exceeding 10 percent of the wall thickness will require removal and replacement. In addition, the Project Engineer reserves the right to reject or independently test welded pipe joints if in their opinion manufacturer recommendations or welding procedures are not being followed.

10.3.2 Backfill Material Placement

The Project Engineer shall observe the placement of all required backfill materials to ensure that the correct materials are being placed in the specified locations as shown on the Engineering Drawings. The Project Engineer shall observe material thickness and compaction efforts to ensure that the materials are being placed to limit voids and damage to the installed piping. The Project Engineer reserves the right to request additional compactive effort when placing backfill materials or the need to expose pipes that are believed to have been damaged during backfill placement.

10.3.3 Survey Measurements

The QA/QC Surveyor and or the Contractor will measure the location and elevation of the leachate pipes at 50-foot intervals and compare these to the design locations and elevations. The QA/QC Surveyor and the Contractor will measure the location and elevations of control points for all other gas collection system components.

10.4 REPORTING

Each field technician will report their observations and the results of their testing and sampling to the Project Engineer. The Project Engineer will assemble the individual reports and will complete a field report for each day that construction occurs. The report will describe the contractor’s activities on that day and will present the list of samples collected for laboratory analysis. The Project Engineer is responsible for photographic documentation, which will serve as a pictorial of work progress, problems and mitigation activities.

11.0 FINAL REPORT

At the completion of the work, the Project Engineer will submit to WMNY a Final Report. This report will conclude that the work has been performed in compliance with the Engineering Drawings, the QA/QC Plan, the Project Specifications, and any revisions to these documents, except as properly authorized and implemented, and that the final report document provides the necessary information to support the conclusion.

At a minimum, this report will include:

a) Summaries of all construction activities;
b) Observation logs and testing data sheets including sample location plans;
c) A discussion of any changes from design and material specifications;
d) Results of construction quality assurance and construction quality control testing including documentation of failed test results, descriptions of procedures used to correct the improperly installed material, and results of all retesting performed;
e) Record Drawings;
f) A comprehensive narrative including, but not limited to, daily reports from the Project Engineer and a series of color photographs of major project features.
g) A certification that the primary liner system leakage rate was below 20 gallons per acre per day using a rolling average for 30 consecutive days;
    - during the primary liner leakage rate evaluation period, at least one inch of rain or equivalent must be introduced into the cell. Data verifying acceptable primary liner performance, including precipitation or the introduction of water to the cell must be provided in the construction certification report
    - the liner performance evaluation period may not be conducted under frozen ground conditions.
h) A summary statement sealed and signed by a Professional Engineer registered in the State of New York (i.e., the Project Engineer-of-Record).

The Record Drawings will note deviations from the approved Engineering Drawings and will include scale drawings depicting the location and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thickness, etc.). A land surveyor licensed to practice in the State of New York will perform all surveying and preparation of base maps required for development of the Record Drawings. These documents will be prepared by the Project Engineer and included as part of the QA/QC Final Report.

In accordance with 363-6.19, the Final Report will be submitted to the NYSDEC. Operation of the facility and any stage in the operation of the facility cannot commence until approval from the NYSDEC is received.

Construction activities will be staged to allow for effective collection and tabulation of a minimum of 30 consecutive days of secondary leachate collection and removal system flow data. This data will be collected upon cell construction completion and will be used as part of the construction documentation to verify that the primary liner system will effectively meet the 20-gallon per acre per day leakage rate threshold. The primary leachate collection system must have an adequate liquid loading throughout the duration of the 30 days using either precipitation derived or pumped liquid.

APPENDIX A

TECHNICAL SPECIFICATIONS

DIVISION 1 – GENERAL

01050 Lines and Grades
01400 Quality Assurance /Quality Control
01500 Construction Facilities and Temporary Controls

DIVISION 2 – SITE WORK

02020 Clearing Grubbing and Stripping Topsoil
02050 Dust Control and Work Area Maintenance
02100 Haul Road Construction
02200 Embankment
02205 Material Processing
02210 Clay Liners
02220 Geosynthetic Clay Liner
02400 Geomembranes
02410 Geomembrane Leak Location Testing
02500 Leachate Collection Systems
02600 Leachate Transfer System
02650 Dewatering
02700 Gas Collection Systems
02800 Storm Water Management
02900 Vegetative Measures for Erosion and Sediment Control
02910 Structural Measures for Erosion and Sediment Control

SECTION 01050

LINES AND GRADES

PART 1 – GENERAL

1.01 Scope

A. This section specifies the requirements for the control of the lines, grades and levels at the Chaffee Facility. The Contractor is responsible for field control and layout for the project construction. The Owner will retain the services of a QA/QC surveyor to measure the constructed dimensions of the facility and check the measurements against the project requirements.

B. Job Conditions:

1. The Contractor is responsible for field control and layout of the subgrade for construction. The Contractor is responsible for performing all work in accordance with the Contract Drawings, Specifications, the QA/QC Plan, Title 6 of the New York Compilation of Codes and Regulations, Part 363 (6 NYCRR 363) and the Chaffee Facility permit for construction.

2. The Owner will retain the services of the QA/QC surveyor to measure the constructed dimensions of the liner system and check the measurements against the project requirements.

3. The Contractor shall complete all work as specified and when each layer is complete and measured by the Contractor's surveyor, shall notify the Engineer for verification by the QA/QC surveyor. The Contractor shall cooperate with the QA/QC surveyor as requested. The QA/QC surveyor will notify the Contractor of any areas that do not meet the project requirements. After the Contractor has remediated these areas, the QA/QC surveyor will check these areas a second time for compliance with the project requirements. If additional work is necessary requiring a third survey check or more for any layer, the third and any additional surveys by the QA/QC surveyor will be at the Contractor's expense.

4. Service of the QA/QC surveyor is intended for the Owner's verification of the Contractor's compliance with the requirements of the Contract Documents and the requirements of the construction permit and shall in no way relieve the Contractor of his/her responsibilities to provide their own inspection and quality control.

5. The QA/QC surveyor will provide the Contractor with a grid, with points spaced approximately 50 feet apart and at key locations such as grade breaks, berms and

anchor trenches. The Contractor will be responsible for maintaining grades and layer thickness between the given points. At each grid point, the grade elevation of each layer of the liner system will be provided. The grade elevations are based on the design elevations and the tolerances as discussed in Part 3.02 of this section.

6. The Contractor will be responsible for survey control and layout of the entire project. The project layout shall be based on the grade elevations provided by the QA/QC surveyor and the tolerances stated in Part 3.02 of this section.

7. The QA/QC surveyor will measure the constructed dimensions to determine if the constructed facility is within the design tolerance based on the grade elevations provided by the QA/QC surveyor at points spaced approximately 50 feet apart and at key locations such as grade breaks, berms and anchor trenches. Any areas not in compliance with the project requirements will be repaired or replaced, until they are within the design tolerance, at no additional cost to the Owner.

8. The QA/QC surveyor will establish horizontal and vertical control points for the site, prior to initiation of site work. The Contractor will be responsible for maintaining these control points during construction and establishing temporary baselines and survey control points during construction.

9. The QA/QC surveyor will check the construction of each layer of the liner system and the appurtenances as described in the QA/QC plan. Each layer of the liner system will be checked including:

a. A survey of existing conditions in the proposed work area;

b. The final prepared surface of the top of the subgrade;

c. Extent and location of all Closed Landfill cap replacement geosynthetics;

d. The top of the secondary clay liner, including thickness;

e. Extent of the geomembrane liner and geomembrane flaps;

f. The extent of the secondary leachate collection system geocomposite;

g. Top and toe of the berms;

h. Middle of both the secondary and primary geomembrane liner anchor trenches

i. The top of the primary leachate collection drainage stone, including thickness;

j. At 50-foot intervals along each pipe and other drainage structures, including any fittings, bends and valves.

Construction of subsequent layers of the liner system will not be allowed until all of the survey data for a given layer are within specified tolerances.

10. A portion of the construction occurs over the Closed Landfill and grade control for checking constructed material thickness must be verified not just by comparison of point data but also by a direct measurement of material thickness. This is due in part to the possible settlement that will occur throughout construction.

11. The QA/QC surveyor will check the construction of the exterior berms and stormwater controls. The Project Engineer may request additional surveys of the exterior features to ensure that the Contractor has completed the work specified on the Contract Drawings. At the completion of the project, the Project Engineer will provide an as-built survey of all the exterior landfill features.

12. In the event of a discrepancy between measurements made by the Contractor and the QA/QC surveyor, the measurements by the QA/QC surveyor will govern.

1.02 Related Work Specified Elsewhere

A. Quality Assurance/Quality Control: Section 01400

B. Clearing Grubbing and Stripping Topsoil: Section 02020

C. Haul Road Construction: Section 02100

D. Embankment: Section 02200

E. Clay Liners: Section 02210

F. Geomembranes: Section 02400

G. Leachate Collection Systems: Section 02500

H. Gas Collection Systems: Section 02700

I. Storm Water Management: Section 02800

J. Vegetative Measures for Erosion and Sediment Control: Section 02900

K. Structural Measures for Erosion and Sediment Control: Section 02910

L. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. Submit plan for construction survey control including survey equipment and location of baselines for control of work.

PART 2 – MATERIALS

None

PART 3 – EXECUTION

3.01 General

A. Prior to commencement of earthwork, the Contractor shall establish all necessary baselines, and horizontal and vertical control points, necessary to accurately complete the construction.

B. Survey measurements are required to be within 0.01 feet in horizontal location and within 0.01 feet in elevation.

C. The Contractor will provide survey control during construction and will measure the as-constructed facility to determine if it is within the required tolerances. When, in the opinion of the Contractor, the construction of each layer of the liner system is complete, the Contractor will notify the Project Engineer.

3.02 Tolerances

A. The exterior landfill features shall be constructed to the dimensions, elevations and grades shown on the Contract Drawings. Pipes and grades shall be constructed to within 1 inch of the design. The Project Engineer may require different tolerances based on the work being performed and the level of accuracy required.

B. The liner system shall be constructed to the tolerances shown in the following table. As shown on the thickness range columns of the table, construction to these tolerances will result in a thickness for each layer greater than the minimum values shown on the Contract Drawings. The elevation tolerance is relative to the theoretical design elevations shown on the Contract Drawings, and the “grade to” elevation is the mean of the minimum and maximum allowable elevations. The Contractor shall set the “grade to” elevation as the target elevation at the control points.

Description	Elevation Tolerance (inches)			Thickness Range (inches)		
	min	grade to	max	min	avg	max
Top of Subgrade	-1.0	-0.5	0			
Top of Secondary Clay Liner	0	+0.5	+1.0			
Thickness of Secondary Clay Liner – 2.0 foot areas				24	25	26
Top of Primary Leachate Collection Layer	+2.0	+2.5	+3.0			
Thickness of Primary Leachate Collection Layer				24	25	26

3.03 QA/QC Surveyor's Measurements

A. The QA/QC surveyor will measure the facility using an approximate 50-foot grid and at 50-foot intervals along pipes and at other key locations as indicated in the QA/QC Plan.

B. A portion of the construction occurs over the Closed Landfill and will require collection of a direct measurement of material thickness. This can be accomplished by field measuring hand auger depths or establishing a direct measure tube at a 50-foot grid.

C. The Project Engineer will notify the Contractor of any locations that are outside the specified tolerances so that they can be repaired or replaced.

END OF SECTION 01050

SECTION 01400

QUALITY ASSURANCE/QUALITY CONTROL

PART 1 – GENERAL

1.01 Scope

A. The Contractor is responsible for performing all work in accordance with the Contract Drawings, Specifications, the QA/QC Plan, Title 6 of the New York Compilation of Codes and Regulations, Part 363 (6 NYCRR 363) and the Chaffee Facility permit for the construction.

B. The Owner has retained a Project Engineer to execute a quality assurance and quality control program as required by the NYSDEC, these Specifications, and the QA/QC Plan. All earthwork, liner, and related construction must be performed in the presence of the Project Engineer's representative. The Contractor shall cooperate with the Project Engineer with sampling and testing as requested by the Project Engineer. The data generated as part of the quality assurance and quality control program will govern over data generated from the Contractor's required quality control program and any other test data.

1. Service of the Project Engineer is intended for the Owner's verification of the Contractor's compliance with the requirements of the Contract Documents and the requirements of the construction permit and shall in no way relieve the Contractor of his/her responsibilities to provide their inspection and quality control.

C. Definitions

1. Quality Assurance (QA). A planned system of activities whose purpose is to provide a continuing evaluation of the quality control program, initiating corrective actions where necessary. It is applicable to both the manufactured product and its field installation.

2. Quality Control (QC). Actions that provide a means of controlling and measuring the characteristics of both the manufactured and the field installed product.

D. Job Conditions

1. Numerous construction activities such as subgrade preparation, embankment construction, borrow material excavation and screening, clay liner construction, geomembrane liner deployment and seaming, deployment of geotextiles, placement of drainage stone and leachate collection pipes, and waste disposal will be ongoing simultaneously at the site. The Contractor will be required to coordinate and schedule his/her work accordingly.

2. QA/QC activities are an integral part of the construction process. Contractors are required to sample materials, perform field tests, and necessary reconstruction and remedial measures as described in the QA/QC Plan and the Specifications.

1.02 Related Work Specified Elsewhere

A. Clearing, Grubbing and Stripping Topsoil: Section 02020

B. Dust Control and Work Area Maintenance: Section 02050

C. Haul Road Construction: Section 02100

D. Embankment: Section 02200

E. Material Processing: Section 02205

F. Clay Liners: Section 02210

G. Geomembranes: Section 02400

H. Leachate Collection Systems: Section 02500

I. Dewatering: Section 02650

J. Gas Collection Systems: Section 02700

K. Storm Water Management: Section 02800

L. Vegetative Measures for Erosion and Sediment Control: Section 02900

M. Structural Measures for Erosion and Sediment Control: Section 02910

N. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. The Contractor is required to submit all documentation and certification as described in the Specifications and QA/QC Plan to the Project Engineer in a timely manner.

1. Submit all documentation in triplicate.

2. Certificates must be signed by an authorized representative of the producer or supplier and state that the material complies to all aspects of the project requirements.

3. Materials used on the basis of a certificate of compliance may be sampled and tested at any time. The fact that material is used on the basis of a certificate of compliance will not afford relief from the responsibility for incorporating material in the work which conforms to the requirements of the Contract, and any such materials not conforming to such requirements will be subject to rejection, whether in place or not.

PART 2 – MATERIALS

None

PART 3 – EXECUTION

3.01 Embankments

A. Prior to construction, the Contractor is required to proof roll the entire subgrade surface as described in the QA/QC Plan. Additionally, the Contractor must construct a test pad and complete moisture density tests as described in the QA/QC Plan and Section 02200 of the Specifications.

B. Compaction Requirements

1. The Contractor will be required to control moisture of embankment materials either at the source or during placement as described in Section 02200 of the Specifications.

2. The Contractor will be required to remediate areas for which the requirements for moisture content and density are not met as described in Section 02200 of the Specifications.

3.02 Material Processing

A. The Contractor shall maintain the processed soil stockpiles at a moisture content near the moisture content required for constructing the landfill liner so that significant adjustment of the moisture content is not required at the landfill.

B. Prior to liner construction work, the Contractor shall monitor the stockpile and measure the moisture content at least twice per shift. These measurements shall be tabulated and provided to the Project Engineer on a daily basis. After liner construction work begins, the Project Engineer will monitor the moisture content of the stockpile. Moisture adjustment should be done at the borrow stockpile. The Engineer will notify the Contractor of the moisture content required at the landfill.

3.03 Clay Liner

A. Prior to construction, the Contractor is required to construct a test pad as described in the QA/QC Plan and Section 02210 of the Specifications.

B. Compaction Requirements

1. The Contractor will be required to control moisture of clay liner material either at the source or during placement as described in Section 02210 of the Specifications.

2. The Contractor will be required to remediate areas for which the requirements for moisture content and density are not met as described in Section 02210 of the Specifications.

C. Shelby Tube Samples

1. The Contractor will be required to retrieve Shelby tube samples as described in the QA/QC Plan and Section 02210 of the Specifications.

2. The Contractor is required to reconstruct areas from which failed Shelby tube samples were taken as described in the QA/QC Plan and Section 02210 of the Specifications.

D. Surface Preparation

1. The surface of the clay liner must be prepared and certified for geomembrane deployment as described in Section 02400 of the Specifications.

3.04 Geomembranes

A. The geomembrane has been purchased by the Owner. Conformance testing as described in the QA/QC Plan and Section 02400 of the Specifications will have been completed prior to material delivery.

B. The geosynthetics contractor Test Seams

1. The geosynthetics contractor is required to prepare test seams and perform shear and peel tests in the field as described in the QA/QC Plan and in Section 02400 of the Specifications.

C. Nondestructive Testing

1. The geosynthetics contractor is required to perform nondestructive testing of liner seams as described in the QA/QC Plan and Section 02400 of the Specifications.

2. Nondestructive testing must be carried out as the seaming work progresses, not at the completion of all seaming work.

3. The geosynthetics contractor will remediate and retest seams which fail nondestructive testing as described in the QA/QC Plan and Section 02400 of the Specifications.

D. Destructive Testing

1. The geosynthetics contractor will retrieve samples of installed liner seam for destructive testing as described in the QA/QC Plan and Section 02400 of the Specifications.

2. The geosynthetics contractor will perform peel and shear tests on samples of the installed liner seam as described in the QA/QC Plan and Section 02400 of the Specifications.

3. Sampling and destructive testing must be carried out as the seaming work progresses, not at the completion of all field seaming.

4. The geosynthetics contractor must reconstruct areas of the liner seam that fail the peel and shear tests as described in the QA/QC Plan and Section 02400 of the Specifications.

E. Inspection

1. The geosynthetics contractor and Project Engineer shall inspect the surface of the compacted clay liner for stones protruding more than ¼ inch before deploying the geomembrane.

2. The geosynthetics contractor must inspect the installed geomembrane for evidence of defects, holes, blisters, undispersed raw materials and any sign of contamination by foreign matter as described in Section 02400 of the Specifications.

3. Any portion of a geomembrane exhibiting a flaw must be repaired by the geosynthetics contractor.

4. Rolls that contain a significant number of defects or are damaged, as

3.05 Geocomposites and Geotextiles

A. The geocomposites and geotextiles have been purchased by the Owner. Conformance testing as described in the QA/QC Plan and Sections 02500 and 02700 of the Specifications will have been completed prior to material delivery.

B. Inspection

1. The geosynthetics contractor and Project Engineer shall inspect the surface of the subgrade for stones protruding more than ¼ inch before deploying the geocomposite.

2. The geosynthetics contractor must inspect the installed geocomposites and geotextiles for evidence of defects, holes, undispersed raw materials and any sign of contamination by foreign matter as described in Section 02500 and 02700 of the Specifications.

3. Any portion of a geocomposite or geotextile exhibiting a flaw must be repaired by the geosynthetics contractor.

4. Rolls that contain a significant number of defects or are damaged, as determined by the Project Engineer, shall be rejected for use.

3.06 Leachate Collection System

A. The Project Engineer will collect samples of the leachate collection stone prior to and following placement to assess the amount of particle breakdown resulting from delivery and placement. Testing will be completed as described in the QA/QC Plan and Section 02500 of the Specifications.

END OF SECTION 01400

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 Scope

A. This section includes the requirements and descriptions of the temporary facilities and controls necessary for completion of the work.

B. Job Conditions

1. The Contractor shall provide and pay for all temporary electrical facilities required for the work.

a. The Contractor shall make his/her own arrangements for any large capacity requirements, air conditioning equipment, field offices, toilets, and continuously operating equipment such as dewatering pumps.

b. Materials for temporary light and power shall be installed in conformance with the National Electric Code.

2. The Contractor shall provide and pay for all temporary phone lines required for the work.

3. The Contractor shall make all arrangements for the supply of temporary water to construction areas and pay for that service.

a. The Contractor shall provide connection to existing pipes and provide any pumps required. Connections, where used, must be approved by the Owner and installed in accordance with applicable regulations.

b. The Contractor shall provide hose extensions and trucks where required to deliver water to the point of use.

c. The Owner is neither responsible for interruptions of water service nor liable to the Contractor for any such interruption.

4. The Contractor shall provide and pay for all toilet accommodations for workers on the project, including separately contracted workers performing electrical, mechanical, or geosynthetics installation.

a. Toilets shall be located in an area approved by the Owner and maintained in a sanitary condition.

b. Provide at least one unit for every 30 persons employed, and separate units for male and female employees.

c. Provide first aid stations at work areas and in the temporary field office.

d. Post telephone numbers of physicians, hospitals and ambulance services by each telephone at the project site.

e. Provide facilities and fixtures in compliance with OSHA and all other applicable federal, state, and local laws and regulations.

f. Enforce proper use of sanitary facilities, including preventing the committing of nuisances in buildings on the site. Discharge employees who violate this rule.

g. Dispose of all wastes in conformance with applicable regulation.

5. The Contractor's vehicles and equipment shall be configured in a manner that minimizes noise to the greatest degree practicable. Noise levels shall conform to the latest OSHA standards and in no case will noise levels be permitted which interfere with the work of the Owner or others. The Owner will require that smart alarms be installed on all of the Contractor's equipment.

6. The Contractor shall be responsible for controlling objectionable dust caused by operation of vehicles and equipment, by clearing and grubbing, or for any reason whatsoever. The Contractor shall apply water or use other methods to keep dust in the air to a minimum, subject to the approval of the Owner.

7. The Contractor will be responsible for implementing dust controls and performing dewatering activities for the entire project, including but not limited to the earthwork and geosynthetics.

8. The Contractor shall provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.

a. In the event of a spill caused by the Contractor's activities, immediately contact the Owner and the NYSDEC.

9. The Contractor shall work in accordance with the approved Stormwater Pollution Prevention Plan (SWPPP) that has been prepared for the facility. As part of the SWPPP the Contractor shall sign a copy of the certification statement and shall provide an updated Erosion and Sediment Control Plan prior to beginning construction.

10. The Contractor shall be responsible for installing and maintaining all of the temporary erosion control, such as silt fence, rock check dams, straw bales, sediment traps and temporary swales.

11. The Contractor shall have use of all existing roads located at the project site. Temporary roads required for the construction shall be built and maintained by the Contractor.

12. The Contractor shall clearly mark all routes of ingress and egress to the location of the work. These routes shall be approved by the Owner prior to use.

13. The Contractor shall clean the debris resulting from work at least once a day and more often if the debris interferes with the work of others or presents a fire hazard.

14. The Contractor shall control to the greatest degree practical, as determined by the Project Engineer, the emission of odors and other fugitive emissions from the work including, but not limited to, dust and blowing papers.

15. The Contractor shall remove temporary facilities when they are no longer required, and restore permanent facilities used for or connected to temporary facilities to their original or better condition.

16. The limits of the area allocated for use by the Contractor for storage and work operations is indicated on the Drawings. If additional space is available, and the Owner's approval is given, the Contractor may have use of other areas of the site. The Contractor shall:

a. Not unreasonably encumber the site with materials or equipment.

b. Not load or surcharge existing site structures or other facilities with equipment or supplies having a weight that will endanger the integrity of the structures.

c. Assume full responsibility for protection and safekeeping of Contractor-supplied or owned products stored on the premises.

d. Move any stored products that interfere with the operations of the Owner or other contractors.

e. Coordinate and cooperate with other contractors and utilities on the site.

f. Restore to original condition any structures, equipment or roadways damaged during storage of equipment or materials.

g. Not restrict access to the site by others.

h. Stockpile materials removed from excavations within the work area as directed by the Project Engineer.

17. The Contractor shall provide its own field office trailer, and shall place the trailer within the working area identified by the Owner. The Contractor shall also provide trailer space for the Project Engineer, the Owner's Construction Manager and staff.

a. The provided trailer space shall be equipped with electrical service.

b. The provided trailer space shall be equipped with tables, chairs and desks for use by the Project Engineer and Construction Manager.

c. The field office trailer shall be removed from the site upon completion of the work.

18. The Contractor shall protect work existing on the premises and Owner's operations from theft, vandalism, and unauthorized entry.

a. The Contractor shall initiate the site's security program in coordination with the Owner's existing security system at job mobilization.

b. The Contractor shall restrict entrance of persons and vehicles into the project site to only those working on the project.

c. The Contractor shall allow entrance only to authorized persons with proper identification.

d. The Contractor shall coordinate access of the Owner's personnel to the site in coordination with the Owner's security forces.

PART 2 – PRODUCTS

None

PART 3 – EXECUTION

None

END OF SECTION 01500

SECTION 02020

CLEARING, GRUBBING AND STRIPPING TOPSOIL

PART 1 – GENERAL

1.01 Scope

A. The Contractor shall furnish all labor, materials, tools and equipment, and perform all operations necessary for clearing, grubbing, stripping and stockpiling topsoil.

C. Definitions

1. Topsoil: The surficial material consisting of organic, highly compressible soils.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance / Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Embankment: Section 02200

E. Dewatering: Section 02650

F. Gas Collection Systems: Section 02700

G. Stormwater Management: Section 02800

H. Vegetative Measures for Erosion and Sediment Control: Section 02900

I. Structural Measures for Erosion and Sediment Control: Section 02910

J. Construction QA/QC Plan: Included with the Contract Documents

PART 2 – MATERIALS

None

PART 3 – EXECUTION

3.01 Clearing and Grubbing

A. The Contractor shall clear and grub according to Section 201 of the New York State Department of Transportation (NYSDOT) Standard Specifications.

B. All tree stumps and tree tops shall be removed from the work area and chipped into sizes suitable for the Owner's use. Additional stockpiles of tree stumps and tree tops as identified by the Owner shall also be removed and chipped. Chipped material will be stockpiled in a location suitable to both the Project Engineer and Owner. All other objectionable materials as identified by the Owner or Project Engineer shall also be removed from the work area and disposed of properly.

3.02 Topsoil Removal

A. All of the topsoil shall be removed from the areas within the proposed construction areas as shown on the Contract Drawings.

B. Topsoil shall be stockpiled onsite in an area designated by the Owner and Project Engineer.

C. Erosion and sediment control shall be provided downgradient of the topsoil stockpile as described in Sections 02900 and 02910.

END OF SECTION 02020

SECTION 02050

DUST CONTROL AND WORK AREA MAINTENANCE

PART 1 – GENERAL

1.01 Scope

A. Dust control will be of importance during construction activities at the site. The Contractor shall conduct operations and maintain the project site, haul roads, and stockpile areas, so as to minimize the creation and dispersion of dust.

1.02 Related Work Specified Elsewhere

A. Clearing, Grubbing and Stripping Topsoil: Section 02020

B. Haul Road Construction: Section 02100

C. Embankment: Section 02200

D. Material Processing: Section 02205

E. Clay Liners: Section 02210

F. Leachate Collection Systems: Section 02500

G. Gas Collection Systems: Section 02700

H. Stormwater Management: Section 02800

I. Vegetative Measures for Erosion and Sediment Control: Section 02900

J. Structural Measures for Erosion and Sediment Control: Section 02910

K. Construction QA/QC Plan: Included with the Contract Documents

PART 2 – MATERIALS

A. Water for dust control is available at the site from one of the sedimentation basins.

B. Chemical dust suppressants shall not be used.

PART 3 – EXECUTION

A. The Contractor shall implement strict dust control measures during active construction periods on site. These control measures will generally consist of water applications that shall be applied a minimum of once per day or more often during dry weather as required to prevent dust emissions or as directed by the Project Engineer or Owner.

B. Existing access roads shall be used by the Contractor whenever possible. If new haul roads are required to access the work areas, then the Contractor shall obtain approval from the Project Engineer or Owner prior to their construction. All haul roads used during execution of work, whether temporary haul roads created by the Contractor or existing site roads, shall be maintained by the Contractor. Unless otherwise approved by the Owner, temporary haul roads will be restored by smooth grading and seeding to re-establish vegetation.

C. Monitoring wells and other permanent site features such as pump controllers, pipes and cleanouts have been installed and are located throughout the site. The Contractor shall protect the existing features from damage during construction. Measures taken to protect the existing features from damage will include flagging and construction of barricades. Any damage caused by construction activities will be repaired and damaged equipment will be replaced by the Owner at the Contractor's expense.

END OF SECTION 02050

SECTION 02100

HAUL ROAD CONSTRUCTION

PART 1 – GENERAL

1.01 Scope

A. Description of work under this section: This section specifies the work required to construct the perimeter landfill access roads and haul roads to be used during and after construction. Access roads will be constructed to allow for egress into the proposed work areas will be created and maintained using soil embankment materials. In the event that roads become damaged due to the Contractors use, the Contractor shall follow these specifications.

Other work included in this section pertains to installing temporary litter fencing and protective pipe bollards as shown on the Drawings.

B. Definitions

1. Excavation: the removal of earthen materials from the subgrade or the stockpile of previously placed soil that is unsuitable.

2. Backfilling: the placement and compaction of earthen materials on the prepared subgrade.

3. Authorized excavation: the excavation of soils to the limits shown on the Drawings. It includes excavation of soil considered unsuitable by the Engineer.

4. Unauthorized excavation: excavation beyond the limits shown and not authorized by the Engineer.

5. Subgrade: the surface upon which construction of the road subbase begins.

C. Job Conditions

1. Crushed stone, gravel base, subbase materials and geotextiles will be supplied by the Owner, the Contractor will be responsible for coordinating the delivery and stockpiling of these materials. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

2. All other materials required in this section will be supplied and installed by the Contractor. Geosynthetics used in the Haul Roads will be installed by the Contractor according to Section 02500 of these specifications.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Embankment: Section 02200

E. Gas Collection Systems: Section 02700

F. Dewatering: Section 02650

G. Storm Water Management: Section 02800

H. Vegetative Measures for Erosion and Sediment Control: Section 02900

I. Structural Measures for Erosion and Sediment Control: Section 02910

J. Construction QA/QC Plan: Included with the Contract Documents

PART 2 – MATERIALS

2.01 Stone Base Material, Item 02101:

A. Stone Base Material shall consist of crushed stone or gravel (not slag) meeting the material requirements in NYSDOT Section 304, Type 4.

2.02 Stone Subbase Material, Item 02102:

A. Stone Subbase Material shall consist of mixed crushed stone or gravel (not slag) meeting the material requirements in NYSDOT Section 703 for size designation 3, 4 and 5. This mixture of material shall be of sufficient quality to provide adequate interlock and stability.

2.03 Heavy Stone Subbase Material, Item 02103:

A. Heavy Stone Subbase Material shall consist of crushed stone or gravel (not slag) with a maximum particle size not exceeding 8 inches.

2.04 Protective Pipe Bollard, Item 02104:

A. The protective pipe bollards will consist of standard weight 4 inch diameter steel pipes meeting the material requirements of ASTM A53 Type E or S.

2.05 Temporary Litter Fence, Item 02105:

A. The Temporary Litter Fence shall consist of 6-inch square timber posts. The posts shall be CCA treated according to AWPA C4-03 requirements or an approved equivalent treatment process. The wire mesh shall be galvanized 12 gage wire with 2 inch by 4 inch mesh.

2.06 Woven Geotextile, Item 02105:

A. Prior to installing stone materials on the subgrade of access roads, a woven geotextile shall be installed. The woven geotextile shall be Mirafi 500X or an approved equivalent. Installation shall be in accordance with the manufacturer's recommendations.

PART 3 – EXECUTION

3.01 Stone Base and Subbase

A. Surface Preparation

1. Before the stone is placed on the surface of the subgrade, the Project Engineer will observe the following:

a. Proof rolling of the subgrade surface by the Contractor as described in the QA/QC Plan;

b. Surface is free of ruts greater than 1 inch deep;

c. The subgrade shall be free of loose material, smooth, firm and free of standing water;

d. The approved separation geotextile, Item 02505 will be installed according to the specifications and manufacturer's recommendations.

e. Areas not meeting this criteria shall be corrected and re-inspected before placement of the stone begins.

B. Placement

1. The Contractor shall place and compact the stone material to a maximum twelve (12) inch thick compacted lift. The maximum thickness may be less depending on the Contractor's equipment or specified thickness as shown on the Drawings.

2. The Contractor shall use equipment appropriate for spreading the material in a uniformly thick layer across the lift.

C. Compaction

1. The Contractor shall compact each lift of stone material with the equipment that was approved prior to construction.

2. The required number of roller passes will be established by both the equipment's capabilities and density tests taken during compaction.

3. The moisture content and dry density criteria for compaction will be established by the Project Engineer based on preconstruction testing. At a minimum, the stone base material shall be compacted to 95 percent of the maximum dry density as measured in the modified proctor test (ASTM D1557).

D. Protection

1. The Contractor is responsible for protecting the stone materials prior to placing either the next lift or Asphalt materials. This includes the following

a. The surface shall be kept free of mud, standing water and construction debris.

b. Areas not meeting this criteria shall be corrected and re-inspected before placement of the next lift or Asphalt begins.

3.02 Pipe Bollard

A. Installation

1. The Contractor shall install the pipe bollards at the locations shown on the Drawings.

2. The pipes shall be installed into a hole created by a continuous flight auger, which shall have a minimum diameter of 12-inches. The holes shall be augered to the minimum depth shown on the Drawings.

a. During installation, the Project Engineer may require a deeper embedment if the soil conditions are deemed unsuitable.

b. The holes shall be cleaned of all loose material prior to installing the pipes and concrete backfill.

c. The pipes shall be installed into the holes and temporarily supported to maintain alignment and stickup during concrete placement.

d. The holes shall be backfilled with concrete.

e. Allow for the concrete backfill to cure for a minimum of three days prior to placing the concrete fill inside the pipe.

3. Upon completion of each pipe bollard, there shall be no visible defects, such as misaligned pipes, spalled or cracked concrete or unfilled pipes as determined by the Project Engineer. If these defects are present, the Contractor shall repair the defects to the satisfaction of the Project Engineer or replace each pipe bollard at no additional cost.

3.03 Temporary Litter Fence

A. Installation

1. The Contractor shall install the timber poles at the location and spacing as shown on the Drawings.

2. The poles shall be installed into a hole created by a continuous flight auger, which shall not have a diameter exceeding 1.5 times the diameter of the poles butt end. The holes shall be augered to the minimum depth shown on the Drawings.

a. During installation, the Project Engineer may require a deeper embedment if the soil conditions are deemed unsuitable.

b. The holes shall be cleaned of all loose material prior to installing the timber poles.

c. After installing the poles, the holes shall be backfilled and compacted with the auger spoils unless they are deemed unsuitable by the Project Engineer.

3. A galvanized 2” by 4” rectangular wire mesh will be installed along the fence alignment as shown on the Drawings.

a. The mesh shall be stapled to each timber pole in a continuous fashion.

b. At each splice joint in the wire mesh (either vertical or horizontal), the mesh shall be overlapped a minimum of 12-inches and be tied at a minimum 12-inch interval using galvanized tie wire.

4. Upon completion of the Litter Fence, there shall be no visible defects, such as misaligned poles or incomplete mesh joints as determined by the Project Engineer. If these defects are present, the Contractor shall repair the defects to the satisfaction of the Project Engineer or replace the Litter Fence at no additional cost.

END OF SECTION 02100

SECTION 02200

EMBANKMENT

PART 1 – GENERAL

1.01 Scope

A. Description of work under this section: This section specifies the work required to construct berms and embankment fill other than the compacted clay liner. Additional work in this phase of construction may include; excavation and decommissioning of manholes/sumps, removal and disposal of Closed Landfill cap materials and excavation and movement of Closed Landfill waste.

B. Definitions

1. Excavation: the removal of earthen materials from the subgrade, South Borrow Area, or Borrow Area C, or the removal of waste materials within the Closed Landfill.

2. Backfilling: the placement and compaction of earthen materials on the prepared subgrade or within excavations.

3. Authorized excavation: the excavation of soils or wastes to the limits shown on the Drawings. It includes excavation of soil/waste considered unsuitable by the Engineer.

4. Unauthorized excavation: excavation beyond the limits shown and not authorized by the Engineer.

5. Subgrade: the surface upon which construction of the modified Closed Landfill cap, secondary clay liner, exterior berm or other landfill features begins.

6. Subgrade Fill: the material used to construct berms, backfill excavations or raise site grades. It is also referred to as embankment fill.

C. Job Conditions

1. Embankment material will be obtained from the subgrade excavations, if required, additional embankment fill may be obtained from onsite stockpiles or the approved borrow areas.

2. Subgrade excavations include removing Closed Landfill barrier protection soils, excavation of the berm support soil and perimeter clay berm. These materials are expected to meet the requirements for embankment stated in Part 2 of this specification section.

3. The Project Engineer will evaluate these materials during excavation to efficiently utilize the best materials for use in subgrade construction. Excess materials or unsuitable materials will be relocated to onsite stockpiles in locations designated by the Owner.

4. The Owner currently has a stockpile of offsite material which may be used as embankment material if required or may procure additional material from offsite for use as embankment material.

5. The contractor is responsible for stockpiling excess materials and maintaining the stockpiles. The contractor will be required to maintain off site material stockpiles in the event that they are used for embankment fill.

6. The contractor is required to remove Closed Landfill geosynthetic cap materials which may consist of geocomposites, geotextiles and geomembranes. These materials shall be cut neatly along the designated removal limit and be disposed of properly within the active landfill. Coordination of disposal time and areas with the Owner.

7. Upon completing the Closed Landfill cap removal, existing waste excavation is required for liner construction. Existing waste shall be excavated and disposed of within the active landfill. Coordination of disposal time and areas with the Owner.

8. The Contractor shall be prepared to construct the subgrade in conjunction with the installation and construction of the other components of the liner system and facility.

9. Pipe bedding material will be supplied by the Owner, the Contractor will be responsible for coordinating the delivery and stockpiling of these materials. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Material Processing: Section 02205

E. Clay Liners: Section 02210

F. Leachate Collection Systems: Section 02500

G. Dewatering: Section 02650

H. Gas Collection Systems: Section 02700

I. Storm Water Management: Section 02800

J. Vegetative Measures for Erosion and Sediment Control: Section 02900

K. Structural Measures for Erosion and Sediment Control: Section 02910

L. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. The Contractor is required to submit the following:

1. At least one week before material placement, submit specifications for the proposed compaction equipment including weight (both static and dynamic) and dimensions of the pads on the roller drums.

2. At least four weeks prior to cap removal, submit a detailed sequence of activities to minimize duration of waste excavation and exposure. Include with this submittal an odor and gas migration mitigation plan, which may include use of odor control misters, temporary covers (tarps, spray on covers and/or soil).

PART 2 – MATERIALS

2.01 Type A Embankment Material, Item 02201:

A. Silty or clayey borrow that is free of deleterious materials such as organics, roots, topsoil, ice, frozen soil, saturated soil or other matter considered unsuitable by the Project Engineer.

B. The maximum particle size shall be limited to 3 inches.

C. This soil is used in the upper 6 inches of the subgrade in fill areas designated on the Drawings.

2.02 Type B Embankment Material, Item 02202:

A. Silty or Clayey borrow that is free of deleterious materials such as organics, roots, topsoil, ice, frozen soil, saturated soil or other matter considered unsuitable by the Project Engineer.

B. The maximum particle size shall be limited to 10 inches.

D. This soil is used to bring the subgrade to within 6 inches of the design grades as designated on the Drawings.

2.03 Pipe Bedding Material, Item 02203:

A. Pipe bedding material shall consist of natural sand and gravel (not slag) meeting the material requirements in NYSDOT Section 304 Type 4.

PART 3 – EXECUTION

3.01 Embankment Material Installation

A. Surface Preparation

1. The surface of the subgrade and any completed lift shall be scarified a minimum depth of 1/2 inch or to the depth of desiccation cracks, whichever is greater, before placing a subsequent lift. Scarification shall be done with the cleats of a bulldozer or a sheepsfoot roller or as necessary to scarify the soil to the depth of desiccation cracks.

2. The surface of the completed lift shall be moistened after scarifying if, in the opinion of the Project Engineer, the moisture content of the lower lift (or subgrade) is too low to create bonding between the two lifts.

B. Placement

1. The Contractor shall place and compact the material to a maximum 12-inch thick compacted lift. The maximum thickness may be less depending on the Contractor's equipment.

2. The Contractor shall use equipment appropriate for spreading the material in a uniformly thick layer across the lift.

3. The Contractor shall place the material at a moisture content near the required moisture content so that significant adjustment of the moisture content is not required within the landfill. Moisture adjustment should be done at the borrow stockpile.

4. If moisture adjustment is required within the landfill, the areas requiring adjustment must be scarified throughout the lift thickness. The Contractor shall allow for adequate drying or mixing of additional water to provide a uniform moisture content throughout the lift.

C. Compaction

1. The Contractor shall compact each lift of the material with the same padfoot or sheepsfoot roller equipment approved before construction.

2. Each lift of the material shall be compacted sufficiently to destroy all clay clods and knead the soil mass together, producing a uniform, homogeneous mass free of all defects, cracks and fissures.

3. The required number of roller passes will be established by the test pad results. However, as a minimum, the Contractor shall compact each lift of fill materials with a minimum of six (6) passes. One pass is defined as one coverage of the compactor.

4. The soil moisture content and dry density criteria for compaction will be established by the Project Engineer based on preconstruction testing. Each lift of the material shall be compacted until all in-place density results satisfy the minimum requirements for dry density and moisture content.

D. Protection

1. The Contractor is responsible for protecting the embankment materials from degrading.

a. Material that has dried shall be scarified, moistened, re-compacted and re-tested or removed. If removed, the soil shall be removed to the depth of unaffected soil, as determined by the Project Engineer.

b. Material shall be protected from freezing. Any fill that has frozen shall be removed to a depth of previously unfrozen soil, as determined by the Project Engineer.

c. The Contractor shall prevent the fill materials from becoming saturated. Soil that becomes excessively wet shall be scarified, allowed to dry, re-compacted and re-tested or shall be removed. If soil is removed, it shall extend to a depth where it has not been disturbed, in the opinion of the Project Engineer.

2. Before the secondary clay liner is placed on the surface of the subgrade in the overliner areas, the Project Engineer will observe the following:

a. Proof rolling of the entire subgrade surface by the Contractor as described in the QA/QC Plan;

b. Surface is free of ruts greater than 1 inch deep;

c. The subgrade shall be free of loose material, smooth, firm and free of standing water.

d. Areas not meeting the criteria stated in Paragraphs 3.01 E. 2. a, b and c shall be corrected and re-inspected before placement of the secondary clay liner begins.

3. At the end of each working day, the Contractor shall compact the surface with a smooth drum roller to create a smooth surface, and the surface shall be graded to drain.
4.

3.02 Pipe Bedding Material Installation

A. The Contractor shall place the pipe bedding material, Item 02203 to the lines and grades shown on the Drawings. The pipe bedding material is used to bed gas collection pipes and stormwater drainage pipes as shown on the Drawings

B. The Contractor shall place the pipe bedding, in loose lifts not exceeding 6 inches.

C. The Contractor shall compact the pipe bedding with suitable equipment. The compaction criteria will be established by the Project Engineer prior to placement. The Project Engineer may determine that the compaction is unsatisfactory and may require the Contractor to recompact the material.

3.03 Sump #3/4 Manhole Decommissioning

A. The Contractor shall decommission the sump #3/4 manhole as shown on the Drawings.

B. The Contractor shall excavate soil materials as required to remove the manhole.

C. The Contractor shall backfill the excavated areas to the design subgrade using a Embankment Fill. Place and compact these materials per their respective sections.

3.04 Cap Removal and Waste Excavation

A. The Contractor shall cut, remove and dispose of the Closed Landfill cap as shown on the Drawings.

B. Cap geosynthetics shall be neatly cut to the design limit, excess material should be left to allow for proper overlaps and connections when installing cap replacement materials. Geosynthetic cap materials shall be moved to the active landfill for disposal at the direction of the Owner.

C. The Contractor shall excavate waste to the proposed design subgrade. Waste shall be moved to the active landfill for disposal at the direction of the Owner. The Owner will compact the relocated waste.

D. Cap removal and waste excavation shall proceed in a timely fashion to avoid odor and gas migration. The Contractor shall be prepared to mitigate these issues through the use of temporary control measures.

E. Upon achieving the design subgrade elevations a 6 inch thick lift of Type A Embankment fill shall be placed prior to installing the required geosynthetic cap materials. This lift of material does not require compaction.

END OF SECTION 02200

SECTION 02205

MATERIAL PROCESSING

PART 1 – GENERAL

1.01 Scope

A. This section specifies the work required to process earthen material for construction of the clay liners.

B. Job Conditions

1. The Contractor shall excavate material from Borrow Area C and the South Borrow Area for processing into Clay Liner Soil (Item 02212). The Contractor shall sequence the material processing work to allow for a proper accounting of all materials that are excavated and processed.

2. The Contractor shall excavate and screen materials to meet the material specifications required by the Contract Documents. The Contractor will stockpile processed materials in an area agreed to by the Owner. If at any time the excavated material appears to change in character, the Contractor shall notify the Owner and the Project Engineer.

3. Rejected materials will be stockpiled in an area agreed to by the Owner. If inspections by the Owner or the Project Engineer indicate clay soils in the rejected pile then the Owner may require additional screening of the rejected materials.

4. The Contractor must coordinate with the Engineer for sampling and testing of the borrow area and the stockpiles.

5. The Contractor shall provide erosion and sediment control measures to prevent the off site migration of sediment from the excavation and stockpile areas.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section02050

D. Embankment: Section 02200

E. Clay Liners: Section 02210

F. Dewatering: Section: 02650

G. Vegetative Measures for Erosion and Sediment Control: Section 02900

H. Structural Measures for Erosion and Sediment Control: Section 02910

I. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. The Contractor is required to submit the following:

1. With the bid, submit specifications for the proposed processing equipment, a plan of the processing area and processing rates and schedule.

2. Erosion control measures.

PART 2 – MATERIALS

2.01 Clay Liner Soil – Type I, Item 02211:

A. The maximum particle size shall be limited to 3 inches.

B. When placed and compacted, it shall have a permeability less than or equal to $1x10^{-7}$ centimeters per second.

2.02 Clay Liner Soil – Type II, Item 02212:

A. The maximum particle size shall be limited to 1 inch.

B. When placed and compacted within the top 8 inches of the secondary clay liner, it shall have a permeability less than or equal to $1x10^{-7}$ centimeters per second.

C. This soil shall also be used as berm cap material along the anchor trenches and where shown on the Drawings, but does not require permeability testing.

2.03 Clay Liner Soil – Type III, Item 02214:

A. The maximum particle size shall be limited to 1 inch.

B. When placed and compacted within the top 6 inches of the bottom 12 inch lift of secondary clay liner, it shall have a permeability less than or equal to $1x10^{-7}$ centimeters per second. The lower 6 inches of the 12 inch thick lift does not require permeability testing.

C. This soil shall also be used as berm cap material along the future cell connections and where shown on the Drawings, but does not require permeability testing.

PART 3 – EXECUTION

3.01 Excavation

A. The Contractor shall excavate material that is located in an approved and designated borrow area The Contractor shall sequence the material processing work to allow for a proper accounting of all materials that are excavated and processed.

3.02 Processing

A. The Contractor shall process materials to meet the material specifications for Clay Liner Soil (Item 02212).

B. If at any time the excavated material appears to change in character so that it would not meet the project requirements, the Contractor shall notify the Owner and the Engineer.

C. The Contractor shall stockpile the processed materials in areas agreed to by the Owner. Separate stockpiles shall be maintained for Item 02212 and oversized materials (reject materials).

D. Reject materials will be stockpiled in an area agreed to by the Owner. If inspections by the Owner or the Engineer indicate clay soils in the reject pile, then the Owner may require additional screening of the reject materials. Additionally, the Contractor shall utilize reject materials for use in other locations as identified by the Project Engineer.

E. The Contractor shall maintain the stockpiles at a moisture content near the moisture content required for constructing the landfill liner so that significant adjustment of the moisture content is not required at the landfill.

F. Material that will be screened for Item 02212 shall initially be screened to 3 inch minus without any water addition. This material will then be screened to minus 1 inch, adding water as necessary to meet the requirements.

G. Prior to liner construction work, the Contractor shall monitor the clay liner stockpiles and measure the moisture content at least twice per shift to check the moisture content. These measurements shall be tabulated and provided to the Project Engineer on a daily basis. After liner construction work begins, the Project Engineer will monitor the moisture content of the stockpile. Moisture adjustment should be done at the borrow stockpiles. The Project Engineer will notify the Contractor of the moisture content required at the landfill.

3.03. Protection

A. The Contractor is responsible for protecting the processed material from degrading.

B. At the end of each working day, the Contractor shall compact the surface of the stockpiles with a smooth drum roller to create a smooth surface, and the surface shall be graded to drain. If necessary, tarps or other protective measures shall be instituted to protect the stockpiles.

C. The Contractor shall provide erosion and sediment control measures to prevent the off-site migration of sediment from the excavation and stockpile areas. This shall include construction of ditches and other drainage facilities and installation of a silt fence or erosion control measures.

END OF SECTION 02205

SECTION 02210

CLAY LINERS

PART 1 – GENERAL

1.01 Scope

A. Description of work under this section: Clay Liner Soils (Items 02211 and 02214) will be excavated from material that is located in Borrow Area C and the South Borrow Area. Clay Liner Soils (Item 02212 will be processed in accordance with Section 02205 of these specifications.

B. Definitions

1. Excavation is the removal of earthen materials from the subgrade or the stockpile or clay liner material previously placed that is unsuitable.

2. Backfilling is the placement and compaction of earthen materials on the prepared subgrade.

3. Authorized excavation is the excavation of soils to the limits shown on the Drawings. It includes excavation of soil considered unsuitable by the Project Engineer.

4. Unauthorized excavation is excavation beyond the limits shown and not authorized by the Engineer.

C. Job Conditions

1. Clay Liner Soils (Items 02211, 02212 and 02214) will be excavated from material that is located in Borrow Area C and the South Borrow Area. The Contractor is responsible for excavation, moisture control, hauling and placing material. The Contractor is responsible for achieving the specified properties with the soil from the borrow sources.

2. Clay Liner Soils (Item 02212) will be processed in accordance with Section 02205 of these specifications. The Contractor is responsible for excavation, stockpiling, processing, moisture control, hauling and placing material. The Contractor is responsible for achieving the specified properties with the soil from the borrow sources.

3. Contractor shall be prepared to construct the clay liner in conjunction with the earthworks and the installation and construction of the other components of the liner system and facility.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Embankments: Section 02200

E. Material Processing: Section 02205

F. Geomembrane Liners: Section 02400

G. Leachate Collection Systems: Section 02500

H. Dewatering: Section 02650

I. Gas Collection Systems: Section 02700

J. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. The Contractor is required to submit the following:

1. Specifications for the proposed compaction equipment including weight (both static and dynamic) and dimensions of the pads on the roller drums.

PART 2 – MATERIALS

2.01 Clay Liner Soil – Type I, Item 02211:

A. The maximum particle size shall be limited to 3 inches.

B. When placed and compacted, it shall have a permeability less than or equal to $1x10^{-7}$ centimeters per second.

C. This soil type shall be used for all clay liner, except the uppermost lift and the lowermost lift in the Overliner area, which are in contact with the geomembrane.

D. The soil shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the Project Engineer.

2.02 Clay Liner Soil – Type II, Item 02212:

A. The maximum particle size shall be limited to 1 inch.

B. When placed and compacted within the top 8 inches of the secondary clay liner, it shall have a permeability less than or equal to $1x10^{-7}$ centimeters per second.

C. This soil shall also be used as berm cap material along the anchor trenches and where shown on the Drawings, but does not require permeability testing.

D. The soil shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the Project Engineer.

2.03 Clay Liner Soil (Berm Cap Soil) – Type III, Item 02214:

A. The maximum particle size shall be limited to 1 inch.

B. When placed and compacted within the top 6 inches of the bottom 12 inch lift of secondary clay liner, it shall have a permeability less than or equal to $1x10^{-7}$ centimeters per second. The lower 6 inches of the 12 inch thick lift does not require permeability testing.

C. This soil shall also be used as berm cap material along the future cell connections and where shown on the Drawings, but does not require permeability testing.

D. The soil shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the Project Engineer.

PART 3 – EXECUTION

3.01 Test Pad

A. Purpose: The Contractor shall construct a test pad using Clay Liner Soil Type I (Item 02211) material to verify the suitability of the Contractor's proposed equipment and methods and to provide soil compaction characteristics to guide the Project Engineer and Contractor during construction of the clay liner.

B. Frequency:

1. One test pad is required if soil properties and the Contractor's equipment do not change through the duration of the project.

2. If the Contractor changes compaction equipment or procedures, the test pad must be repeated.

3. If in the opinion of the Project Engineer, there is a substantial change in the clay liner properties, which could affect the Contractor's ability to produce a liner with the required permeability, construction of another test pad will be required.

C. Requirements: Test pad requirements follow:

1. Test pad dimensions: 12 feet wide (minimum) by 75 feet long (minimum), 1.0 feet thick (minimum) compacted and shall be constructed on a 3 horizontal: 1 vertical slope.

2. Soil for each of the two lifts of the test pad shall be placed and compacted to a maximum eight (8) inch thick compacted lift.

3. Soil moisture and placement density shall be within the range determined by the Engineer based on pre-construction testing and evaluation. As a minimum, the soil shall be compacted to a minimum of 90 percent of the maximum dry density measured by the modified Proctor test (ASTM D1557).

D. Engineer's measurements:

1. The Field Technician shall measure the in-place dry density of each lift of the test pad as described in the Construction Quality Assurance plan.

2. The Field Technician shall collect Shelby tube samples from the compacted lifts as described in the Construction Quality Assurance plan.

3. The Contractor shall measure the thickness of the clay liner lifts in both the compacted and uncompacted states as described in the Construction Quality Assurance plan.

4. The minimum number of passes required to achieve the desired results will be evaluated by the Project Engineer.

3.02 Surface Preparation

A. The surface of a completed lift shall be scarified a minimum depth of 1/2 inch before placing a subsequent lift or to the depth of desiccation cracks, whichever is greater. Scarification shall be done with the cleats of a bulldozer or a sheepsfoot roller or other appropriate equipment.

B. The surface of the completed lift shall be moistened after scarifying if, in the opinion of the Project Engineer, the moisture content of the lower lift is too low to create bonding between the two lifts.

3.03 Placement

A. The Contractor shall place clay liner soil to a maximum eight (8) inch thick compacted lift, unless otherwise noted on the Drawings such as the initial lift of secondary clay liner soil at the berm cap which will be placed as twelve (12) inches thick. All lifts shall comply with the requirements stated in this section.

B. The initial lift of soil placed for the secondary clay liner will not be processed, but will require hand removal of all stones exceeding the maximum particle size during placement.

C. The Contractor shall use equipment appropriate for spreading the clay soil in a uniformly thick layer across the lift.

D. The Contractor shall place the clay liner soil at a moisture content near the required moisture content so that significant adjustment of the moisture content is not required within the landfill. Moisture adjustment should be done at the borrow stockpile.

3.04 Compaction

A. The Contractor shall compact each lift of clay liner soil with the same padfoot or sheepsfoot roller equipment approved from the test pad construction.

B. Each lift of clay liner soil shall be compacted sufficiently to destroy all clay clods and knead the soil mass together, producing a uniform, homogeneous mass free of all hydraulic defects, cracks and fissures.

C. The required number of roller passes will be established by the test pad results. However, as a minimum, the Contractor shall compact each lift of clay soil liner with a minimum of six (6) passes. One pass is defined as one coverage of the compactor.

D. The soil moisture content and dry density criteria for compaction will be established by the Project Engineer based on preconstruction testing. Each lift of clay liner soils shall be compacted until all in-place density results satisfy the minimum requirements for dry density and moisture content.

E. The Contractor shall assist the Project Engineer with collecting Shelby tube samples of the compacted clay soil liner at the completion of each lift, as described in the QA/QC plan. (Shelby tube sampling and testing is not required for portions of placed Clay Liner Soils-Type II or III, Items 02212 and 02214). In the event that a Shelby tube sample fails to have the required permeability, the Contractor will be required to excavate to the elevation of the Shelby tube to allow for in-place density testing and supplemental Shelby tube sampling, as described in the QA/QC plan.

3.05. Protection

A. The Contractor is responsible for protecting the clay soil liners from degrading.

1. Clay soil liner that has dried shall be scarified, moistened, re-compacted and re-tested or removed from the liner. If removed, the soil shall be removed to the depth of unaffected clay soil liner, as determined by the Project Engineer.

2. The clay soil liner shall be protected from freezing. Any clay soil liner that has frozen shall be removed to a depth of previously unfrozen soil, as determined by the Project Engineer.

3. The Contractor shall prevent the clay soil liner from becoming saturated. Soil that becomes excessively wet shall be scarified, allowed to dry, re-compacted and re-tested or shall be removed. If soil is removed, it shall extend to a depth where it has not been disturbed, in the opinion of the Project Engineer.

B. Before the geomembrane is placed on the surface of the clay soil lines, the Project Engineer will observe the condition of the surface of the liners to determine that the surfaces are:

1. Free of stones protruding greater than 1/4 inch;

2. Free of desiccation cracks greater than 1/4 inch deep;

3. Free of ruts greater than 1 inch deep;

4. Smooth, free of loose material, firm and free of standing water;

5. Areas not meeting the criteria stated in Paragraphs 3.05 B. 1, 2, 3 and 4 shall be corrected and re-inspected before placement of the geomembrane begins.

C. At the end of each working day and following completion of each clay soil liner, the Contractor shall compact the surface with a smooth drum roller to create a smooth surface and grade the surface to drain.

END OF SECTION 02210

SECTION 02220

GEOSYNTHETIC CLAY LINER

PART 1 – GENERAL

1.01 Scope

A. The geosynthetics contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the construction of the geosynthetic clay liner (GCL) portion of the primary soil liner and final cover as specified herein, as shown on the Drawings, and in accordance with the QA/QC Plan.

B. Definitions

1. Geosynthetic Clay Liner (GCL) is a manufactured hydraulic barrier consisting of a layer of bentonite clay encased between two non-woven geotextiles.

2. Fishmouth is the uneven mating of two GCL panels to be joined wherein the upper sheet has excessive length that prevents it from being bounded flat to the lower sheet. The resulting opening is referred to as a "fishmouth."

C. Job Conditions

1. The geosynthetic clay liner has been purchased by the Owner.

2. The geosynthetics contractor must protect it at all times, place it to the lines and grades shown on the Drawings and construct seams between adjacent sheets of GCL.

3. The geosynthetics contractor shall coordinate the delivery and stockpiling of the GCL with the Contractor. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

4. The surface of the secondary drainage layer and cover soil will be prepared by the Contractor prior to deployment of the GCL. The surface shall be smooth and free of stones, rocks, sticks, roots, sharp objects, or debris of any kind. The surface shall provide a firm, unyielding foundation for the GCL with no sudden, sharp or abrupt changes or break in grade. No standing water or excessive moisture will be allowed.

5. The geosynthetics contractor shall be prepared to place the GCL in conjunction with the earthworks and the installation and construction of the other components of the liner or final cover system.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Clay Liners: Section 02210

D. Geomembrane Liners: Section 02400

E. Dewatering: Section 02650

F. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. Prior to GCL Procurement

1. GCL Manufacturer Information

a. Corporate background and information including name, address, phone number, and contact person.

b. Quality control procedures for manufacturing.

2. List of components used in the GCL manufacture and model numbers.

B. Within 20 Days following Owner-Geosynthetics Contractor Agreement

1. The geosynthetics contractor shall indicate the GCL installer. If in the opinion of the Project Engineer, the installer has a history of projects where unacceptable performance can be documented, that installer may be disqualified from work on this project.

2. Submit to the Project Engineer for approval by the Owner, a copy of the installed GCL warranty to be issued by the Installer upon completion of the GCL installation.

3. Shop drawings including GCL panel layout as described in Part 3.04-B of this Section and details showing seaming procedures. A minimum of two prints is required. Panel layout and orientation will be subject to approval by the Project Engineer.

C. Prior to Liner Material Delivery to the Project Site

1. The GCL manufacturer shall submit to the Project Engineer samples of the proposed geosynthetic clay liner material, QA/QC certification that the materials meet the required specifications and the manufacturer's instructions for handling and installing the material, at least ten days prior to delivery of materials to the site.

2. The GCL roll QA/QC certification shall include sampling frequency, test results and manufacturer's inspection certification.

3. Method of transporting the GCL and means to protect it on site until deployment.

D. Prior to Installation

1. A written statement of secondary drainage layer or subgrade acceptance as described in part 3.02-A of this section.

2. Submit to the Project Engineer for approval, a schedule of operations, including means and methods of installation, seaming and samples of standard daily report forms, parcel and seam logs and any other standard forms to be used.

E. During Installation Submitted Daily

1. Daily construction progress reports showing GCL placed by date.

F. Upon Completion, Prior to Final Payment

1. Certification that the material installation is complete and in accordance with the specifications.

2. Material and Installation Warranties for the Project.

PART 2 – MATERIALS

2.01 Geosynthetic Clay Liner, Item 02221:

A. The GCL shall be a needle punched reinforced composite comprised of a uniform layer of bentonite sandwiched between two non woven layers of geotextile and shall have:

1. A maximum permeability $5x10^{-9}$ cm/sec

2. Clay mass of 3.6 kg/m^2

B. Geotextile - The geotextile shall meet the following requirements:

1. Non-woven and needle punched.

2. Have a minimum weight of 6 ounces per square yard

C. Bentonite - The bentonite used in the GCL shall have the following properties:

1. Maximum fluid loss = 18 ml.

2. Swell Index = 24 ml/2g (minimum)

D. In addition to the property values listed above, the GCL shall:

1. Have an interface friction angle between both secondary drainage layer or cover soil (Item 02213) and geomembrane (Item 02401) acceptable to the Project Engineer as described in the QA/QC Plan.

2. Have an internal shear strength, which exceeds the weakest interface in the liner system in which it is being used and is acceptable to the Project Engineer as described in the QA/QC Plan.

PART 3 – EXECUTION

3.01 Delivery, Storage and Handling

A. The GCL shall be packaged at the manufacturing facility in a protective, waterproof wrap and shipped so that no damage is incurred. During shipment, the GCL shall be adequately protected at all times from puncture, abrasion, excessive heat or cold, moisture, or deleterious conditions in accordance with instructions from the Manufacturer and their warranty conditions.

B. Materials shall be delivered only after the required submittals have been received and approved by the Project Engineer.

C. The GCL shall be stored at the site following the Manufacturer's recommended procedures so that the warranty is not voided. The GCL shall be stored such that it is not exposed to moisture, such as within a truck trailer, within an enclosed building, or on skids at the storage area. If stored outside, it must be covered with an additional waterproof tarp, in a method approved by the Project Engineer.

D. Appropriate handling equipment and techniques as recommended by the Manufacturer and approved by the Project Engineer shall be used. Handling, storage, and care of the GCL prior to and following installation at the site is the responsibility of the geosynthetics contractor. The geosynthetics contractor shall be liable for all damages to the materials incurred prior to final acceptance of the GCL by the Owner. Any GCL damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the Project Engineer, at no additional cost to the Owner.

3.02 Surface Preparation

A. The Installer shall provide a written statement that the secondary drainage layer or subgrade surface on which the GCL will be installed is acceptable. This written statement shall be given to the Project Engineer prior to commencement of the GCL deployment in the area under consideration.

B. Special care shall be taken to maintain the prepared surface. A frozen or wet compacted surface will not be acceptable for deployment of the GCL.

C. No GCL shall be placed onto an area which has been softened by precipitation or which has cracked due to desiccation. The Contractor is required to correct the surface if stones are protruding greater than 1/4 inch, if desiccation cracks are measured to be 1/4 inch deep or greater or equipment causes ruts 1 inch deep or more, as determined by the Project Engineer.

D. Any damage to the prepared surface caused by installation of the GCL shall be repaired at the Contractor's expense.

3.03 Conformance Testing

A. The geosynthetic clay liner has been purchased by the Owner. Conformance testing as described in the QA/QC Plan and Section 02220 of the Specifications will have been completed prior to material delivery.

B. Additional samples if required shall be selected by the Project Engineer in accordance with the procedures outlined in the QA/QC Plan. The Project Engineer may increase the frequency of sampling at their discretion in the event that test results do not comply with these specifications and the QA/QC Plan. The additional testing shall be performed at the expense of the GCL manufacturer.

C. Any GCL that are not certified in accordance with Part 1.03, or that conformance testing indicates non-compliance with these specifications or the QA/QC Plan shall be rejected and replaced with new material by the GCL manufacturer, at no additional cost to the owner.

3.04 GCL Deployment

A. Record Keeping:

1. The Installer shall maintain daily reports and copies shall be provided to the Project Engineer daily. These reports will contain at a minimum:

a. Date
b. Hours Worked
c. Weather Conditions

d. Areas Worked
e. Daily Production
f. Manpower On Site
g. Equipment Used
h. Type and Results of Quality Control Testing Completed by the Installer
i. Problems Encountered During Construction and Resolution
j. Daily statement of acceptance of the subgrade surface to which the liner is deployed

B. Field Panel Identification:

1. A field panel is the unit area of GCL, which is to be seamed in the field (i.e., a field panel is a roll or a portion of a roll cut in the field). Field panels shall be installed at the location and positions indicated in submitted shop drawings, as approved or modified.

2. Each field panel must be given an "identification code" (number or letter-number) consistent with the layout plan. The Project Engineer and Installer shall agree upon this identification code.

C. GCL Deployment Procedures:

1. Field panels shall be deployed to create a shingle effect on the landfill floor or the final cover. The downslope sheet shall be overlapped by the sheet immediately upslope of it.

2. GCL's shall be deployed over prepared and approved subgrade surface as soon as practical. The material shall be placed so as not to cause subgrade disturbance. GCL's shall not be deployed through standing water or during any precipitation. Care shall be exercised to ensure that no large stones or foreign objects are trapped beneath the GCL.

3. The installer shall deploy the GCL in a controlled manner, allowing the GCL roll to "free fall" down a slope is unacceptable.

4. The installer shall only deploy GCL that can be completed in one day. Completion includes deploying, seaming, and covering with geomembrane. If inclement weather is approaching or is present, no additional GCL shall be placed until the previously placed GCL is covered with geomembrane and seamed. GCL that becomes wet and hydrates shall be removed and replaced at no additional cost to the Owner.

5. GCL's shall not be placed on frozen compacted clay liner or cover soils, as determined by the Project Engineer.

6. The Installer shall employ placement methods that ensure that:

a. No equipment or vehicles of any type will be allowed on the GCL.

b. Equipment used shall not damage the GCL by handling, trafficking, leakage of hydrocarbons, or other means.

c. Personnel working on GCL's shall not smoke, wear damaging shoes, or engage in other activities that could damage the GCL.

d. The method used to unroll the panels shall not damage the supporting compacted clay liner or cover soils.

e. The prepared surface underlying the GCL shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after GCL placement.

f. All soils immediately underlying the GCL must be kept clean and free of debris.

g. The method used to place the panels shall be so as to limit tension in the GCL.

h. Temporary loads and/or anchors (e.g., sandbags, tires), that will not damage the GCL, shall be placed on the GCL to prevent uplift by wind.

i. There shall be no fueling of any equipment on the GCL.

7. Any field panel or portion thereof that becomes seriously damaged (torn, twisted, or crimped) shall be replaced with new material at no cost to the Owner. Less serious damage may be repaired at the Project Engineers option and at no cost to the Owner. Damaged panels or portions of damaged panels shall be removed from the work area.

8. Bentonite shall appear to be uniformly distributed throughout the deployed GCL. Areas that appear to lack sufficient bentonite, in the opinion of the Project Engineer, shall be replaced at no cost to the owner.

3.05 Field Seaming

A. Seam Layout:

1. In general, seams shall be orientated parallel to the line of maximum slope, i.e., oriented down, not across the slope. In corners and at odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seam shall be located on the berm side slopes or within 5 feet of the toe of the side slope.

B. Weather Conditions for Seaming:

1. No seaming shall be attempted during any precipitation.

C. Overlapping:

1. GCL panels shall be overlapped a minimum of 12 inches.

D. Seam Preparation:

1. Seams shall be aligned to prevent wrinkles and "fishmouths."

E. General Seaming Requirements:

1. If seaming operations are carried out at night, adequate illumination shall be provided. Night seaming will only be permitted if approved by the Project Engineer.

2. Fishmouths or wrinkles at the seam overlaps shall be repositioned to achieve a flat overlap, meeting the minimum panel overlap of 6 inches.

F. Seaming Process:

1. The underlying GCL sheet should be marked 12 inches from the edge with a water proof marker.

2. The overlying GCL sheet shall be placed to align with the mark along the edge of the underlying sheet. Powdered bentonite shall be provided at a minimum application rate of ¼ pound per lineal foot of seam, side seams do not require additional bentonite if GCL is provided with approved edge enhancement.

G. Defects and Repairs:

1. The GCL will be inspected before and after seaming for evidence of defects, holes, needles, undispersed raw materials and any sign of contamination by foreign matter. The surface of the GCL shall be clean at the time of inspection.

2. Repair Procedures:

a. The Installer shall repair any portion of the GCL exhibiting isolated tears or puncture holes. The Installer must submit a repair procedure plan to the Project Engineer for approval.

b. At a minimum, the repair shall consist of an oval or round patch of the same GCL that extends a minimum of 12 inches beyond the defect in all directions.

3. Repair Verification:

a. Each repair shall be numbered and logged.

4. The GCL shall not be covered until it has been inspected and accepted by the Project Engineer.

3.06 Protecting the GCL

A. The geosynthetics contractor is responsible for protecting the GCL.

1. The Contractor shall cover the GCL completely before any precipitation occurs and before the end of the shift in which it was deployed. The Contractor shall prevent the GCL from exposure to moisture at all times.

2. Covering the GCL shall be completed such that the continuity of the GCL is not compromised.

END OF SECTION 02220

SECTION 02400

GEOMEMBRANES

PART 1 – GENERAL

1.01 Scope

A. Description of Work

1. The geosynthetics contractor shall furnish all labor, materials, tools, supervision, transportation, and installation equipment necessary for the installation of textured geomembranes as specified herein, as shown on the Contract Drawings, and in accordance with the Construction Quality Assurance / Quality Control (QA/QC) Plan, and the New York Compilation of Codes, Rules and Regulations, Title 6, Part 363 (6 NYCRR Part 363).

2. The geosynthetics contractor shall be prepared to install the geomembranes in conjunction with earthworks and other components of the liner or cover system.

B. Definitions

1. Anchor Trench: A trench within which the ends of a geosynthetic are buried to hold it in place (e.g., along the top of a berm).

2. Boot: A bellows-type covering to exclude dust, dirt, moisture, etc., from a geomembrane protrusion.

3. Construction Quality Assurance / Quality Control (QA/QC) Plan: A planned system of activities whose purpose is to provide a continuing evaluation of the quality control program, initiating corrective actions where necessary. It is applicable to both manufactured products and field installations.

4. Destructive Tests: Tests performed on geomembrane samples cut out of a field installation or test strip to verify specification performance requirements, e.g., shear and peel tests of geomembrane seams during which the specimens are destroyed.

5. Environmental Stress Crack: External or internal stress propagation in a plastic caused by environmental conditions which are usually chemical or thermal in nature.

6. Extrudate: The molten polymer that is emitted from an extruder during seaming using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon, rod, bead or pellets.

7. Extrusion Seams: A seam between two geomembrane sheets achieved by heat extruding a polymer material between or over the overlap areas.

8. Field Seams: The seaming of geomembrane rolls or panels together in the field making a continuous liner or cover system.

9. Fishmouth: The uneven mating of two geomembranes to be joined wherein the upper sheet has excessive length that prevents it from being bonded flat to the lower sheet. The resulting opening is referred to as a "fishmouth".

10. Field Panel: A geomembrane roll or a portion of a roll cut in the field.

11. Geomembrane: An impermeable membrane liner or barrier used in civil engineering for geotechnical projects.

12. Geomembrane Installer: An experienced geosynthetics contractor fully qualified to complete the work described in this section. The geomembrane installer may be the same as the geomembrane manufacturer and/or supplier.

13. Grinding: The removal of oxide layers and waxes from the surface of a geomembrane in preparation for extrusion fillet or extrusion flat seaming.

14. Heat Fusion: The process of joining two or more thermoplastic geomembranes by heating areas in contact with each other to the temperature at which fusion occurs. A controlled pressure usually aids the process.

15. High Density Polyethylene (HDPE): A polymer prepared by low-pressure polymerization of ethylene as the principal monomer and having the characteristics of ASTM D1248 Type III and IV polyethylene. HDPE geomembranes are manufactured with medium density polyethylene with a density equal to or greater than 0.9329 g/cm^3. After the addition of carbon black, the polymer will have a density greater than or equal to 0.941 g/cm^3 as noted in ASTM D1248.

16. Hot Wedge: Common method of heat seaming of thermoplastic geomembranes by a fusing process wherein heat is delivered by a hot wedge passing between the opposing surfaces to be bonded.

17. Linear Low Density Polyethylene (LLDPE): A ethylene/olefin copolymer having a linear molecular structure. The comonomers used to produce the resin can include 1-butene, 1-hexene, 1-octene or 4-methyl-1-pentene. LLDPE resins have a natural density in the range of 0.915 to 0.926 g/ml. After the addition of carbon black, the polymer will have a density no greater than 0.939 g/cc as noted in ASTM D1248.

18. Nondestructive Test: A test method, which does not require the removal of samples from, nor damage to, the installed liner or cover system. The evaluation is done in an insitu manner. The results do not indicate the seam's mechanical strength.

19. Oxide Layer: The reacting of atmospheric oxygen with the surface of the geomembrane.

20. Pinholes: Very small imperfections in sheets of seamed geomembranes.

21. Seaming Boards: Smooth wooden planks placed beneath the area to be seamed to provide a uniform resistance to applied roller pressure in the fabrication of seams.

22. Test Strips: Trial sections of seamed geomembranes used to establish machine setting of temperature, pressure and travel rate for a specific geomembrane under a specific set of atmospheric conditions for machine-assisted seaming.

23. Vacuum Box: A commonly used type of nondestructive test method, which develops a vacuum in a localized region of a geomembrane seam in order to evaluate the seam's tightness and suitability.

24. Spark Test: A commonly used type of nondestructive test method which checks the continuity of a geomembrane seam by seeking areas along the seam for which arcing of electric current can occur.

C. Job Conditions

1. Numerous construction activities such as subgrade preparation, embankment construction, recovery of borrow materials, clay liner construction, geomembrane liner deployment and seaming, deployment of geotextiles or GCL, placement of drainage stone and leachate collection pipes, and waste disposal will be ongoing simultaneously at the site. The geosynthetics contractor will be required to coordinate and schedule their work accordingly.

2. The surface of the clay liner, cap replacement area, or cover soil subgrade will be prepared by the Contractor prior to deployment of the geomembrane. The surface shall be smooth and free of stones, rocks, sticks, roots, sharp objects, or debris of any kind. The surface shall provide a firm, unyielding foundation for the geomembrane with no sudden, sharp or abrupt changes or break in grade. No standing water or excessive moisture will be allowed.

3. The Owner will provide a storage area for geomembrane rolls delivered to the site. The Contractor will assist in the delivery and stockpiling of the materials. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner. The geomembrane manufacturer must furnish the Owner with complete written instructions for storage and handling at least two weeks prior to delivery.

At a minimum this area shall be well drained and free of dust and mud and the rolls will be covered with a tarp.

4. Regulations require sampling and testing of the geomembrane and field seams by the Project Engineer. The geosynthetics contractor shall assist the Project Engineer in collecting samples for laboratory testing, as described in the QA/QC plan

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Construction Quality Control/Quality Assurance: Section 01400

C. Clay Liners: Section 02210

D. Leachate Collection Systems: Section 02500

E. Dewatering: Section 02650

F. Gas Collection Systems: Section 02700

G. Construction QA/QC Plan: Included with the Contract Documents

H. USEPA/530/SW-89/069 Technical Guidance Document: The Fabrication of Polyethylene FML Seams

I. USEPA/530/SW-91/051 Technical Guidance Document: Inspection Techniques for the Fabrication of Geomembrane Field Seams

J. USEPA/600/2-88/052 Method 90/90 Compatibility Test for Wastes and Membrane Liners

K. ASTM: American Society for Testing and Materials

L. GRI: Geosynthetic Research Institute Test Methods and Standards

1.03 Submittals

A. Submit the following items as directed by the Project Engineer. Submittals not received and approved within the required time frame may, at the Project Engineer's discretion, delay the project at no additional cost to the Owner.

B. Prior To Liner Material Procurement:

1. Geomembrane Manufacturer Information (Not required if the manufacturer has been previously approved for this site).

a. Corporate background and information including name, address, phone number, contact person, year of incorporation, and number of employees.

b. Manufacturing capabilities must include:

1.) Daily production quantity available for this contract.

2.) Quality control procedures for manufacturing.

3.) List of material properties including certified test results, to which geomembrane samples are attached. All test results must meet or exceed the minimum geomembrane properties indicated in Section 2.01 and 2.02 and Table 02400-1.

4.) Documentation demonstrating at least three years experience manufacturing 60 mil HDPE (or thicker) and 40 mil LLDPE (or thicker), textured geomembrane in rolls having a minimum width of 15 feet, monolithic with no seams.

c. A list of at least five different projects, totaling a minimum of 50 acres, for which the Liner Manufacturer has manufactured a 60 mil textured HDPE and 40 mil textured LLDPE geomembrane. For each facility the following information will be provided.

1.) Name and purpose of facility, its location and date of installation.

2.) Name of Owner, Designer, Fabricator (if any), Installer and the name of the contact person at the site who can discuss the project.

3.) Surface area of geomembrane manufactured and geomembrane material.

4.) Available information on the performance of the lining system and the facility.

d. Resin origin (resin suppliers name, resin production plant) and identification (brand name, number).

2. Installer Information (Not required if the installer has been previously approved for this site).

a. Corporate background and information.

b. Copy of installer's letter of approval or license by the Geomembrane Manufacturer and/or fabricator.

c. Installation capabilities, including:

1.) information on equipment and personnel;

2.) average daily production anticipated for this project;

3.) quality control procedures; and

4.) samples of field seams, a certified list of minimum values for seam properties, and the test methods employed.

d. The Liner Installer must submit a project list with references that document experience on at least five different projects, totaling a minimum of 50 acres for which the Liner Installer has installed a HDPE Liner, including at least five projects of comparable size utilizing textured 60 mil HDPE and textured 40 mil LLDPE. For each facility the following information will be provided:

1.) Name and purpose of facility, its location and date of installation.

2.) Name of Owner, Project Engineer, Fabricator (if any), and the name and number of the Owner's contact person.

3.) Thickness of geomembrane, and surface area of geomembrane manufactured.

4.) Available information on the performance of the lining system and the facility.

5.) Resumes of all personnel who will perform seaming operations on this project, including dates and duration of employment.

6.) Resume of the installation supervisor to be assigned to this project, including dates and duration of employment. The superintendent shall have supervised the installation of a minimum of 2,000,000 ft^2 of polyethylene geomembrane and 500,000 ft^2 of geotextile.

7.) At least one seamer shall have experience seaming a minimum of 100,000 linear feet of polyethylene geomembrane seams using the same type of seaming apparatus to be use at this site. Seamers with such experience will be designated "master seamers" and shall provide direct supervision over less experienced seamers.

8.) All seaming personnel shall have seamed at least 10,000 linear feet of polyethylene geomembrane seams using the same type of seaming apparatus to be used at this site.

4. Submit to the Project Engineer for approval by the Owner, a copy of the installed warranty to be issued by the Installer upon completion of the liner or cover material installation.

C. Within 30 Days following Owner-Geosynthetic contractor Agreement

1. Shop drawings including panel layout as described in Part 3.03-B of this Section and details showing welding processes, pipe boots and seaming procedures at all geomembrane penetrations. A minimum of two prints is required. Panel layout and orientation will be subject to approval by the Project Engineer.

2. Proposed Construction Schedule.

D. Prior to Liner Material Delivery to the Project Site (Supplied by Geomembrane Manufacturer)

1. Resin QA/QC information and backup documentation including test results as described in Parts 2.01 and 2.03-A of this Section, and Section 6 of the QA/QC Plan.

2. Certification that the manufactured geomembrane sheet meets specifications as described in Part 2.02 of this Section and the QA/QC Plan.

3. Geomembrane liner roll QA/QC certification describing sampling frequency, test results and manufacturer's inspection certification as described in Part 2.03 of this Section, and Section 6 of the QA/QC Plan. All test results must meet or exceed the minimum geomembrane properties indicated in Table 02400-1.

4. Certification stating geomembrane roll numbers, and base resin type and lot from which it was produced.

5. Extrudate certification as described in Part 3.04-G-2-d of this Section.

6. The Geomembrane Manufacturer must furnish the Owner with complete written instructions for storage and handling of geomembrane rolls. At a minimum the rolls shall be stored in an area that is well drained and free of dust and mud and shall be covered with tarps to minimize damage due to the elements.

7. Resumes of all members of all liner crews, including prior HDPE and LLDPE liner installation experience. Liner crew staff will be subject to approval by the Project Engineer and the Owner.

8. A complete manufacturing and construction quality control plan, including a schedule of operations, means and methods of installation and seam testing.

E. Prior to Installation

1. A written statement of surface acceptance as described in Part 3.01-A of this Section for each specific area of work.

2. Submit to the Project Engineer for approval, a schedule of operations, including means and methods of installation, seam testing (procedures/equipment) and samples of standard daily report forms, parcel and seam logs and any other standard forms to be used.

F. During Installation Submitted Daily

1. Daily construction progress reports as described in Part 3.03-A of this Section clearly showing HDPE membrane placed by date.

2. Daily weld test records, including testing of trial seams.

3. Daily records of field seam testing (destructive and nondestructive) for the liner components of the base liner system or cover system including seam samples for the Owner's archives and for independent laboratory testing as described in Parts 3.04-I and 3.04-J of this Section.

4. Field test results for the Installer's destructive test samples.

G. Upon Completion, Prior to Final Payment

1. As-built 24" x 36" panel layout drawings (four (4) prints) with panel identification as described in Part 3.03-C and identification of all defects and repairs as described in Part 3.04-K-5 of this Section. The scale shall be 1" = 50 feet.

2. Summary and log of all field quality control testing completed by the Installer.

3. Certification that the material installation is complete and in accordance with the specifications.

4. Material and Installation Warranties for the Project as described in Section 3.09.

PART 2 – MATERIALS

2.01 Resin

A. The geomembrane shall be manufactured from new, first-quality polyethylene resin, and shall be designed and manufactured specifically for use in landfill structures, formulated to be chemically resistant, free of leachable additives and resistant to ultraviolet degradation. Reclaimed polymer shall not be added to the resin; however, the use of polymer recycled during the manufacturing process shall be permitted if performed with appropriate deadlines and if the recycled polymer does not exceed 10% by weight of the total polymer weight.

B. The clear polyethylene resin shall meet the following specifications:

PROPERTY	TEST METHOD	REQUIREMENT
HDPE Polymer Density	ASTM D1505	> 0.932 g/ml (not including carbon black)
LLDPE Polymer Density	ASTM D1505	< 0.926 g/ml (not including carbon black)
Melt Flow Index	ASTM D1238	1.0 g/ 10 min. Maximum

C. The Geomembrane Manufacturer shall provide certification that the resin meets these requirements along with a copy of the quality control certificates.

2.02 60 mil Textured HDPE Geomembrane, Item 02401:

A. The Geomembrane Manufacturer shall furnish geomembranes having a textured surface and a minimum average thickness of 57 mils, with no single test having a thickness of less than 51 mils and the lowest individual test value for 8 out of 10 to be 54 mils. The textured surfaces shall have a minimum average asperity height of 16 mils.

B. The geomembranes sheets shall have properties that comply with the required property values shown in Table 02400-1 at the end of this Section. Standard sheet and tensile properties must be demonstrated by conformance sampling and testing as described in Section 6 of the QA/QC Plan, which includes a sampling frequency of once every 50,000 ft^2 of geomembrane manufactured for this project. The miscellaneous sheet properties need not be run at the 1 per 50,000 ft^2 frequency. The Manufacturer must certify for this project, however, that these tests have been run on Geomembrane Liner Sheeting made from the particular resin and provide the test results.

C. In addition to the property values listed in Table 02400-1, the geomembranes shall:

1. Contain a maximum of 2% by weight of additives, fillers, or extenders (not including carbon black),

2. Not have striations, pinholes, or bubbles on the surface or in the interior,

3. Be produced so as to be free of holes, blisters, modules, undispersed raw materials, or any contamination by foreign matter;

4. Be manufactured in a single layer (thinner layers shall not be welded together to produce the final thickness),

5. Have an interface friction angle between the GCL (Item 02221), Cushion Geotextile (Item 02504) Secondary Collection Geocomposite (Item 02506) and upper most lift of the Secondary Clay Liner (Clay Liner Soil Type II, Item 02212) acceptable to the Project Engineer as described in Section 6 of the QA/QC Plan.

6. Demonstrate chemical compatibility with representative leachate based on results from ASTM D5747 (USEPA/600/2-88/052 Method 90/90) as described in Section 6 of the QA/QC Plan. The properties listed below must not change (compared to baseline values) after the 120 day immersion period by more than the maximum allowable shown in the following Table:

PROPERTY	**TEST METHOD**	**MAXIMUM ALLOWABLE CHANGE**
Weight	ASTM D5747	2%
Volume	ASTM D5747	1%
Yield Strength	ASTM D6693	20%
Elongation at Yield	ASTM D6693	30%
Elastic Modulus	ASTM D6693	30%
Tear Strength	ASTM D1004	20%
Puncture Resistance	ASTM D4833	30%

7. Exhibit a 100 hour transition time based on an evaluation of stress crack resistance according to the *Notched Constant Tensile Load Test* as described by ASTM D5397, and

8. Have a water vapor transmission rate less than 0.03 grams per meter squared per day as measured by ASTM E96.

D. Pipe boots shall be fabricated by the Geomembrane Manufacturer to the dimensions shown on the Contract Drawings or fabricated by the geosynthetics installer in the field. The geosynthetics installer shall ensure and document that the pipe boots are fabricated from the same resin as the polyethylene geomembrane pipes to which they are welded.

2.03 40 mil Textured LLDPE Geomembrane, Item 02402:

A. The Geomembrane Manufacturer shall furnish geomembranes having a textured surface, a minimum average thickness of 38 mils with no single test having a thickness of less than 34 mils and the lowest individual test value for 8 out of 10 to be 36 mils. The textured surfaces shall have a minimum average asperity height of 16 mils.

B. The geomembranes sheets shall have properties that comply with the required property values shown in Table 02400-2 at the end of this Section. Standard sheet properties must be demonstrated by conformance sampling and testing as described in Section 6 of the QA/QC Plan, which includes a sampling frequency of once every 50,000 ft2 of geomembrane manufactured for this project. The miscellaneous sheet properties need not be run at the 1 per 50,000 ft2 frequency. The Manufacturer must certify for this project, however, that these tests have been run on Geomembrane Liner Sheeting made from the particular resin and provide the test results.

C. In addition to the property values listed in Table 02400-2, the geomembranes shall:

1. Contain a maximum of 2% by weight of additives, fillers, or extenders (not including carbon black),

2. Not have striations, pinholes, or bubbles on the surface or in the interior,

3. Be produced so as to be free of holes, blisters, modules, undispersed raw materials, or any contamination by foreign matter;

4. Be manufactured in a single layer (thinner layers shall not be welded together to produce the final thickness),

5. Have an interface friction angle between the Gas Venting Geotextile (Item 02705), GCL (Item 02221) and Clay Liner or cover soils acceptable to the Project Engineer as described in Section 6 of the QA/QC Plan.

6. Textured geomembrane shall be fabricated, using coextrusion or impingement methods and not by lamination or embossing methods. Texturing applied, using impingement methods, shall be bonded securely to the parent geomembrane sheet.

D. Pipe boots shall be fabricated by the Geomembrane Manufacturer to the dimensions shown on the Contract Drawings or fabricated by the geosynthetics installer in the field. The geosynthetics installer shall ensure and document that the pipe boots are fabricated from the same resin as the polyethylene geomembrane pipes to which they are welded.

2.04 Quality Control

A. Quality control requirements including sampling frequency and testing for both resin and manufactured rolls of geomembrane are described in the QA/QC Plan. The QA/QC

Plan requires certification, which documents that the resin and manufactured sheets conform to the specifications, and that rolls were inspected for defects during manufacturing. Rolls must be identified and labeled prior to shipment as described in ASTM D4873.

B. Resin:

1. Any geomembrane manufactured from non-complying resin shall be rejected.

C. Rolls:

1. The Geomembrane Manufacturer shall continuously monitor geomembranes during the manufacturing process for inclusions, bubbles, or other defects.

2. No geomembrane shall be accepted which exhibits any defects.

3. The Geomembrane Manufacturer shall continuously monitor the geomembrane thickness during manufacture.

4. No geomembrane shall be accepted which fails to meet the minimum thickness requirement.

2.05 Delivery, Storage and Handling

A. The geomembrane shall be packaged and shipped by appropriate means so that no damage is incurred. During shipment and storage the geomembrane shall be adequately protected at all times from puncture, abrasion, excessive heat or cold, degradation of the material, adhesion of individual whorls of a roll or layers, or other damaging or deleterious conditions in accordance with instructions from the Geomembrane Manufacturer and their warranty conditions.

B. Materials shall be delivered only after the required submittals have been received and approved by the Project Engineer.

C. Appropriate handling equipment and techniques as recommended by the Geomembrane Manufacturer and approved by the Project Engineer shall be used. Handling, storage, and care of the geomembranes prior to and following installation at the site is the responsibility of the geosynthetics installer. The geosynthetics installer shall be liable for all damages to the materials incurred prior to final acceptance of the liner or cover system by the Owner. Any geomembrane damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the Project Engineer, at no additional cost to the Owner. At a minimum the rolls shall be stored in an area that is well drained and free of dust and mud and shall be covered with tarps to minimize damage due to the elements.

PART 3 – EXECUTION

3.01 Earthwork

A. Surface Preparation

1. The geosynthetics installer shall provide a written statement that the surface on which the geomembrane will be installed is acceptable. This written statement shall be given to the Project Engineer prior to commencement of geomembrane installation in the area under consideration.

2. Special care shall be taken to maintain the prepared soil surface so that it is smooth and free of loose material.

3. No geomembrane shall be placed onto an area which has been softened by precipitation or which has cracked due to desiccation. The soil surface shall be observed before deployment to evaluate the effects of desiccation cracking and/or softening on the integrity of the soil liner or cover soils. The Contractor is required to correct the geomembrane subgrade surface if stones are protruding greater than 1/4 inch, desiccation cracks are measured to be 1/4 inch deep or greater or equipment causes ruts 1 inch deep or more, as determined by the Project Engineer.

4. Any damage to the soil surfaces or underlying geosynthetics caused by installation activities shall be repaired at the geosynthetic contractor's expense.

5. The Contractor shall be responsible for dewatering areas that have been accepted for geomembrane deployment, including anchor trenches.

B. Crest Anchorage System:

1. The anchor trench shall be excavated prior to geomembrane placement to the lines, grades, and configuration shown on the Contract Drawings.

2. No loose soil shall be allowed beneath the geomembrane.

3. The geomembranes shall be secured in the anchor trench using rolls of geotextile, geocomposite or other temporary means approved by the Proejct Engineer. Secondary geocomposite shall be deployed over the secondary HDPE liner and cushion geotextile shall be deployed over the primary HDPE liner. After deployment of the cushion geotextile the anchor trench shall be backfilled with soil within 24 hours.

4. The cap geomembrane will require temporary anchorage to allow for installation. Upon completing the installation, weld new to old geomembranes and cover with cushion geotextile.

5. The anchor trench shall be backfilled and compacted by the Contractor after all the geosynthetics have been installed in the trench as shown on the Contract Drawings. Care shall be taken when backfilling the trenches to prevent any damage to the geomembrane. Backfill will be placed and compacted in one lift with vibratory compaction equipment until stable as determined by the Project Engineer.

5. Soil used to backfill the anchor trenches shall be Clay Liner Soil-Type II or III (Item 02212 or 02214)as shown on the Contract Drawings, compacted in lifts not exceeding 12 inches in thickness.

6. Anchor trenches shall be maintained in a free draining condition. Filling in anchor trenches having standing water will not be permitted.

7. Slightly rounded corners shall be provided in the trench where the geomembrane adjoins the trench to avoid sharp bends in the geomembrane.

3.02 Conformance Testing

A. The geomembrane has been purchased by the Owner. Conformance testing as described in the QA/QC Plan and Section 02400 of the Specifications will have been completed prior to material delivery.

B. Additional samples if required shall be selected by the Project Engineer in accordance with the procedures outlined in the QA/QC Plan. The Project Engineer may increase the frequency of sampling at their discretion in the event that test results do not comply with parts 2.02 and 2.03 of this Section and the QA/QC Plan. The additional testing shall be performed at the expense of the Geomembrane Manufacturer.

C. Any geomembranes that are not certified in accordance with Part 1.03, or that conformance testing indicates do not comply with Parts 2.02 and 2.03 of this Section, or the QA/QC Plan shall be rejected and replaced with new material by the Geomembrane Manufacturer, at no additional cost to the Owner.

3.03 Geomembrane Deployment

A. Record Keeping:

1. The geosynthetics installer shall maintain daily reports and copies shall be provided to the Project Engineer daily. These reports will contain at a minimum:

a. Date

b. Hours Worked

c. Areas Worked

d. Daily Production

e. Manpower On Site

f. Equipment Used

g. Type and Results of Quality Control Testing Completed By the geosynthetics contractor

h. Problems Encountered During Construction and resolution

i. Daily statement of acceptance of the subgrade surface to which the liner is deployed

B. Panel Layout Drawings:

1. The Installer shall produce layout drawings at least two weeks prior to geomembrane delivery at the site. These drawings shall be suitable for use as construction drawings and shall indicate the geomembrane configuration, dimensions, details, locations of seams, etc. The drawings shall be on 24" x 36" sheets and at a scale of 1" = 50'. The layout drawings must be approved by the Owner and Project Engineer prior to the installation of any geomembranes. The layout drawings, as modified and/or approved by the Project Engineer, shall become part of these specifications.

2. The layout shall result in no butt seams on any of the berm sideslopes as described below.

3. In general, seams shall be oriented parallel to the line of maximum slope (i.e., down, not across, the slope). In corners and odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seams shall be located on the berm side slopes or within 5 feet of the toe of the side slope. No seams shall be located in areas of potential stress concentrations.

C. Field Panel Identification:

1. A field panel is the unit area of liner, which is to be seamed in the field (i.e. a field panel is a roll or a portion of a roll cut in the field). Field panels shall be installed at the location and positions indicated in the layout drawings, as approved or modified.

2. Each field panel must be given an "identification code" (number or letter-number) consistent with the layout plan. This identification code shall be agreed upon by the Project Engineer and Installer. The field panel identification code shall be related, through a table or chart, to the original resin, and the constituent rolls. The Installer shall document all "as constructed" field panels, destructive test samples, pipe penetration locations, repairs, etc. on the panel layout drawings.

D. Geomembrane Deployment Procedures:

1. Field panels shall be installed as approved or modified at the location and positions indicated in the layout drawings.

2. Placement of the textured geomembrane over the GCL shall be completed by using a temporary rub sheet or similar method to limit friction between the materials and the development of tension in the GCL.

3. Field panels shall be deployed to create a shingle effect on the landfill floor. The downslope sheet shall be overlapped by the sheet immediately upslope of it.

4. The Installer shall deploy the geomembrane in a controlled manner, allowing the geomembrane roll to "free fall" down a slope is unacceptable.

5. Field panels shall be placed one at a time, and each field panel shall be seamed to adjacent panels the same day that it is placed.

6. Geomembranes shall not be placed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, in the presence of winds in excess of 20 miles per hour or if the material temperature is less than 32˚F.

7. Geomembranes shall not be placed on frozen clay liner or cover soils, as determined by the Project Engineer.

8. At the time of deployment, the geomembrane shall be inspected for defects, rips, holes, flaws, deterioration or damage. Geomembrane sheets that are seriously damaged as determined by the Project Engineer shall be replaced with new material at no cost to the Owner. Less serious damage may be repaired at the Project Engineers option and at no cost to the Owner. Damaged sheets or portions of damaged sheets shall be removed from the work area.

9. The Installer shall employ placement methods to ensure that:

a. No vehicles of any type will be allowed on the liner.

b. Equipment used shall not damage the geomembrane by handling, trafficking, leakage of hydrocarbons, or other means.

c. Personnel working on geomembranes shall not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane.

d. The method used to unroll and deploy the panels shall not scratch, crimp or puncture the geomembrane and shall not damage the supporting soil or GCL.

e. The prepared surface underlying the geomembrane shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after geomembrane placement.

f. All surfaces immediately underlying the liner must be kept clean and free of debris.

g. The method used to place the panels shall minimize wrinkles and limit stress in the liner at a temperature of 50° F.

h. The method used to place the panels shall be so as to limit tension in the covered geomembrane. This may involve seaming during specified times of the day to control thermally induced tension in the liner.

i. Temporary loads and/or anchors (e.g., sandbags, tires), that will not damage the geomembrane, shall be placed on the geomembrane to prevent uplift by wind.

j. There shall be no placement of fuel storage containers or fueling of any equipment on the geomembrane.

k. No equipment will be allowed on the geomembrane. All lightweight equipment including seaming equipment shall be placed on rub sheets.

l. Direct contact with the liner shall be minimized; i.e., the liner in excessively high traffic areas shall be adequately protected.

m. The liner shall be installed in the anchor trench as shown on the Contract Drawings. The Contractor shall be responsible for excavating and backfilling the anchor trench.

10. Any field panel or portion thereof that becomes seriously damaged (torn, twisted, or crimped) shall be replaced with new material at no cost to the Owner. Less serious damage may be repaired at the Project Engineers option and at no cost to the Owner. Damaged panels or portions of damaged panels shall be removed from the work area.

3.04 Field Seaming

A. Seam Layout:

1. In general seams shall be orientated parallel to the line of maximum slope, i.e., oriented down, not across the slope. Butt seams shall be avoided to the extent practical on slopes steeper than 25 percent. In corners and at odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seams shall be less than 5feet from the toe of the side slope, except where approved by the Project Engineer.

B. Personnel:

1. The Installer's field crew supervisor must have successfully installed a minimum of 50 acres of textured geomembrane material on at least ten different projects. Either the field crew supervisor or his/her designated assistant with the same minimum qualifications must be present at the site during periods of geomembrane liner installation.

2. At least one seamer per shift will have successfully installed a minimum of 25 acres of comparable geomembrane material.

C. Weather Conditions for Seaming:

1. Unless approved by the Project Engineer and the NYSDEC, seaming shall not be attempted when either air or sheet temperature is below 32° F, when the air temperature is above 120° F, when the sheet temperature exceeds 158° F, during periods of precipitation or when winds are in excess of 20 miles per hour. At air temperatures between 32° F and 40° F, seaming shall be allowed if the geomembrane is preheated either by sun or a hot air device and, if there is no excessive cooling from the wind. At ambient air temperatures above 40° F, no preheating shall be required. In all cases, the geomembrane shall be dry and protected from wind damage.

2. If the installer Contract Drawings to use methods that may allow seaming at air temperatures below 32° F or above 120° F, he shall submit a procedure for approval by the Project Engineer and the NYSDEC.

3. Air temperatures shall be measured six inches above the geomembrane surface.

D. Overlapping and Temporary Bonding:

1. Geomembrane panels shall be overlapped a minimum of 3 inches for extrusion welding and 4 inches for fusion welding, but in any event, sufficient overlap shall be provided to allow peel tests to be performed on destructive test samples of the seam.

2. The procedure used to temporarily bond adjacent panels together shall not damage the geomembrane. The temperature of the air at the nozzle of spot welding apparatus shall be controlled such that the geomembrane is not damaged.

3. No solvent or adhesive shall be used unless the product has been approved in writing by the Owner. Samples of any proposed solvent or adhesive shall be submitted to the QA/QC consultant for testing and evaluation at the geosynthetics contractor's expense.

E. Seam Preparation:

1. Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material. Seaming shall not be conducted in the presence of standing water and/or soft subgrades as determined by the Project Engineer. All wet surfaces shall be thoroughly dried and all soft subgrades compacted and approved by the Project Engineer prior to seaming.

2. For extrusion welding seam overlap grinding is required. The grinding process shall be completed according to the manufacturer's instructions within ten minutes of the seaming operation and in a manner that does not damage the geomembrane.

a. Grinding must be performed with #80 grit paper or finer or with other approved equipment.

b. Grinding marks must be perpendicular to the seam direction.

c. The depth of the grinding marks must be less than 5% of the sheet thickness.

d. Grinding marks must not appear beyond 0.25 inches from the extrudate after it is placed.

3. Seams shall be aligned to prevent wrinkles and "fishmouths."

F. General Seaming Requirements:

1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

2. If required, a flat board can be used to create a firm substrate, or similar hard surface, directly under the seam overlap to achieve proper support.

3. If seaming operations are carried out at night, adequate illumination shall be provided. Night seaming will only be permitted if approved by the Project Engineer.

4. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and any portion where the overlap is inadequate shall then be patched with an oval or round patch of the same geomembrane that extends a minimum of 6 inches beyond the cut in all directions.

5. All welding apparatus shall be equipped with diagnostic gauges for operating temperatures, pressures, roller speeds, etc. (as applicable to the equipment type).

G. Seaming Process:

1. Approved processes for seaming are extrusion welding and fusion welding. The primary method of welding shall be fusion. Seaming equipment shall not damage the geomembrane. Proposed alternative processes shall be documented and submitted to the Project Engineer for approval. All seaming procedures shall strictly adhere to the Manufacturer's field quality control manual as approved by the Project Engineer. The Installer shall also follow industry standards for seam fabrication as outlined in the USEPA Technical Guidance Documents referenced in Part 1.02 of this specification section.

2. Extrusion Equipment and Procedures:

a. The Installer shall maintain at least one spare operable seaming apparatus on site.

b. Extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus at the nozzle.

c. Prior to beginning a seam, the extruder shall be purged until all heat-degraded extrudate has been removed from the barrel. Whenever the extruder is stopped, the barrel shall be purged of all heat degraded extrudate.

d. The Installer shall provide documentation regarding the extrudate to the Project Engineer and shall certify that the extrudate is compatible with the specifications, and consists of the same resins as the geomembrane.

e. The electric generator shall be placed on rub or scrub sheets. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

3. Fusion Equipment and Procedures:

a. The Installer shall maintain at least one spare operable seaming apparatus on site.

b. Fusion-welding apparatus shall be automated vehicular-mounted devices equipped with gauges giving the applicable temperatures, pressures and seaming rate.

c. Fusion cross seams shall be extrusion welded a minimum distance of 6 inches from the point of intersection.

d. A moveable protective layer may be used directly below each geomembrane overlap to be seamed to prevent the buildup of moisture between the sheets.

e. The electric generator shall be placed on a smooth base such that no damage occurs to the geomembrane. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

H. Trial Seams:

1. Trial seams shall be made on fragment pieces of geomembrane to verify that field seaming conditions are adequate. Section 6 of the QA/QC Plan describes the size and frequency at which trial seams will be prepared.

2. Trial seams shall be cut into 1-inch wide strips and tested for peel strength and shear strength. All test specimens must meet the following criteria before seaming can begin:

For 60 mil textured HDPE

a. Shear All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 120 lb/in.

b. Peel All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 78 lb/in for extrusion welds and 91 lb/in for fusion welds.

For 40 mil textured LLDPE

a. Shear All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 60 lb/in.

b. Peel All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 44 lb/in for extrusion welds and 50 lb/in for fusion welds.

3. Testing details are described in Section 6 of the QA/QC plan.

I. Nondestructive Seam Continuity Testing:

1. The geosynthetics contractor shall non-destructively test all field seams over their full length as described in Section 6 of the QA/QC Plan. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all seaming work. The installer shall complete any required repairs in accordance with Part 3.04-K of this Section. The following procedures shall apply to locations where seams cannot be non-destructively tested.

a. If the seam is accessible to testing equipment prior to final installation, the seam shall be non-destructively tested prior to final installation.

b. If the seam cannot be tested prior to final installation, the seam shall be made and then capped with an additional strip of geomembrane and extrusion welded to the two panels

2. Procedures to be followed when a nondestructive test result is not accepted are described in Section 6 of the QA/QC Plan. The geosynthetics installer will locate failed seam areas on the panel layout drawing.

J. Destructive Testing:

1. Destructive seam tests shall be performed on samples collected from selected locations to evaluate seam strength and integrity. Destructive tests shall be carried out as the seaming work progresses, not at the completion of all field seaming.

2. Sampling:

a. Requirements for sample size and frequency are described in Section 6 of the QA/QC Plan. Sample locations shall be determined during seaming. At least one sample will be taken for each 1,000 feet of constructed secondary geomembrane seam and for each 1,000 feet of constructed primary geomembrane. However, samples must be taken at least once per day for each operator and welding device. This applies to fusion welding machines and extrusion welders performing tie-in seams, cross seams or reconstructed seams; not minor patchwork. Minor patchwork refers to the repair of destructive test sample locations, repair of punctures for the air channel test and patches and beads over punctures or tears. The Project

Engineer will be responsible for choosing the locations. The Installer shall not be informed in advance of the locations where the seams samples will be taken. The Project Engineer may increase the sampling frequency at their option.

b. Samples shall be cut by the Installer at the locations designated by the Project Engineer as the seaming progresses. Each sample shall be numbered and the sample number and location identified on the panel layout drawing. All holes in the geomembrane resulting from the destructive seam sampling shall be immediately repaired in accordance with the repair procedures described in Part 3.04-K of this Section. The continuity of the new seams in the repaired areas shall be tested according to Part 3.04-I of this Section.

c. Destructive seam samples shall be divided, and distributed as described in Section 6 of the QA/QC Plan.

3. Laboratory Testing:

a. Destructive seam samples shall be tested for peel and shear strength, as described in Section 6 of the QA/QC Plan, by an independent geosynthetics testing laboratory. The geosynthetics laboratory shall provide test results to the Project Engineer no more than 24 hours after the samples are received at the laboratory. Criteria for acceptance are described in paragraph 3.04.J.4.

4. The Project Engineer shall determine acceptance of the destructive test sample according to the following criteria:

a. The sample must pass visual inspection by the Project Engineer and the specimens tested by the installer must fail by film tear bond (FTB).

b. Test results obtained by the geosynthetics laboratory must meet the following criteria:

For 60 mil textured HDPE

a. <u>Shear</u> All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 120 lb/in.

b. <u>Peel</u> All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 78 lb/in for extrusion welds and 91 lb/in for fusion welds.

For 40 mil textured LLDPE

a. Shear All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 60 lb/in.

b. Peel All specimens (3 out of 3) must fail by FTB at a strength equal to or greater than 44 lb/in for extrusion welds and 50 lb/in for fusion welds.

5. Destructive Test Failure:

a. Procedures to be followed when a destructive test seam sample is not accepted are described in Section 6 of the QA/QC Plan. Whenever a sample fails, the Project Engineer will require additional tests for seams that were formed by the same seamer and/or seaming apparatus or seamed during the same time shift. The installer shall complete any required repairs in accordance with Part 3.04-K of this Section.

b. Over the length of the seam failure, the installer shall either:

1.) Cut out the failed seam, reposition the panel and reseam with fusion welding, or,

2.) Add cap strip and extrusion weld cap to the two panels, or,

c. In cases exceeding 50 feet of reconstructed seam, a sample taken from within the reconstructed seam zone must pass destructive testing.

K. Defects and Repairs:

1. The geomembrane will be inspected before and after seaming for evidence of defects, holes blisters, undispersed raw materials and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the geosynthetics installer if surface contamination inhibits inspection. The geosynthetics installer shall ensure that an inspection of the geomembrane precedes any seaming of that section.

2. Each suspect seam location shall be non-destructively tested using pressurized air channel or vacuum box methods described in Section 6 of the QA/QC Plan as appropriate. Each location that fails nondestructive testing shall be marked by the Project Engineer and repaired by the Installer.

3. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the Project Engineer shall identify all excessive geomembrane wrinkles. These are wrinkles that have the potential to fold over so as not to provide a smooth uniform surface, which will in turn affect the composite nature of the liner or cover system. The Installer shall cut and reseam all wrinkles as identified. The seams thus produced shall be tested like any other seams.

4. Repair Procedures:

a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Installer. The Installer must submit a repair procedure plan to the Project Engineer for approval. The procedures available include:

1.) Patching; used to repair large holes (greater than 1/4 inch), tears, undispersed raw materials, and contamination by foreign matter (patch extrusion welded to parent sheet);

2.) Extrusion cap welding: used to repair small tears, pinholes, or other minor localized flaws;

3.) Capping: used to repair large lengths of failed seams (cap strip/roll sheet extrusion welded);

4.) Fusion weld reseaming: used to repair large lengths of failed seams by cutting out bad seam and replacing with a strip of new material fusion welded into place.

b. In addition the following shall be satisfied:

1.) Surfaces of the geomembrane, which are to be repaired shall be abraded no more than ten minutes prior to the repair;

2.) All surfaces must be clean and dry at the time of repair;

3.) All seaming equipment used in repair procedures must be approved;

4.) The repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the Project Engineer and the geosynthetics installer;

5.) Patches or caps shall extend at least 6 inches beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 inches; and

6.) The geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.

5. Repair Verification:

a. Each repair shall be numbered and logged and shall be non-destructively tested using the methods described in Section 6 of the QA/QC Plan. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests will require the repair to be redone and retested until a passing test results. At the discretion of the Project Engineer, sampling and destructive testing may be required on large caps.

3.05 Protecting the Geomembrane

A. Either the geosynthetics installer or Contractor shall place suitable materials such as tires, sand bags, etc. on the geomembrane to secure it until authorization is given to cover it. The geosynthetics installer and Contractor are responsible to correct any damage to the geomembrane at its own expense until the geomembrane is accepted.

B. The geomembrane shall not be covered until all destructive and non-destructive test data and conformance data are reviewed and accepted by the Project Engineer.

3.06 Materials in Contact with the Liner

A. The geosynthetics installer shall assist the Contractor, as necessary, to ensure that the geomembrane is not damaged during its installation or during the installation of other components of the liner or cover system or by other construction activities.

B. A geocomposite drainage layer will be installed directly on the secondary geomembrane. See the Contract Drawings for details and locations.

C. A cushion geotextile will be installed between the leachate collection system and the primary geomembrane and between the secondary clay liner and the existing cap geomembrane as shown on the Contract Drawings. Granular or soil materials shall not be placed on the geotextiles at air temperatures below 31°F or above 140° F, unless it can be demonstrated to the satisfaction of the Project Engineer that no liner damage will result.

D. Equipment shall not be driven directly on the geomembranes. Light weight construction equipment shall not operate on top of the geomembrane without the geotextile cushion and at least 12 inches of cover.

E. In heavy traffic areas such as access ramps, and in areas used by heavy construction equipment, such as loaded dump trucks, at least 3 feet of cover must be placed over the geomembrane and geotextile cushion. Sharp Turning of wheeled vehicles is strictly prohibited.

F. Appurtenances:

1. Installation of the geomembrane in sump areas, and connection of the geomembrane to appurtenances shall be made according to specifications. The Contractor shall ensure that the geomembrane has not been visibly damaged while making connections to sumps and appurtenances. Spark testing will be performed in instances where it is not possible to perform the vacuum test.

2. All clamps, slips, bolts, nuts, or other fasteners used to secure the geomembrane to each appurtenance shall be at least as durable as the geomembrane.

3.07 Geomembrane Acceptance

A. The geosynthetics installer shall retain all ownership and responsibility for the geomembrane until accepted by the Owner.

B. The geomembrane shall be accepted by the Owner when:

1. The installation is finished.

2. All documentation of installation is completed to the satisfaction of the Project Engineer including all of the geomembrane related test data and certification materials referred to in these specifications and the QA/QC Plan.

3. Verification of the adequacy of all field seams and repairs including associated testing is complete.

4. Installer's record drawings of seam field panel locations, destructive sample locations, repair locations, pipe penetration locations, etc. are submitted to and approved by the Project Engineer.

5. Installer's daily construction progress reports and all field logs are submitted to and approved by the Project Engineer.

3.08 Product Protection

A. The Contractor shall use all means necessary to protect all prior work and all materials and completed work of other sections.

B. In the event of damage, the Contractor shall make all repairs, replacements, sampling and testing necessary, to the approval of the Project Engineer and at no additional cost to the Owner.

3.09 Warranty of Geomembrane Liner

A. The Manufacturer of geomembrane liners shall warrant to the Owner that the geomembrane liner, for the herein referenced project, is free from manufacturing and installation defects and that the liner, when properly installed and maintained, will not suffer deterioration due to typical atmospheric and operating conditions as intended by the design specification.

B. The warranty shall take effect upon final acceptance of the liner installation and when all terms and conditions of the Contract Documents are satisfied for this item and shall be for a period of **one year**.

C. The Installer shall make any replacement or necessary repairs to the liner and its components during the warranty period, at no additional cost to the Owner, for those situations where repairs by warranty shall apply.

D. The geomembrane liner shall perform in the manner for which it was designed. The warranty shall be submitted to and approved by the Project Engineer and the Owner prior to installation of the liner.

E. Warranty shall include agreements between the Installer and the Manufacturer, if they are not one and the same, that will make all terms binding and that will incur no additional costs to the Owner during the warranty period specified herein.

F. Warranty shall be written in accordance with the laws and jurisdiction of the courts of the State of New York. Should any dispute hereafter arise concerning the interpretation or enforcement of this warranty or any rights, obligations or remedies herein, then venue in all cases shall be exclusively vested in any Sate or Federal Court in the State of New York having proper jurisdiction.

TABLE 02400-1 REQUIRED HDPE GEOMEMBRANE PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Standard Sheet Properties				
Thickness	Minimum average value Lowest individual for any of the ten values	mils	57 51	ASTM D5994
Asperity Height	Minimum average value	mils	16	ASTM D7466 See Notes 1 and 2
Density (includes 2% to 3% Carbon Black Content)	Minimum	g/cm^3	0.94	ASTM D1505/D792 Method A
Carbon Black Content	Range	%	2-3	ASTM D1603/D4218
Carbon Black Dispersion	N/A	none	9 of 10 in Cat. 1 or 2 1 in Cat. 3	ASTM D5596
Tensile Properties				
Tensile Strength at Yield	Minimum (each direction)	lb./in	126	ASTM D6693
Tensile Strength at Break	Minimum (each direction)	lb./in	90	ASTM D6693
Elongation at yield	Minimum (each direction)	%	12	ASTM D6693
Elongation at break	Minimum (each direction)	%	100	ASTM D6693
Tear Resistance	Minimum	lb.	42	ASTM D1004
Puncture Resistance	Minimum	lb.	90	ASTM D4833
Miscellaneous Sheet Properties				
Single Point Stress Crack Resistance	Minimum	hours	500	ASTM D5397 Appendix
Water Vapor Transmission Rate	Maximum	$gr/m^2/day$	0.03	ASTM E96
Oxidative Induction Time (Standard OIT)	Minimum average value	minutes	100	ASTM D3895
Oven Aging at 85°C (Standard OIT)	Minimum average value	% retained after 90 days	55	ASTM D5721
UV Resistance (High Pressure OIT)	Minimum average value	% retained after 1600 hours	50	ASTM D7238

Note 1: Asperity height requirements shall be modified based on direct shear test requirements listed in Section 6.0 of the QA/QC Plan.
Note 2: Asperity height measurements shall be taken at uniform intervals across the entire roll width.

TABLE 02400-2 REQUIRED LLDPE GEOMEMBRANE PROPERTY VALUES

PROPERTIES	QUALIFIERS	UNITS	VALUES	METHOD
Standard Sheet Properties				
Thickness	Minimum average value Lowest individual for any of the ten values	mils	38 34	ASTM D5994
Asperity Height	Minimum average value	mils	16	ASTM D7466 See Notes 1 and 2
Density (includes 2% to 3% Carbon Black Content)	Maximum	g/cm^3	0.939	ASTM D1505/D792 Method A
Carbon Black Content	Range	%	2-3	ASTM D1603/D4218
Carbon Black Dispersion	N/A	none	9 of 10 in Cat. 1 or 2 1 in Cat. 3	ASTM D5596
Tensile Properties				
Tensile – Break Strength	Minimum (each direction)	lb./in	60	ASTM D6693
Tensile – break elongation	Minimum (each direction)	%	250	ASTM D6693
Miscellaneous Sheet Properties				
Oxidative Induction Time (Standard OIT)	Minimum average value	minutes	100	ASTM D3895
Oven Aging at 85°C (Standard OIT)	Minimum average value	% retained after 90 days	35	ASTM D3895
UV Resistance (High Pressure OIT)	Minimum average value	% retained after 1600 hours	35	ASTM D5885
2% Modulus	Maximum	lb/in	2400	ASTM D 5323
Axi-Symmetric Break Resistance Strain	Minimum	%	30	ASTM D 5617
Tear Resistance	Minimum average value	lb.	22	ASTM D1004
Puncture Resistance	Minimum average value	lb.	44	ASTM D4833

Note 1: Asperity height requirements shall be modified based on direct shear test requirements listed in Section 6.0 of the QA/QC Plan.
Note 2: Asperity height measurements shall be taken at uniform intervals across the entire roll width.

END OF SECTION 02400

SECTION 02410

GEOMEMBRANE LEAK LOCATION TESTING

PART 1 - GENERAL

1.01 Scope

A. This section includes a description of the electrical leak location testing using the dipole method on the geomembrane placed between soil materials.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Clay Liners: Section 02210

E. Geosynthetic Clay Liner: Section 02220

F. Geomembranes: Section 02400

G. Leachate Collection Systems: Section 02500

H. Dewatering: Section 02650

I. Construction QA/QC Plan: Included with the Contract Documents

1.03 References

A. ASTM D6747 – Standard Guide for Selection of Techniques for Electrical Leak Location of Leaks in Geomembranes

B. ASTM D7007 – Standard Practices for Locating Leak in Geomembranes Covered with Water or Earth Materials

1.04 Submittals

A. Prior to commencement of the electrical leak location survey, the electrical leak location consultant shall submit a Work Plan. The Electrical leak location (ELL) Survey Work Plan shall include:

1. Qualifications of the proposed electrical leak location consultant including the square footage and number of projects of successful method application the electrical leak location consultant has performed of the proposed survey method.

2. Description of the proposed survey method, procedures, site preparations, estimated duration of survey, and quality control and field sensitivity testing procedures.

3. A Statement of Qualifications meeting the requirements of Section 1.05.

4. A list of number and types of defects located for the three qualifying projects of the supervising leak location technician or documentation of the ELL operator certification for said technician.

B. If necessary, the electrical leak location consultant shall provide any permanent electrodes, wires, and installation instructions to the Contractor prior to the installation of the geomembrane.

C. The electrical leak location consultant shall report the general results of the survey to the Contractor and Project Engineer during the daily progress of the field work.

D. Prior to the demobilization of the survey personnel from the site, the electrical leak location consultant shall submit a list of locations of the leaks detected to the Project Engineer, Contractor and the Geomembrane Installer.

E. The electrical leak location consultant shall submit a letter report documenting the field work and results of the surveys to the Owner within fourteen (14) days after completion of the field work.

1.05 Qualifications

A. The electrical leak location consultant shall have experience in conducting electrical leak location surveys of the proposed method including having tested a minimum of 5,000,000 square feet of the proposed survey methods on at least five projects. In addition, the leak location survey shall be supervised by a professional or technician with a minimum of 2,000,000 square feet of electrical leak location testing experience using the proposed method on at least three projects. Alternatively, the field professional or technician may maintain current Level 3 ELL operator certification in lieu of the minimum project and square footage requirement.

PART 2 – MATERIALS

A. If necessary, the electrical leak location consultant shall provide any permanent electrodes, wires, and installation instructions to the Contractor prior to the installation of the geomembrane.

PART 3 – EXECUTION

3.01 Preparation and Support

A. The Contractor is responsible for preparing the survey area for the electrical leak location survey. The preparation consists of, but is not limited to, the following:

1. Install any necessary electrodes.

2. Coordinate with the electrical leak location consultant to provide a survey area within the liner expansion area that is electrically isolated from the surrounding ground (i.e. the cover soil is not tied into the ground surface outside of the cover area). Isolation can be accomplished by open trenching or installation of a non-conductive insulator such as the liner materials.

2. Provide the electrical leak location consultant the liner installation schedule.

3. Provide water, water truck and driver, and wet the survey area prior to and during the dipole survey to ensure that there is adequate moisture in the material(s) covering the geomembrane for the dipole electrical leak location testing. To detect a leak, moisture must exist in the leak and be in contact with moisture in the materials above and below the liner. Therefore, the material(s) covering the geomembrane must be moistened with water prior to conducting the electrical leak location survey. In order to achieve uniform moisture distribution, the Contractor shall add water as the construction progresses on and within cover layer(s). A water truck must be available at all times as it may be necessary to wet the surface just in advance of the survey, as deemed necessary by the electrical leak location consultant.

4. The leak detection distance testing procedures require digging a hole down to the surface of the geomembrane to place the artificial leak. The Contractor is to provide a backhoe and/or hand labor, as appropriate, to excavate the cover soils down to the geomembrane. The Contractor is also responsible for backfilling the calibration hole, and uncovering and retrieving the artificial leak apparatus, and backfilling the hole appropriately, including patching any intervening geotextiles.

B. The Contractor shall uncover and expose any leaks detected for repair by the Geomembrane Installer in accordance with the Specification Section 02400.

3.02 Survey

A. The dipole electrical leak location survey shall be performed after the placement of the cover materials.

B. The electrical leak location consultant is responsible for calibrating all equipment utilized to achieve optimum data quality and sensitivity for the site conditions.

C. All work shall be performed in accordance with current industry and ASTM standards.

D. Data acquisition shall be GPS-based and a voltage map of the recorded dipole measurements shall be generated in three dimensions with appropriate contour intervals and colored voltage ranges.

E. Manual measurements shall be made to verify leak signals after data analysis and to pinpoint the leak positions on top of the protective cover layer for excavation while the survey personnel are on site. Within one foot of the liner, the Contractor's laborers shall hand excavate possible leak locations to expose the liner.

F. Additional manual measurements should be made to guide the Contractor's personnel while they excavate the leak, if required.

G. After the identification and excavation of a leak, the soil around the leak location shall be tested while the leak is uncovered and cleaned to check for adjacent leaks.

H. Leak locations shall be logged, visibly marked, and reported for repair.

I. The electrical leak location consultant shall report the general results of the survey to the Project Engineer and Contractor during the daily progress of the field work.

J. Prior to the demobilization of the survey personnel from the site, the electrical leak location consultant shall submit a list of locations of the leaks detected to the Project Engineer and Contractor.

K. The electrical leak location consultant shall submit a letter report documenting the field work and results of the surveys to the Project Engineer and Contractor within fourteen (14) days after completion of the field work.

END OF SECTION 02410

SECTION 02500

LEACHATE COLLECTION SYSTEMS

PART 1 – GENERAL

1.01 Scope

A. The secondary leachate collection system consists of a minimum 12 -inch thick layer of drainage stone. The drainage stone is placed on a secondary collection geocomposite, Item 02506, that covers and protects the geomembrane liner and provides additional drainage. Also included in the system is a perforated 6-inch diameter HDPE collection pipe, which connects to sumps or previously installed secondary collection pipes. In areas surrounding the collection pipes as shown on the Drawings, the drainage stone shall be replaced with coarse drainage stone, Item 02501. The Contractor will be responsible for installing the pipe and drainage stone as shown on the Drawings. It should be noted that the drainage stone is not required on the sideslope. A separate geosynthetics contractor will install the geosynthetic materials.

B. The primary leachate collection system consists of a minimum 24-inch thick layer of drainage stone, Item 02502. The drainage stone is placed on a cushion geotextile, Item 02504, that covers and protects the geomembrane liner. Also included in the system is a perforated 8-inch diameter HDPE collection pipe, Item 02508, which connects to previously installed 8-inch piping or sump areas. In areas surrounding the collection pipes as shown on the Drawings, the drainage stone shall be replaced with coarse drainage stone, Item 02501. The Contractor will be responsible for installing the pipe and drainage stone as shown on the Drawings. A separate geosynthetics contractor will install the geosynthetic materials.

C. Separation and cushion geotextiles described in this section are also utilized in several other locations of this construction. The typical cap replacement section requires a cushion geotextile, Item 02504 be placed over the geomembrane. The separate geosynthetics contractor will install this cushion geotextile. In addition, separation geotextiles will be used to cap cut geocomposites, in select pipe trenches to separate granular and soil materials and to separate berm cap materials from certified geosynthetics. Separation geotextiles will typically be installed by the Contractor.

D. Definitions

1. Backfilling: is the placement and compaction of granular materials on the liner.

2. Geocomposite is a manufactured drainage material consisting of a geonet encased between two non-woven geotextiles.

E. Job Conditions

1. The Owner will supply the drainage stone and HDPE pipe. Deliveries will be coordinated and stockpiled by the Contractor. Stockpiles will be placed in approved areas designated by the QA/QC Engineer and Owner and shall be maintained by the Contractor.

2. The Contractor will be responsible to supply and install all pipe fittings.

3. The Owner will supply and the geosynthetics contractor will install the geocomposite and geosynthetic materials, with the exception of separation geotextile as discussed above. The Contractor will assist in the delivery and stockpiling of the materials. Stockpiles will be placed in approved areas designated by the QA/QC Engineer and Owner.

4. The geosynthetics supplier is responsible for achieving the specified properties of all the geosynthetic materials.

5. The geosynthetics supplier must furnish the Owner with complete written instructions for storage and handling of geocomposite and geosynthetic rolls. At a minimum the rolls shall be stored in an area that is well drained and free of dust and mud and shall be covered with tarps to minimize damage due to the elements.

6. The geosynthetics contractor shall be prepared to place the geocomposite in conjunction with the earthworks and the installation and construction of the other components of the liner system.

7. Contractor is responsible for protection of all above ground and below ground structures and utilities or wells, whether shown on the Drawings or not. Contractor will replace any damaged items due to the Contractor's operations.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Embankment: Section 02200

E. Clay Liner: Section 02210

F. Geomembrane Liner: Section 02400

G. Dewatering: Section 02650

H. Gas Collection Systems: Section 02700

I. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

Submit the following:

A. At least one month prior to hauling the drainage stone to the site, submit certificates from the suppliers stating that the materials meet the specified quality and gradation requirements. At this time submit samples for testing as required by the QA/QC Engineer. Submit procedures for transporting material to the placement area and dust and noise control. This must also include a plan for placement and spreading the granular drainage materials on the cushion geotextile and the geomembrane liner.

B. At least two weeks prior to delivery of leachate collection pipes, provide the following:

1. Quality control/quality assurance test reports in accordance with the applicable test standards outlined in this section and in the QA/QC Plan,

2. Shop drawings showing details of the pipe connections and other pertinent details and manufacturers written certification that the pipe complies with these specifications

3. The Contractor's proposed procedures, equipment (including a relationship between hydraulic carriage pressure and fusion pressure) and names of certified individuals who will be performing the fusion welding prior to welding. Documents such as "Qualification Procedures for making PE 3408 Polyethylene Heat Fusion Joints" by Plexco or "Heat Fusion Qualification Guide" by Driscopipe shall be consulted to develop the butt fusion procedure.

The geosynthetics supplier is required to submit the following:

A. A sample of the proposed geocomposite material and results of testing required by the QA/QC Plan.

B. At least two weeks before the geocomposite is delivered to the site, manufacturer certification indicating fiber type, geotextile manufacturing process, geonet polymer type and density and manufacturer quality control data listed in the QA/QC plan.

C. At least two weeks prior to delivery of geotextiles, Items 02504 and 02505, provide a certificate from the material supplier that indicates the fiber type, manufacturing process, and that the material meets or exceeds the specified physical requirements. The supplier will provide quality control /quality assurance test reports in accordance with the applicable

test standards outlined in this section and in the QA/QC Plan. The reports will be provided prior to using the material and at the frequency specified in the QA/QC Plan. Each geotextile roll delivered to the site must be labeled according to ASTM D4873, to indicate the manufacturer, style number and roll number, and documentation of this data provided to the QA/QC Engineer for each roll.

PART 2 – MATERIALS

2.01 Coarse Drainage Stone (Primary Drainage Layer – Slopes <10%), Item 02501:

A. Coarse drainage stone shall be crushed stone (except limestone), crushed gravel or screened gravel meeting the requirements of NYSDOT Specifications Section 703-02, size designation #3. Slag and limestone will not be permitted.

B. The gradation of the coarse drainage stone shall be such that 100% of the material passes a 2-1/2-inch sieve and less than 1% passes the number 200 sieve. Deviation from these guidelines may be allowed at the discretion of the Project Engineer if the material meets permeability requirements but in no case shall exceed 5%. The following gradation requirements serve as a general guideline for the selection of material suitable for placement of coarse drainage stone. Deviation from these guidelines may be allowed at the discretion of the QA/QC Engineer. Coarse drainage stone must meet the permeability requirements described of this subsection and shall have no more that 5% passing the number 200 sieve after placement.

Sieve Size	Percent Finer by Weight
2-1/2 inch	100
2 inch	90 - 100
1-1/2 inch	35 - 75
1 inch	0 - 15
No. 200	0 - 5

C. Coarse drainage stone shall meet the soundness requirements described in the NYSDOT Specifications Section 703-02, Tables 703-2 (specifically the magnesium sulfate test ASTM C88 and the Los Angeles abrasion test ASTM C131) and 703-3. In addition, the drainage stone requires testing to estimate that the amount of calcium carbonate equivalent does not exceed 15 percent (specifically ASTM D3042) using a solution with a pH representative of landfill leachate.

D. When placed and compacted, it must have permeability greater than or equal to 1 cm/sec.

E. The material shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the QA/QC Engineer.

2.02 Drainage Stone (Primary Drainage Layer – Slopes>10%), Item 02502:

A. Drainage stone shall be crushed stone (except limestone), crushed gravel or screened gravel meeting the requirements of NYSDOT Specifications Section 703-02, size designation #2. Slag and limestone will not be permitted.

B. The gradation of the drainage stone shall be such that 100% of the material passes a 1 1/2-inch sieve and less than 1% passes the number 200 sieve. Deviation from these guidelines may be allowed at the discretion of the Project Engineer if the material meets permeability requirements but in no case shall exceed 5%. The following gradation requirements serve as a general guideline for the selection of material suitable for placement of drainage stone. Deviation from these guidelines may be allowed at the discretion of the QA/QC Engineer. Drainage stone must meet the permeability requirements described in subpart D of this subsection and shall have no more that 5% passing the number 200 sieve after placement.

Sieve Size	Percent Finer by Weight
1-1/2 inch	100
1 inch	90 - 100
1/2 inch	0 - 15
No. 200	0 - 5

C. Drainage stone shall meet the soundness requirements described in the NYSDOT Specifications Section 703-02, Tables 703-2 (specifically the magnesium sulfate test ASTM C88 and the Los Angeles abrasion test ASTM C131) and 703-3. In addition, the drainage stone requires testing to estimate that the amount of calcium carbonate equivalent does not exceed 15 percent (specifically ASTM D3042) using a solution with a pH representative of landfill leachate.

D. When placed and compacted, it must have a permeability greater than or equal to 0.1 cm/sec.

E. The material shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the QA/QC Engineer.

2.03 Fine Drainage Stone (Secondary Drainage Layer), Item 02503:

A. Fine drainage stone shall be crushed stone (except limestone), crushed gravel or screened gravel meeting the requirements of NYSDOT Specifications Section 703-02, size designation #1A. Slag and limestone will not be permitted.

B. The gradation of the fine drainage stone shall be such that 100% of the material passes a 1/2-inch sieve and less than 1% passes the number 200 sieve. Deviation from these guidelines may be allowed at the discretion of the Project Engineer if the material meets permeability requirements but in no case shall exceed 5%. The following gradation

requirements serve as a general guideline for the selection of material suitable for placement of fine drainage stone. Deviation from these guidelines may be allowed at the discretion of the QA/QC Engineer. Fine drainage stone must meet the permeability requirements described in subpart D of this subsection and shall have no more that 5% passing the number 200 sieve after placement.

Sieve Size	Percent Finer by Weight
1/2 inch	100
1/4 inch	90 - 100
1/8 inch	0 - 15
No. 200	0 – 5

C. Fine drainage stone shall meet the soundness requirements described in the NYSDOT Specifications Section 703 -02, Tables 703-2 (specifically the magnesium sulfate test ASTM C88 and the Los Angeles abrasion test ASTM C131) and 703-3. In addition, the drainage stone requires testing to estimate that the amount of calcium carbonate equivalent does not exceed 15 percent (specifically ASTM D3042) using a solution with a pH representative of landfill leachate..

D. When placed and compacted, it must have a permeability greater than or equal to 0.1 cm/sec

E. The material shall be free of all deleterious matter such as ice, organics, frozen soil, saturated soil, or other matter considered unsuitable by the QA/QC Engineer.

2.04 Cushion Geotextile, Item 02504:

The cushion geotextile, shall be a twelve-ounce per square yard (or greater) nonwoven polypropylene fabric meeting the following minimum average values:

PROPERTY	REQUIREMENT
Mass/Unit Area oz/yd^2 (min)	12.0
Grab Strength (lbs)	300
CBR Puncture Strength (lbs)	800
Trapezoidal Tear (lbs)	115

2.05 Separation Geotextile, Item 02505:

The separation geotextile, shall be a six-ounce per square yard (or greater) nonwoven polypropylene fabric meeting the following minimum average values:

PROPERTY	REQUIREMENT	
	ELONGATION < 50%	**ELONGATION ≥ 50%**
Mass/Unit Area oz/yd^2	6.0	6.0
Grab Strength (lbs)	180	113
CBR Puncture Strength (lbs)	380	230
Trapezoidal Tear (lbs)	68	41
Apparent Opening Size	70 - 100 sieve	70 - 100 sieve

2.06 Secondary Collection Geocomposite, Item 02506

A. The geocomposite material must possess a transmissivity greater than or equal to $5x10^{-4}$ m^2/sec when subjected to a vertical soil stress of 13,000 pounds per square foot and at a gradient of 0.1. The geocomposite should be tested using boundary conditions (i.e. underlying and overlying materials) to replicate secondary collection field conditions with a minimum 100 hour seating time. The geocomposite components shall meet the following requirements.

B. Geotextile - shall have the following minimum characteristics:

1. Six-ounce per square yard non-woven polypropylene fabric

2. Apparent Opening Size = 70 sieve

3. Permittivity = 1.5 sec^{-1}

C. Geonet - shall have the following characteristics:

1. Shall be made of HDPE

2. Thickness = 300 mil

3. Transmissivity = $8x10^{-3}$ m^2/sec

2.07 Leachate Collection Pipes, Items 02508 and 02510:

A. Each pipe section delivered to the site must be labeled to indicate the manufacturer, HDPE material type, size and SDR.

B. The leachate collection pipe Item 02508 shall be 8-inch diameter perforated, high-density polyethylene (HDPE) pipe, respectively. The pipe shall have a standard dimension ratio (SDR) of 11. The pipe shall be of type PE3408 as manufactured by PolyPipe, Inc. or approved equivalent. Perforations shall be 3/8-inch diameter and shall be made in the pattern shown on the Drawings.

C. The leachate cleanout riser pipes on the berm slopes, Item 02510, and fittings shall be 8-inch diameter, non-perforated high-density polyethylene (HDPE) pipe, respectively. The pipe shall have a standard dimension ratio (SDR) of 11. The pipe shall be of type PE3408 as manufactured by PolyPipe, Inc. or approved equivalent.

PART 3 – EXECUTION

3.01 Geocomposite Installation

A. Delivery, Storage and Handling

1. The geocomposite shall be packaged and shipped by appropriate means so that no damage is incurred. During shipment and storage the geocomposite shall be adequately protected at all times from puncture, abrasion, excessive heat or cold, degradation of the material, or other damaging or deleterious conditions in accordance with instructions from the Manufacturer and their warranty conditions

2. Materials shall be delivered only after the required submittals have been received and approved by the QA/QC Engineer.

3. Appropriate handling equipment and techniques as recommended by the Manufacturer and approved by the QA/QC Engineer shall be used. Handling, storage, and care of the geocomposite prior to and following installation at the site is the responsibility of the geosynthetics contractor. The geosynthetics contractor shall be liable for all damages to the materials incurred prior to final acceptance of the geocomposite by the Owner. Any geocomposite damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the QA/QC Engineer, at no additional cost to the Owner. At a minimum the rolls shall be stored in an area that is well drained and free of dust and mud and shall be covered with tarps to minimize damage due to the elements.

B. HDPE Liner Condition

1. The geosynthetics contractor shall have completed the installation and acceptance of the secondary HDPE liner prior to placement of the geocomposite.

2. The geosynthetics contractor shall take necessary precautions to prevent damage to underlying geosynthetics layers during placement of the geocomposite. Geocomposite shall only be place on surfaces that are clean.

C. Deployment

1. The geocomposite shall be protected from exposure to sunlight during transport and storage and at all times shall be kept clean and free of material between the geotextiles.

2. The geocomposite shall be deployed such that it lies smooth on the secondary geomembrane surface, free of wrinkles, folds and creases.

3. The geocomposite shall be deployed to create a shingle effect on the landfill floor. The downslope sheet shall be overlapped by the sheet immediately upslope of it.

4. The geocomposite shall be laid out in a staggered configuration such that the ends of adjacent sheets do not result in a continuous seam

5. The geosynthetics contractor shall deploy the geocomposite in a controlled manner, allowing the geocomposite roll to “free fall” down a slope is unacceptable.

6. At the time of deployment, the geocomposite shall be inspected for defects, rips, holes, flaws deterioration or damage. Geocomposite sheets having any of the referenced features shall be rejected and removed from the site at the geosynthetic contractor’s expense.

7. In some areas, two or more layers of geocomposites will be required: such areas are identified in the Drawings.

8. The geosynthetic contractor shall employ placement methods to ensure that:

a. Placement of the geocomposite over the textured geomembrane shall be completed by using a temporary rub sheet or similar method to limit friction between the materials and the development of tension in the geomembrane.

b. The prepared surface underlying the geocomposite shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after geocomposite placement.

c. All surfaces immediately underlying the geocomposite must be kept clean and free of debris, including stones.

D. Seaming

1. All seams shall be made according to manufacturer's specifications. Seaming procedures shall be submitted for approval before beginning deployment of the geocomposite material. For long seams this includes overlapping the lower geotextile 4 inches, overlapping the geonets 6-inches with plastic ties installed at 5-foot intervals on the floor, 1-foot intervals on the sideslopes and overlapping the upper geotextile 4-inches and sewing. For butt seams, the geocomposite shall be overlapped 12 inches with plastic ties installed at 6-inch intervals and the upper geotextiles shall be capped with an 18-inch wide strip of geotextile. The upper geotextile on the lower geocomposite and the lower geotextile on the upper geocomposite shall be removed to allow the geonet portions of the geocomposites to be in direct contact as shown in the Drawings.

2. In general, seams shall be oriented parallel to the line of maximum slope (i.e., down, not across, the slope). In corners and odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seams shall be located on the berm side slopes or within 5 feet of the toe of the side slope. No seams shall be located in areas of potential stress concentrations.

E. Defects and Repairs:

1. The geocomposite will be inspected before and after seaming for evidence of defects, holes, and any sign of contamination by foreign matter. The surface of the geocomposite shall be clean at the time of inspection.

2. Repair Procedures:

a. The geosynthetic contractor shall repair any portion of the geotextile portions of the geocomposite exhibiting isolated tears or puncture holes. The geosynthetics contractor must submit a repair procedure plan to the QA/QC Engineer for approval.

b. At a minimum, the repair shall consist of an oval or round patch of the same geotextile that extends a minimum of 12 inches beyond the defect in all directions.

c. Defects found in the geonet portions of the geocomposite will not be allowed, and shall be repaired at no additional cost to the Owner. The geosynthetics contractor must submit a repair procedure plan to the QA/QC Engineer for approval.

3. Repair Verification:

a. Each repair shall be numbered and logged.

4. The geocomposite shall not be covered until it has been inspected and accepted by the QA/QC Engineer.

F. Covering

1. At no time shall operation of vehicles or equipment be permitted directly on the geocomposite.

2. The geosynthetics contractor or Contractor shall ballast the geocomposite with sandbags to prevent displacement of the geocomposite by wind. Such sandbags shall be installed during placement and shall remain on the geocomposite and succeeding geosynthetics layers until the geosynthetics are covered by a soil layer. Care shall be exercised when handling sandbags over geocomposite material, to prevent rupture or damage of the sandbags.

3. The Contractor shall protect the geocomposite from being inundated with sediment laden stormwater. If sediment accumulates on the geotextile, the geocomposite shall be washed to the satisfaction of the QA/QC Engineer or replaced at the discretion of the QA/QC Engineer.

4. Cover materials shall be placed on the geocomposite within 30 days of deployment. If the geocomposite is to remain exposed for over 30 days, UV blocking tarps or approved equivalents shall be used to protect the geocomposite until cover materials are placed.

5. Wrinkles that form in the geocomposite panel prior to covering shall be either repositioned or replaced to the satisfaction of the QA/QC Engineer.

6. The Contractor shall place the overlying material on the geocomposite by working from a platform of soil placed on the geocomposite. Soils shall be placed on the slopes, working from the toe to the crest.

7. Low ground pressure construction equipment (i.e applies less than 5 psi of ground pressure) shall only be allowed to operate on top of the geocomposite when at least 12 inches of cover is present.

8. In heavy traffic areas such as access ramps, and in areas used by heavy construction equipment, such as loaded dump trucks, at least 3 feet of cover must be placed over the geocomposite. Sharp Turning of wheeled vehicles is strictly prohibited.

9. The Contractor will assist the QA/QC Engineer whenever requested, to evaluate whether the geocomposite has been damaged by placement of overlying materials. This may include excavation of overlying material to allow evaluation of the geocomposite.

10. The geocomposite will be rejected if during or after installation, any defects, holes, flaws or deterioration are detected. Rejected geocomposite and any overlying materials shall be replaced by either the geosynthetics contractor or Contractor at no additional expense to the Owner.

3.02 Granular Drainage Materials Installation

A. The Contractor shall place the granular drainage material, Items 02501 thru 02503 to the lines and grades shown on the Drawings, subject to the tolerances in these specifications.

B. The Contractor shall place the granular drainage materials, for the primary collection layer in loose lifts to the thickness shown on the Drawings. All granular drainage materials, shall be tracked with at least one pass of a bulldozer or other construction equipment such that the materials are stable as determined by the QA/QC Engineer.

C. The Contractor shall use equipment appropriate for spreading the drainage stone in a uniformly thick layer across the lift. The Contractor's procedure for spreading and placement of the granular drainage stone must protect the cushion geotextile, geomembrane liner and the collection pipes and limit damage to these materials. The Contractor shall place the drainage stone by working from a platform of placed material. Soils shall be placed on the slopes, working from the toe to the crest. Light weight construction equipment shall not operate on top of the geomembrane without at least 12 inches of cover. In heavy traffic areas such as access ramps, and in areas used by heavy construction equipment, such as loaded dump trucks, at least 3 feet of cover must be placed over the geomembrane. Sharp Turning of wheeled vehicles is strictly prohibited. The Contractor will assist the QA/QC Engineer as requested to evaluate potential damage to the underlying liner materials. Any damage will be repaired by the Contractor at no expense to the Owner.

D. QA/QC Engineer’s measurements:

1. The QA/QC Engineer shall collect samples from the compacted lifts as described in the QA/QC Plan. The samples will be tested for gradation and permeability to assess the degree of particle breakdown and the effect on the material permeability.

2. If the test results indicate non-compliance with the specifications, the area of the failing test sample will be evaluated to determine the reason for the non-compliance. If necessary, additional samples will be obtained to determine the extent of the material that is not in compliance. Once the zone of non-compliance is determined, the Contractor is responsible for removal of the unsuitable zone and replacement of this zone with material that meets the project specifications. This remedial work will be completed at no additional expense to the Owner.

E. Granular drainage materials will also be used in the Sump #5 decommissioning and gas well/gas piping modifications. Granular materials placed in these locations will may

require hand placement and tamping to adequately distribute the materials and eliminate voids.

F. The prepared surface underlying the drainage stone shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after drainage stone placement. All surfaces immediately underlying the drainage stone must be kept clean and free of debris.

G. The Contractor is responsible for protecting the granular drainage layers from degrading. This includes protection of the granular drainage layer from contamination by fine-grained soil or sediment resulting from rainfall runoff. If stone becomes contaminated with soil or sediment, the Contractor shall replace the stone to the QA/QC Engineer's satisfaction no expense to the Owner.

3.03 Geotextiles

A. Delivery, Storage and Handling

1. The geotextile shall be packaged and shipped by appropriate means so that no damage is incurred. During shipment and storage the geotextile shall be adequately protected at all times from puncture, abrasion, excessive heat or cold, degradation of the material, or other damaging or deleterious conditions in accordance with instructions from the Manufacturer and their warranty conditions

2. Materials shall be delivered only after the required submittals have been received and approved by the QA/QC Engineer.

3. Appropriate handling equipment and techniques as recommended by the Manufacturer and approved by the QA/QC Engineer shall be used. Handling, storage, and care of the geotextile prior to and following installation at the site is the responsibility of the geosynthetics contractor. The geosynthetics contractor shall be liable for all damages to the materials incurred prior to final acceptance of the geotextile by the Owner. Any geotextile damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the QA/QC Engineer, at no additional cost to the Owner. At a minimum the rolls shall be stored in an area that is well drained and free of dust and mud and shall be covered with tarps to minimize damage due to the elements.

B. Liner Condition

1. The geosynthetics contractor shall have completed the installation and acceptance of the cap LLDPE liner or primary HDPE liner prior to placement of the cushion geotextiles.

2. The geosynthetics contractor shall take necessary precautions to prevent damage to underlying layers during placement of the geotextile. Geotextile shall only be place on surfaces that are clean.

C. Deployment

1. The geotextile shall be protected from exposure to sunlight during transport and storage and at all times shall be kept clean.

2. The geotextile shall be deployed such that it lies smooth on the underlying surface, free of wrinkles folds and creases.

3. The geotextile shall be deployed to create a shingle effect on the landfill floor. The downslope sheet shall be overlapped by the sheet immediately upslope of it.

4. The geotextile shall be laid out in a staggered configuration such that the ends of adjacent sheets do not result in a continuous seam

5. The geosynthetics contractor shall deploy the geotextile in a controlled manner, allowing the geotextile roll to “free fall” down a slope is unacceptable.

6. At the time of deployment, the geotextile shall be inspected for defects, rips, holes, flaws deterioration or damage. Geotextile sheets having any of the referenced features shall be rejected and removed from the site at the Contractor’s expense.

7. The geosynthetics contractor shall employ placement methods to ensure that:

a. Placement of the geotextile over the textured geomembrane shall be completed by using a temporary rub sheet or similar method to limit friction between the materials and the development of tension in the geomembrane.

b. The prepared surface underlying the geotextile shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after geotextile placement.

c. All surfaces immediately underlying the geotextile must be kept clean and free of debris, including stones.

D. Seaming

1. All seams shall be made according to manufacturer’s specifications. Seaming procedures shall be submitted for approval before beginning deployment of the geotextile material. Overlapped seams will be required to have at least 18 inches of overlap.

2. In general, seams shall be oriented parallel to the line of maximum slope (i.e., down, not across, the slope). In corners and odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seams shall be located on the berm side slopes or within 5 feet of the toe of the side slope. No seams shall be located in areas of potential stress concentrations.

E. Defects and Repairs:

1. The geotextile will be inspected before and after seaming for evidence of defects, holes, needles and any sign of contamination by foreign matter. The surface of the geotextile shall be clean at the time of inspection.

2. Repair Procedures:

a. The geosynthetics contractor shall repair any of the geotextile exhibiting isolated tears or puncture holes. The geosynthetics contractor must submit a repair procedure plan to the QA/QC Engineer for approval.

b. At a minimum, the repair shall consist of an oval or round patch of the same geotextile that extends a minimum of 12 inches beyond the defect in all directions.

3. Repair Verification:

a. Each repair shall be numbered and logged.

4. The geotextile shall not be covered until it has been inspected and accepted by the QA/QC Engineer.

F. Covering

1. At no time shall operation of vehicles or equipment be permitted directly on the geotextile.

2. Either the geosynthetics contractor or Contractor shall ballast the geotextile with sandbags to prevent displacement of the geotextile by wind. Such sandbags shall be installed during placement and shall remain on the geotextile until covered by a soil layer. Care shall be exercised when handling sandbags over the geotextile material, to prevent rupture or damage of the sandbags.

3. The Contractor shall protect the geotextile from being inundated with sediment laden stormwater. If sediment accumulates on the geotextile, the geotextile shall be washed to the satisfaction of the QA/QC Engineer or replaced at the discretion of the QA/QC Engineer.

4. Cover soils shall be placed on the geotextile within 30 days of deployment. If the geotextile is to remain exposed for over 30 days, UV blocking tarps or approved equivalents shall be used to protect the geotextile until cover soils are placed.

5. Wrinkles that form in the geotextile panel prior to covering shall be either repositioned or replaced to the satisfaction of the QA/QC Engineer.

6. The Contractor shall place the overlying material on the geotextile by working from a platform of soil placed on the geotextile. Soils shall be placed on the slopes, working from the toe to the crest.

7. Low ground pressure construction equipment (i.e applies less than 5 psi of ground pressure) shall only be allowed to operate on top of the geotextile when at least 12 inches of cover is present.

8. In heavy traffic areas such as access ramps, and in areas used by heavy construction equipment, such as loaded dump trucks, at least 3 feet of cover must be placed over the geotextile. Sharp Turning of wheeled vehicles is strictly prohibited.

9. The Contractor will assist the QA/QC Engineer whenever requested, to evaluate whether the geotextile has been damaged by placement of overlying materials. This may include excavation of overlying material to allow evaluation of the geotextile.

10. The geotextile will be rejected if during or after installation, any defects, holes, flaws or deterioration are detected. Rejected geotextile and any overlying materials shall be replaced by the geosynthetics contractor or Contractor at no additional expense to the Owner.

3.04 Pipes

A. Leachate collection pipes shall be installed by the Contractor to the lines and grades shown on the Drawings, subject to the tolerances in these specifications.

B. All pipes shall be surveyed prior to backfilling by the Contractor’s surveyor and the QA/QC surveyor.

C. Pipe shall be handled and assembled in accordance with manufacturer's recommended procedures. Perforations shall be placed with the holes down. Care shall be taken that there is sufficient coarse drainage material beneath the pipe so that the holes are open for drainage.

D. Pipe shall be joined using butt fusion welding techniques in accordance with manufacturers recommendations and following the procedure submitted by the Contractor and approved by the QA/QC Engineer. The Project Engineer will observe the fusion welding of the pipe ends and will reject welds that do not conform to the manufacturer's

recommendations. The QA/QC Engineer reserves the right to submit sample joints to an independent laboratory for testing and to disqualify either welders, equipment or welding procedures that in the opinion of the QA/QC Engineer, are not suitable. Any defective welds will be repaired by the Contractor at no additional expense to the Owner.

E. Following welding procedures, pipes shall be debeaded and free of obstructions.

F. Pipes shall be welded as close to the installation area as practical, dragging long lengths of welded pipe across the construction area is not permitted. If during movement or placement of the pipes, scratches or gouges occur, the QA/QC Engineer will evaluate any damage caused to the pipes. Damages exceeding 10% of the wall thickness will require removal and replacement of the pipe by the Contractor at no additional cost to the Owner.

G. Each stretch of completed pipeline shall be inspected prior to backfilling. Backfilling operations shall not be initiated prior to inspection and approval by the QA/QC Engineer.

H. After the perforated pipe has been placed, coarse drainage stone shall be placed around and over the pipe. The backfill shall not be dropped from a height of more than one foot. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material. Leachate collection system pipe (primary and secondary) shall be camera inspected to verify that the system is free of obstructions and construction-related debris.

I. The solid pipes on the slope of the berms shall be surrounded with the leachate collection materials as shown on the Drawings. The backfill shall not be dropped from a height of more than one foot. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

J. The Contractor shall protect the pipes from damage at all times during and after installation. No equipment will be allowed to operate on the pipe unless there is sufficient cover material on the pipe to prevent damage to the pipe. At least three feet of cover material is required over the pipe prior to driving haul trucks over the pipe.

K. The Contractor will assist the QA/QC Engineer whenever requested, in evaluating potential damage to the pipes. At a minimum, the pipe will be exposed and evaluate in the location of haul roads. This will include excavation of overlying backfill materials to expose the pipe prior to completion of construction. Any damaged pipe will be replaced at no additional expense to the Owner.

END OF SECTION 02500

SECTION 02600

LEACHATE TRANSFER SYSTEM

PART 1 – GENERAL

1.01 Scope

A. The leachate transmission piping will consist of dual contained HDPE piping, Item 02601. Also, construction of a cleanout as shown on the Drawings is required.

B. The Contractor will be responsible for installing the pipe and backfilling the trenches as shown on the Contract Drawings. Leachate transmission piping will be installed along the perimeter of Cells 7 and 8.

C. As part of the leachate transfer system, existing dual contained sump/manhole #3/#4 will be relocated reusing the existing dual contained manhole or new dual contained manhole. The sump/manhole acts as a collection point and pump station to transmit leachate into the existing transmission piping.

D. Definitions

1. Backfilling: is the placement and compaction of granular or embankment materials in areas shown on the plans.

2. Authorized excavation: is the excavation of material to the limits shown on the plans. It includes excavation of material considered unsuitable by the Project Engineer.

3. Unauthorized excavation: is excavation beyond the limits shown and not authorized by the Project Engineer.

E. Job Conditions

1. The Owner will supply the HDPE pipe, except that the Contractor is responsible for coordinating deliveries and stockpiling of these materials. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

2. The Contractor will be responsible to supply and install all pipe fittings.

3. The Contractor will coordinate all site activities with subcontractors and the Owner.

4. Contractor is responsible for protection of all above ground and below ground structures and utilities or wells, whether shown on the plans or not. Contractor will replace any damaged items due to the Contractor's operations.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Embankment: Section 02200

D. Leachate Collection Systems: Section 02500

E. Dewatering: Section 02650

F. Storm Water Management: Section 02800

G. Vegetative Measures for Erosion and Sediment Control: Section 02900

H. Structural Measures for Erosion and Sediment Control: Section 02910

I. Construction QA/QC Plan: Part 2 of the Contract Documents

1.03 Submittals

A. At least two weeks prior to construction of leachate transmission piping, provide the following:

1. Quality control/quality assurance test reports in accordance with the applicable test standards outlined in this section and in the QA/QC Plan,

2. Shop drawings showing details of the pipe connections and other pertinent details and manufacturers written certification that the pipe complies with these specifications

3. The Contractor’s proposed procedures, equipment (including a relationship between hydraulic carriage pressure and fusion pressure) and names of certified individuals who will be performing the fusion welding prior to welding. Documents such as “Qualification Procedures for making PE 3408 Polyethylene Heat Fusion Joints” by Plexco or “Heat Fusion Qualification Guide” by Driscopipe shall be consulted to develop the butt fusion procedure.

PART 2 – MATERIALS

2.01 Leachate Transmission Piping, Item 02601

A. Each pipe section delivered to the site must be labeled to indicate the manufacturer, HDPE material type, size and SDR.

B. The leachate transmission pipe, Item 02601, shall be a dual contained high density polyethylene (HDPE) pipe as shown on the Contract Drawings. The pipe shall have a standard dimension ratio (SDR) of 17. The pipe shall be of type PE3408 as manufactured by Phillips Driscopipe, Inc. or approved equivalent.

PART 3 – EXECUTION

3.01 Pipes

A. Leachate transmission piping shall be installed to the lines and grades shown on the Contract Drawings, subject to the tolerance in these specifications.

B. All pipes shall be surveyed prior to backfilling by the Contractor's surveyor and the QA/QC surveyor.

C. Pipe shall be handled and assembled in accordance with manufacturer's recommended procedures.

D. HDPE pipe shall be joined using butt fusion or electro-fusion welding techniques in accordance with manufacturer's recommendations and approved by the Project Engineer. The Project Engineer will observe the fusion welding of the pipe ends and will reject welds that do not conform to the manufacturer's recommendations. The Project Engineer reserves the right to submit sample joints to an independent laboratory for testing and to disqualify either welders, equipment or welding procedures that in the opinion of the Project Engineer are not suitable. Any defective welds will be repaired by the Contactor at no additional expense to the Owner.

E. Pipes shall be welded as close to the installation area as practical, dragging long lengths of welded pipe across the construction area is not permitted. If during movement or placement of the pipes, scratches or gouges occur, the Project Engineer will evaluate any damage caused to the pipes. Damages exceeding 10% of the wall thickness will require removal and replacement of the pipe by the Contractor at no additional cost to the Owner.

F. The pipes shall be installed as shown on the plans. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

G. The Contractor shall protect the pipes from damage at all times during and after installation. No equipment will be allowed to operate on the pipe unless there is sufficient

cover material on the pipe to prevent damage to the pipe. At least 3 feet of cover material is required over the pipe prior to driving equipment over the pipe.

H. The Contractor will assist the Project Engineer whenever requested, in evaluating potential damage to the pipes. At a minimum, the pipe will be exposed and evaluated in the location of haul roads. This will include excavation of overlying backfill materials to expose the pipe prior to completion of construction. Any damaged pipe will be replaced at no additional expense to the Owner.

I. The Contractor will be required to pressure test all of the dual contained piping, which includes both the containment and carrier pipes. The testing will not be allowed until the pipes are covered with a minimum of two feet of backfill. Testing will be done using either hydrostatic or air pressure. If any of the pipes fail, the contractor shall remediate or replace the failing pipe to the QA/AC Engineer's satisfaction and at no additional cost to the Owner.

END OF SECTION 02600

SECTION 02650

DEWATERING

PART 1 – GENERAL

1.01 Scope

A. This section specifies the removal and control of surface and ground water from the work area. Dewatering consists of performing all work necessary to remove snow, ice surface water and ground water to perform all work in the dry. The Contractor shall maintain and operate adequate surface and subsurface drainage methods to the satisfaction of the Project Engineer.

B. Job Conditions:

1. The Contractor must be familiar with the site's topography, precipitation trends and surface and ground water conditions.

2. There is a potential for ground water seepage into excavations and for wet subgrade conditions.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/ Quality Control: Section 01400

C. Clearing, Grubbing and Stripping Topsoil: Section 02020

D. Embankment: Section 02200

E. Material Processing: Section 02205

F. Clay Liners: Section 02210

G. Geomembrane Liners: Section 02400

H. Leachate Collection Systems: Section 02500

I. Gas Collection Systems: Section 02700

J. Stormwater Management: Section 02800

K. Construction QA/QC Plan: Included with the Contract Documents

L. SWPPP for Stormwater Discharges Associated with Industrial Activities: Included with the Contract Documents

1.03 Submittals

A. Submit proposed dewatering methods and equipment to the Project Engineer and for review prior to dewatering.

PART 2 – MATERIALS

None

PART 3 – EXECUTION

3.01 Surface Water

A. Maintain and operate adequate surface drainage facilities to keep the construction site dry and excavation slopes and bottoms stable to allow the construction of earthen fills to proceed unhindered.

B. Surface water must be intercepted and diverted away from working areas.

C. Surface water shall not be allowed to collect and pond on subgrades or fill surfaces.

3.02 Groundwater

A. The Contractor shall maintain on site pumps hoses, etc. to control ground water.

B. Some excavations may encounter ground water at the time of construction. Where encountered, the Contractor shall use pumps, sumps, well points, etc. to lower the ground water elevation to produce a stable subgrade before proceeding with construction of overlying structures.

C. If determined by the Project Engineer that a permanent groundwater control system is required, the Contractor will be asked to submit a bid for installing the required permanent groundwater controls.

3.03 Disposal of Water

A. Surface water shall be diverted or pumped to the sedimentation ponds located at the south side of the site. All surface water must be discharged in accordance with the Owner's storm water discharge permit as described in the SWPPP, included with the Contract Documents.

B. Dispose of all collected ground water in accordance with the Owner's discharge permits.

3.04 Restoration

A. Upon completion of dewatering activities, the Contractor must restore drainage channels, settling basins and sumps to the satisfaction of the Owner.

END OF SECTION 02650

SECTION 02700

GAS COLLECTION SYSTEMS

PART 1 - GENERAL

1.01 Scope

A. This work consists of modifying the existing gas collection system located on the south slope of the Closed Landfill and expanding the gas collection system into the Area 7/8 of the landfill.

The Owner will contract separately with a well driller to overdrill the gas wells as shown on the Drawings. The separate well driller will be responsible to remove required Closed Landfill cap materials to allow for overdrilling, remove spoils and obtain backfill materials from owner designated stockpiles.

B. The Contractor will be required to coordinate gas well and gas collection work with the Owner. Gas Collection system valves will only be opened/closed or adjusted by the Owner.

C. The Contractor will be responsible for construction and modification of the gas collection system components, installing the perforated and solid piping and backfilling the trenches as shown on the Drawings.

D. Definitions

1. Backfilling: is the placement and compaction of granular or embankment materials in areas shown on the Drawings.

2. Authorized excavation: is the excavation of material to the limits shown on the Drawings. It includes excavation of material considered unsuitable by the Project Engineer.

3. Unauthorized excavation: is excavation beyond the limits shown and not authorized by the Project Engineer.

E. Job Conditions

1. The Owner will supply the HDPE pipe, except that the Contractor is responsible for coordinating deliveries and stockpiling of these materials. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

2. The Contractor will be responsible to supply and install all pipe fittings.

3. The Contractor will coordinate all site activities with subcontractors and the Owner.

4. Contractor is responsible for protection of all above ground and below ground structures and utilities or wells, whether shown on the Drawings or not. Contractor will replace any damaged items due to the Contractor's operations.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Clearing, Grubbing and Stripping Topsoil: Section 02020

D, Dust Control and Work Area Maintenance: Section 02050

E. Embankment: Section 02200

F. Clay Liners: Section 02210

G. Geomembrane Liners: Section 02400

H. Leachate Collection Systems: Section 02500

I. Dewatering: Section 02650

J. Construction QA/QC Plan: Included with the Contract Documents

1.03 Submittals

A. At least two weeks prior to construction of gas piping, provide the following:

1. Quality control/quality assurance test reports in accordance with the applicable test standards outlined in this section and in the QA/QC Plan,

2. Shop drawings showing details of the pipe connections and other pertinent details and manufacturers written certification that the pipe complies with these specifications

3. The Contractor's proposed procedures, equipment (including a relationship between hydraulic carriage pressure and fusion pressure) and names of certified individuals who will be performing the fusion welding prior to welding. Documents such as "Qualification Procedures for making PE 3408 Polyethylene Heat Fusion Joints" by Plexco or "Heat Fusion Qualification Guide" by Driscopipe shall be consulted to develop the butt fusion procedure.

PART 2 - MATERIALS

2.01 Solid Gas Collection Pipes, Items 02701, 02703 and 02704

A. Each pipe section delivered to the site must be labeled to indicate the manufacturer, HDPE material type, size and SDR.

B. The solid gas collection pipes, Items 02701, 02703 and 02704, shall be 6-inch, 8-inch or 10-inch diameter high-density polyethylene (HDPE) pipes. The pipes shall have a standard dimension ratio (SDR) of 17 unless otherwise specified on the construction drawings. The pipes shall be of type PE3408 as manufactured by Phillips Driscopipe, Inc. or approved equivalent.

2.02 Perforated Gas Pipe, Item 02702

A. Each pipe section delivered to the site must be labeled to indicate the manufacturer, material type, size and SDR/Schedule.

B. The perforated gas collection pipe, Item 02702, shall be 8-inch diameter high-density polyethylene (HDPE) pipe or Schedule 80 PVC. The HDPE pipes shall have a standard dimension ratio (SDR) of 17. The HDPE pipes shall be of type PE3408 as manufactured by Phillips Driscopipe, Inc. or approved equivalent. Perforations shall be 5/8-inch diameter and shall be made in the pattern shown on the Drawings.

2.03 Gas Venting Geotextile, Item 02705

The gas venting geotextile, shall be a sixteen-ounce per square yard (or greater) nonwoven polypropylene fabric meeting the following minimum average values:

PROPERTY	REQUIREMENT
Mass/Unit Area oz/yd^2 (min)	16.0
Grab Strength lbs (min)	380
Elongation % (min)	50
Trapezoidal Tear lbs (min)	145
Puncture Resistance lbs (min)	240
Apparent Opening Size (U.S. Sieve Number Equivalent) (Max)	100

2.04 Gas Venting Strips, Item 02706

The gas venting strips, shall be a composite material of a formed polystyrene core surrounded on all sides by, and bonded to, a non-woven, needle punch filter fabric, meeting the manufacturer's specified values. The supplied and installed material shall be AkwaDrain as manufactured by American Wick Drain Corporation or approved equivalent.

PART 3 – EXECUTION

3.01 Gas Well Decommissioning

A. The gas wells shall be overdrilled to the depth and diameter shown on the Drawings.

B. The separate gas well driller shall remove the required Closed Landfill cap materials to allow for drilling. Temporary shutdown and capping of gas collection piping shall be coordinated with the Owner, prior to working on any gas well.

C. Overdrilling shall completely remove/destroy all rigid pipe materials within the specified depth.

D. The separate gas well driller is responsible to transport backfill materials, Drainage Stone (Item 02502), to the gas well for placement.

E. The separate gas well driller is responsible to transport all spoil materials from the overdrilled gas wells to the active landfill for disposal at the direction of the Owner. The Owner will compact the relocated waste.

3.02 Gas Venting Geotextile

A. Delivery, Storage and Handling

1. The geotextile shall be packaged and shipped by appropriate means so that no damage is incurred. During shipment and storage the geotextile shall be adequately protected at all times from puncture, abrasion, excessive heat or cold, degradation of the material, or other damaging or deleterious conditions in accordance with instructions from the Manufacturer and their warranty conditions

2. Materials shall be delivered only after the required submittals have been received and approved by the Project Engineer.

3. Appropriate handling equipment and techniques as recommended by the Manufacturer and approved by the Project Engineer shall be used. Handling, storage, and care of the geotextile prior to and following installation at the site is the responsibility of the geosynthetics contractor. The geosynthetics contractor shall be liable for all damages to the materials incurred prior to final acceptance of the geotextile by the Owner. Any geotextile damaged as a result of poor delivery, storage, or handling methods shall be repaired or replaced, as determined by the Project Engineer, at no additional cost to the Owner. At a minimum the rolls shall be stored in an area that is well drained and free of dust and mud and shall be covered with tarps to minimize damage due to the elements.

B. Site Condition

1. The geosynthetics contractor shall have completed the installation and acceptance of the gas venting strips prior to placement of the gas venting geotextiles.

2. The geosynthetics contractor shall take necessary precautions to prevent damage to underlying layers during placement of the geotextile. Geotextile shall only be place on surfaces that are smooth.

C. Deployment

1. The geotextile shall be protected from exposure to sunlight during transport and storage and at all times shall be kept clean.

2. The geotextile shall be deployed such that it lies smooth on the underlying surface, free of wrinkles folds and creases.

3. The geotextile shall be deployed to create a shingle effect on the landfill floor. The downslope sheet shall be overlapped by the sheet immediately upslope of it.

4. The geotextile shall be laid out in a staggered configuration such that the ends of adjacent sheets do not result in a continuous seam

5. The geosynthetics contractor shall deploy the geotextile in a controlled manner, allowing the geotextile roll to “free fall” down a slope is unacceptable.

6. At the time of deployment, the geotextile shall be inspected for defects, rips, holes, flaws deterioration or damage. Geotextile sheets having any of the referenced features shall be rejected and removed from the site at the Contractor’s expense.

7. The geosynthetics contractor shall employ placement methods to ensure that:

a. Placement of the geotextile over the textured geomembrane shall be completed by using a temporary rub sheet or similar method to limit friction between the materials and the development of tension in the geomembrane.

b. The prepared surface underlying the geotextile shall not be allowed to deteriorate after acceptance, and shall remain acceptable during and after geotextile placement.

c. All surfaces immediately underlying the geotextile must be kept clean and free of debris, including stones.

D. Seaming

1. All seams shall be made according to manufacturer's specifications. Seaming procedures shall be submitted for approval before beginning deployment of the geotextile material. Overlapped seams will be required to have at least 18 inches of overlap.

2. In general, seams shall be oriented parallel to the line of maximum slope (i.e., down, not across, the slope). In corners and odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seams shall be located on the berm side slopes or within 5 feet of the toe of the side slope. No seams shall be located in areas of potential stress concentrations.

E. Defects and Repairs:

1. The geotextile will be inspected before and after seaming for evidence of defects, holes, needles and any sign of contamination by foreign matter. The surface of the geotextile shall be clean at the time of inspection.

2. Repair Procedures:

a. The geosynthetics contractor shall repair any of the geotextile exhibiting isolated tears or puncture holes. The geosynthetics contractor must submit a repair procedure plan to the Project Engineer for approval.

b. At a minimum, the repair shall consist of an oval or round patch of the same geotextile that extends a minimum of 12 inches beyond the defect in all directions.

3. Repair Verification:

a. Each repair shall be numbered and logged.

4. The geotextile shall not be covered until it has been inspected and accepted by the Project Engineer.

F. Covering

1. At no time shall operation of vehicles or equipment be permitted directly on the geotextile.

2. Either the geosynthetics contractor or Contractor shall ballast the geotextile with sandbags to prevent displacement of the geotextile by wind. Such sandbags shall be installed during placement and shall remain on the geotextile until covered. Care shall be exercised when handling sandbags over the geotextile material, to prevent rupture or damage of the sandbags.

3. The Contractor shall protect the geotextile from being inundated with sediment laden stormwater. If sediment accumulates on the geotextile, the geotextile shall be washed to the satisfaction of the Project Engineer or replaced at the discretion of the Project Engineer.

4. The geotextile shall be covered within 30 days of deployment. If the geotextile is to remain exposed for over 30 days, UV blocking tarps or approved equivalents shall be used to protect the geotextile until cover soils are placed.

5. Wrinkles that form in the geotextile panel prior to covering shall be either repositioned or replaced to the satisfaction of the Project Engineer.

6. The Contractor will assist the Project Engineer whenever requested, to evaluate whether the geotextile has been damaged by placement of overlying materials. This may include excavation of overlying material to allow evaluation of the geotextile.

7. The geotextile will be rejected if during or after installation, any defects, holes, flaws or deterioration are detected. Rejected geotextile and any overlying materials shall be replaced by the geosynthetics contractor or Contractor at no additional expense to the Owner.

3.03 Gas Venting Strips (if specified)

A. The Manufacturer shall provide a certificate of compliance stating that the material provided meets the published values listed in the manufacturer's material cut sheet.

B. Gas Venting Strips shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations.

C. Gas Venting Strips will be joined as specified by the manufacturer, or as approved by the Project Engineer.

D. The Gas Venting Strips shall be placed and anchored on a prepared surface approved by the Project Engineer, prior to the installation of the Gas Venting Geotextile.

E. At the time of installation, Gas Venting Strips shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage. The subgrade to receive Gas Venting Strips shall be prepared to a relatively smooth condition free of protruding materials, depressions, debris or any other unsuitable conditions and must be approved by the Project Engineer prior to placement.

F. Where applicable, Gas Venting Strips shall be anchored in place as necessary to keep the Gas Venting Strips from displacing during installation of the Gas Venting Geotextile.

6. The Gas Venting Strips shall be protected at all times during construction from damage resulting from sunlight, excessive surface water, construction traffic, improper installation procedures, or any other condition which can result in damage to the fabric. Gas Venting Strips found to be damaged as a result of improper construction procedures or inadequate protection, shall be replaced by the geosynthetics contractor or Contractor at no additional expense to the Owner.

3.04 Pipes

A. Gas system piping shall be installed to the lines and grades shown on the Drawings, subject to the tolerance in these specifications.

B. All pipes shall be surveyed prior to backfilling by the Contractor's surveyor and the QA/QC surveyor.

C. Pipe shall be handled and assembled in accordance with manufacturer's recommended procedures.

D. HDPE pipe shall be joined using butt fusion or electro-fusion welding techniques in accordance with manufacturer's recommendations and approved by the Project Engineer. The Project Engineer will observe the fusion welding of the pipe ends and will reject welds that do not conform to the manufacturer's recommendations. The Project Engineer reserves the right to submit sample joints to an independent laboratory for testing and to disqualify either welders, equipment or welding procedures that in the opinion of the Project Engineer are not suitable. Any defective welds will be repaired by the Contactor at no additional expense to the Owner.

E. Pipes shall be welded as close to the installation area as practical, dragging long lengths of welded pipe across the construction area is not permitted. If during movement or placement of the pipes, scratches or gouges occur, the Project Engineer will evaluate any

damage caused to the pipes. Damages exceeding 10% of the wall thickness will require removal and replacement of the pipe by the Contractor at no additional cost to the Owner.

F. Drainage stone (Item 02502) shall be placed around and over the perforated pipes as shown on the Drawings. The backfill shall not be dropped from a height of more than one foot. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

G. Pipe bedding material (Item 02203) shall be placed around and over the solid pipes as shown on the Drawings. The backfill shall not be dropped from a height of more than one foot. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

H. The Contractor shall protect the pipes from damage at all times during and after installation. No equipment will be allowed to operate on the pipe unless there is sufficient cover material on the pipe to prevent damage to the pipe. At least three feet of cover material is required over the pipe prior to driving haul trucks over the pipe.

I. The Contractor will assist the Project Engineer whenever requested, in evaluating potential damage to the pipes. At a minimum, the pipe will be exposed and evaluate in the location of haul roads. This will include excavation of overlying backfill materials to expose the pipe prior to completion of construction. Any damaged pipe will be replaced at no additional expense to the Owner.

END OF SECTION 02700

SECTION 02800

STORM WATER MANAGEMENT

PART 1 – GENERAL

1.01 Scope

A. The stormwater management system consists of constructing permanent and temporary basins, downchutes, channels, culverts and drainage pipes with their respective linings to prevent erosion.

B. The construction of the channels will be completed during the embankment phase, berm cap placement, or the final cover phase of the project as shown on the Drawings. Materials and placement procedures for embankment and clay materials are discussed in Section 02200 and 02210 of these specifications.

C. Definitions

1. Backfilling: is the placement and compaction of granular or embankment materials in areas shown on the Drawings.

2. Authorized excavation: is the excavation of material to the limits shown on the Drawings. It includes excavation of material considered unsuitable by the Project Engineer.

3. Unauthorized excavation: is excavation beyond the limits shown and not authorized by the Project Engineer.

D. Job Conditions

1. The Owner will supply the HDPE pipe and rip-rap stone except that the Contractor is responsible for coordinating deliveries and stockpiling of these materials. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

2. The Contractor will coordinate all site activities with subcontractors and the Owner.

3. Contractor is responsible for protection of all above ground and below ground structures and utilities or wells, whether shown on the Drawings or not. Contractor will replace any damaged items due to the Contractor's operations.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Clearing, Grubbing and Stripping Topsoil: Section 02020

D. Dust Control and Work Area Maintenance: Section 02050

E. Haul Road Construction: Section 02100

F. Embankment: Section 02200

G. Clay Liners: Section 02210

H. Dewatering: Section 02650

I. Vegetative Measures for Erosion and Sediment Control: Section 02900

J. Structural Measures for Erosion and Sediment Control: Section 02910

K. Construction QA/QC Plan: Included with the Contract Documents

L. SWPPP for Stormwater Discharges Associated with Industrial Activities: Included with the Contract Documents

PART 2 – MATERIALS

2.01 HDPE Drainage Pipe, Item 02801:

A. Drainage culverts shall be high-density polyethylene (HDPE) pipe as shown on the Drawings. The culverts shall consist of corrugated exterior polyethylene pipe with a smooth interior wall. Culvert diameters are as shown on the Drawings.

B. Smooth interior wall polyethylene pipe shall meet the requirements stated in AASHTO M294 for Type S pipe.

C. Culverts shall be equipped with drop inlets and flared end sections upon installation as shown on the Drawings.

2.02 Rip-Rap Stone, Item 02802:

A. The erosion protection stone shall consist of crushed stone or screened gravel meeting the material requirements in NYSDOT Section 620 and sizes as shown on the Drawings.

2.03 Subsurface Drainage Collection Pipes, Item 02803:

A. Each pipe section delivered to the site must be labeled to indicate the manufacturer, HDPE material type, size and SDR.

B. The drainage collection pipe Item 02803 shall be 6-inch diameter perforated, high-density polyethylene (HDPE) pipe, respectively. The pipe shall have a standard dimension ratio (SDR) of 17. The pipe shall be of type PE3408 as manufactured by PolyPipe, Inc. or approved equivalent. Perforations shall be 3/8-inch diameter and shall be made in the pattern shown on the Drawings.

PART 3 – EXECUTION

3.01 Drainage Pipes and Culverts

A. Stormwater drainage pipes, catch basins and culverts shall be installed to the lines and grades shown on the Drawings, subject to the tolerance in these specifications.

B. Pipe shall be handled and assembled in accordance with manufacturer's recommended procedures.

C. The pipes shall be installed as shown on the Drawings. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

D. HDPE pipe shall be joined using butt fusion or electro-fusion welding techniques in accordance with manufacturer's recommendations and approved by the Project Engineer. The Project Engineer will observe the fusion welding of the pipe ends and will reject welds that do not conform to the manufacturer's recommendations. The Project Engineer reserves the right to submit sample joints to an independent laboratory for testing and to disqualify either welders, equipment or welding procedures that in the opinion of the Project Engineer are not suitable. Any defective welds will be repaired by the Contactor at no additional expense to the Owner.

E. Pipes shall be welded as close to the installation area as practical, dragging long lengths of welded pipe across the construction area is not permitted. If during movement or placement of the pipes, scratches or gouges occur, the Project Engineer will evaluate any damage caused to the pipes. Damages exceeding 10% of the wall thickness will require removal and replacement of the pipe by the Contractor at no additional cost to the Owner.

F. Drainage stone (Item 02502) shall be placed around and over the perforated pipes as shown on the Drawings. The backfill shall not be dropped from a height of more than one

foot. Care shall be taken so that the alignment or grade of the pipe is not altered by placement of the backfill material.

G. The Contractor shall protect the pipes from damage at all times during and after installation. No equipment will be allowed to operate on the pipe unless there is sufficient cover material on the pipe to prevent damage to the pipe.

H. The Contractor will assist the Project Engineer whenever requested, in evaluating potential damage to the pipes. At a minimum, the pipe will be exposed and evaluated. This will include excavation of overlying backfill materials to expose the pipe prior to completion of construction. Any damaged pipe will be replaced at no additional expense to the Owner.

3.02 Rip-Rap Stone Installation

A. Rip-Rap stone shall be placed in one lift to the lines and grades shown on the Drawings. Stone shall be placed in the manner specified in NYSDOT Standard Specifications Section 620. The stone shall be placed in a manner that avoids segregation. Smaller stone shall be chinked into voids to provide a relatively smooth stable surface.

3.03 Drainage Channels

A. Stormwater channels shall be installed to the lines and grades shown on the Drawings, subject to the tolerance in these specifications.

B. Channel protection shall be installed in accordance with Section 02900 of these specifications.

C. Stormwater channels will be connected to the existing stormwater drainage pipes or channels as shown on the Drawings, additional pipe, fittings and grates will be provided by the Owner.

3.04 Downchutes

A. Downchutes shall be installed to the lines and grades shown on the Drawings, subject to the tolerance in these specifications.

B. As shown on the Drawings, Rip-Rap lined downchutes shall be constructed by placing a layer of 60 mil textured HDPE (Item 02401) geomembrane over a geocomposite gas venting layer on top of prepared subgrade surfaces followed by a geocomposite drainage layer and a barrier protection layer prior to installing the specified rip-rap stone.

3.05 Stormwater Basins

A. Stormwater basins shall be installed to the lines and grades shown on the Drawings, subject to the tolerance in these specifications.

B. As shown on the Drawings, the bottom pond liner system for the stormwater basins shall be constructed by placing a low permeability pond liner soil over prepared subgrade surfaces prior to installing the specified rip-rap stone. The sideslope pond liner system for the stormwater basins shall be constructed by placing a low permeability pond liner soil over prepared subgrade surfaces prior to placement of topsoil.

C. As shown on the Drawings, the emergency spillway for the stormwater basins shall be constructed by placing a geotextile over prepared subgrade surfaces prior to installing the specified rip-rap stone.

END OF SECTION 02800

SECTION 02900

VEGETATIVE MEASURES FOR EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 Scope

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to provide vegetative measures for erosion and sediment control and site landscaping. Work will include applying topsoil, fertilizer, and seed. The Contractor shall not disturb previously landscaped areas, areas requiring disturbance will be replaced as required by the Owner and in accordance with the Drawings.

B. Fall planting of grass seed is preferred, between September 1, and November 1. For spring planting, planting can begin when ground conditions are suitable, but no later than June 1. Summer planting may be necessary and may require irrigation to establish the seed.

C. The Contractor shall supply and install all of the required seed mixtures with a minimum two-year warranty.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Clearing, Grubbing and Stripping Topsoil: Section 02020

E. Haul Road Construction: Section 02100

F. Embankment: Section 02200

G. Material Processing: Section 02205

H. Clay Liners: Section 02210

I. Dewatering: Section 02650

J. Stormwater Management: Section 02800

K. Structural Measures for Erosion and Sediment Control: Section 02910

L. Construction QA/QC Plan: Included with the Contract Documents

M. SWPPP for Stormwater Discharges Associated with Industrial Activities: Included with the Contract Documents

1.03 Reference Standards

A. All work for this section shall be performed in accordance with the "New York Standards and Specifications for Erosion and Sediment Control" dated November 2016 (i.e., Guidelines). The Guidelines are incorporated herein by reference.

1.04 Submittals

A. The Contractor is required to submit the following:

1. Manufacturer's Certificate of Compliance for seed mix.

2. Procedure for applying vegetative stabilization.

3. Seeding and Fertilizing Schedule.

1.05 Warranty/Monitoring

A. Warranty all seeding and plants for a period of two years from date of final acceptance of work. During the two-year warranty period the Contractor shall replace grass areas, which have died, or are in the process of dying and reseed with appropriate mixtures as necessary.

B. Replacement and Damages:

1. Decisions of the Project Engineer and Owner for required replacements shall be conclusive and binding upon the Contractor.

2. The Contractor is responsible for repairing damage to property also caused by defective workmanship and materials.

C. Exclusions:

1. The Contractor is not liable for replacement costs of plants damaged by deicing compounds, fertilizers, pesticides or other materials not specified in the Contract Documents or not applied by the Contractor or under the Contractor’s supervision, by relocating or removal by others, by acts of God, or by vandalism.

1.06 Replacements

A. Grass, which dies or requires replacement for other reasons during the two-year warranty period, shall be replaced as soon as possible during the following acceptable planting season.

1. Spring Replacement Season: All grass – when ground becomes workable and water levels have receded, no later than June 1.

2. Fall Replacement Season: September 1 to November 1.

3. Procedure: Rework existing topsoil in replacement areas, apply seed and amendments in accordance with these specifications, restore the areas damaged by these operations to original conditions, notify the Project Engineer after completing the work, the Project Engineer will inspect the areas for final acceptance.

PART 2 – MATERIALS

2.01 Topsoil, Item 02901

A. Topsoil shall be obtained from the onsite stockpiles or supplied by the Owner at an approved offsite location. The Contractor will be responsible for coordinating deliveries and stockpiling of the topsoil. Stockpiles will be placed in approved areas designated by the Project Engineer and Owner.

B. Topsoil supplied from an offsite source shall meet the following criteria:

1. Topsoil shall have at least 2 percent and no greater than 6 percent by weight of fine textured stable organic material. Muck soil shall not be considered topsoil.

2. Topsoil shall have at least 20 percent fine textured material (passing the No. 200 sieve) and not more than 15 percent clay.

3. Topsoil treated with soil sterilants or residual herbicides shall not be allowed.

4. Topsoil shall be relatively free of stones over 1-1/2 inches diameter, trash, noxious weeds such as nutsedge and quackgrass, and will have less than 10 percent gravel by volume.

5. Topsoil containing soluble salts greater than 500 ppm shall not be used.

6. Topsoil and compost stockpiled at the site may be made available to the Contractor by the Owner. It shall be the Contractor's responsibility to verify that any such materials made available to the Contractor by the Owner meet all of the requirements of this Section and are suitable for use in the intended application.

7. Topsoil shall not be delivered to the site or used while in a frozen or muddy condition. Topsoil as delivered to the site shall have a pH between 6.0 and 7.0. Lime shall be applied and incorporated with the topsoil as indicated by testing and as directed by the Owner before the topsoil is delivered to the working area.

2.02 Fertilizer, Item 02902

A. Fertilizer shall be standard commercial grade fertilizer meeting the requirements of all State and Federal regulations and standards of the Association of Office Agricultural Chemists. Fertilizer shall be delivered to the site in original, properly labeled, unopened, clean, containers each showing the manufacturer's guaranteed analysis conforming to applicable fertilizer regulations and standards. Fertilizer shall be 5N-10P-10K, unless otherwise specified in the Contract Documents.

2.03 Seed, Item 02903

A. Seed shall be labeled in accordance with USDA Rules and Regulations under the Federal Seed Act and applicable State seed laws. Seed shall be furnished in sealed bags or containers bearing the date of the last germination, which date shall be within a period of 6 months prior to commencement of seeding operations. No seed shall be used unless properly labeled and no seed shall be used after its date of expiration. Seed shall be from same or from the previous year's crop; each variety of seed shall have a purity of not less than 85%, a percentage of germination not less than 80%, shall have a weed seed content of not more than 1% and contain no noxious weeds. The above percentages are by weight.

B. The seed shall be furnished and delivered premixed in the proportions specified in Section 2.03(D) below. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer for each seed mix. These certificates shall include the guaranteed percentages of purity for each type of seed in the mix, weed content, and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates.

C. Seed for temporary seedings shall be annual or perennial ryegrass applied at a rate of 30 lbs. per acre or 0.7 lbs. per 1,000 ft^2. For Temporary Seedings in October or November, use certified Aroostook winter rye, applied at a rate of 100 lbs. per acre or 2.5 lbs. per 1,000 ft^2.

D. Seed mix for permanent seedings shall be:

Common white clover	8 lbs/acre
Tall fescue	20 lbs/acre
Perennial Ryegrass	5 to 10 lbs/acre

2.04 Mulch, Item 02904

A. Mulch shall consist of small-grain straw anchored with wood fiber unless otherwise noted.

B. Straw mulches shall not contain sticks larger than 1/4-inch diameter or other materials which could prevent matting during application. No straw mulch shall be used within 48 hours after cutting. Straw, hay, and salt hay shall be free from mold and other objectionable material and shall be in an air-dry condition suitable for placing with mulch blower equipment.

C. Wood fiber mulch for anchoring shall be wood cellulose processed into a uniform fibrous physical state. Wood cellulose fiber shall contain a green dye that will provide easy visual inspection for uniformity of the slurry spread. The wood cellulose fiber, including dye, shall contain no growth or germination-inhibiting properties. It shall be manufactured in such a manner that, after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogeneous material. When sprayed over straw mulch, the material shall allow absorption and percolation of moisture. The manufacturer shall submit a certificate that the wood cellulose fiber meets the following requirements:

Quantity	Specification Limit
Particle Length	0.375 inch maximum
Particle Thickness	0.047 inch maximum
Net Dry Weight Content	minimum stated on bag
pH	4.0 to 8.5

Quantity	Specification Limit
Ash Content	1.6% maximum
Water Holding Capacity	90% minimum

The material shall be delivered in packages of uniform weight and bear the name of the manufacturer, the net weight, and a supplemental statement of net weight content.

D. Alternative mulches and anchoring materials meeting the requirements of the Guidelines may be substituted, subject to approval by the Owner.

2.05 Class C Vegetation, Item 02905

A. Drainage channels indicated on the Drawings as having vegetative linings shall be seeded and mulched using the materials described in Section 2.03 and 2.04 of this specification, except that the seed mixture shall be:

Common white clover	8 lbs/acre
Tall fescue	20 lbs/acre
Birdsfoot Trefoil	8 lbs/acre
Redtop	2 lbs/acre

PART 3 – EXECUTION

3.01 Application

A. For all areas to be permanently seeded, the following steps shall be implemented.

1. Topsoil shall be applied as specified in 3.02(A), below.

B. Fertilizer (5N-10P-10K) shall be applied at a rate of 600 pounds per acre. Fertilizer shall be disked into soil surfaces to a depth of 6 to 12 inches.

1. Seed shall be applied at the rate specified in Section 2.03 and 2.05.

2. Mulch will be applied at a rate of 4,000 lbs/acre on 3H:1V or steeper slopes. Also, lime will be applied, if needed, at the rates determined by the Owner based on results of soils tests.

3. As an alternative to seeding and mulching, hydroseeding may be performed using mixture of seed (at previously defined application rates) and wood fiber cellulose (at a rate of 2000 pounds per acre). The wood cellulose fiber shall be mixed with water at a maximum rate of 50 pounds of wood cellulose fiber per 100 gallons. The Contractor is responsible for cleaning all structures and paved areas of unwanted deposits of the hydroseed mixture.

C. For all areas to be temporarily seeded, the same steps shall be implemented except that neither topsoil nor fertilizer shall be used and the seed mix presented in Section 2.03(C) shall be used.

3.02 Installation

A. Where topsoil is required, it shall be applied as follows.

1. The Contractor shall maintain previously established grades, as shown on the Drawings in a true and even condition. Topsoil shall be placed to a minimum compacted depth of 6 inches on slopes greater than 4H:1V. All other areas to be permanently seeded shall have a minimum compacted thickness of 4 inches.

2. The subgrade shall be raked and all rubbish, sticks, roots, and stones larger than 1.5 inches shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with topsoil. Before placement of topsoil, all construction work in the immediate area shall have been completed.

3. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades, and elevations shown on the Drawings. No topsoil shall be spread in water or while frozen or muddy.

4. Lime shall be applied to topsoil in a preparation area at the rates indicated by soil testing to bring the topsoil pH to a range of 6.0 to 7.0. Lime may not be mixed with fertilizer for application. Lime shall be spread evenly throughout the topsoil.

5. All stiff clods, lumps, roots, litter and other foreign material shall be removed from the area and disposed of by the Contractor. All depressions caused by settlement shall be filled with additional topsoil and the surface shall be regraded until a smooth and even finished grade is created.

6. The Contractor shall maintain the specified depth of topsoil from the time it is placed until seeding and securing of the mulch are completed.

B. No seeding shall be done on frozen ground or when the temperature is 32°F or lower. Schedules for seeding and fertilizing must be submitted to the Owner for approval prior to beginning the work. Seeding shall be done within twenty-four hours following soil preparation. Mulch materials shall be applied on seeded areas within forty-eight hours after seeding.

C. Before seeding, all gullies, washes, or disturbed areas that develop subsequent to final dressing of topsoil shall be repaired. All areas shall be loosened by discing, harrowing, or other approved methods immediately prior to seeding. For areas flatter than 3 horizontal:1 vertical (3:1), the topsoil shall be loosened to a depth of 3 inches. For areas 3:1 and steeper, the topsoil shall be loosened to a depth of 1 inch.

D. In order to prevent unnecessary erosion of newly topsoiled and graded slopes and unnecessary siltation of drainage ways, the Contractor shall carry out permanent seeding and mulching within 1 day after and as soon as a portion of the project has been

satisfactorily completed and/or as directed by the Project Engineer. Also, temporary mulching shall be installed over disturbed surfaces that have not been constructed to final grades and have been inactive for 10 days, except for slopes steeper than 3H:1V, which shall receive temporary seeding and mulching after 2 days of inactivity. When protection of newly topsoiled and graded areas is necessary at a time which is outside of the normal seeding seasons, the Contractor shall protect those areas by whatever means necessary, as approved by the Project Engineer, and shall be responsible for prevention of siltation in the areas beyond the limit of work.

3.03 Maintenance and Provisional Acceptance

A. The Contractor shall keep all seeded areas watered and in good condition, reseeding all seeded areas if and when necessary until a good, healthy, uniform growth is established over the entire area seeded. The Contractor shall maintain all temporarily seeded areas in an approved condition throughout the project and shall maintain permanently seeded areas for a period of one calendar year after the date of Owner's acceptance of the work.

B. The permanently seeded and fertilizer areas will be inspected to verify that the grass has successfully been established based on the following criteria.

1. No bare spots exist larger than one square foot.
2. No more than 5 percent of total area has bare spots.

Any areas not meeting these criteria shall be reseeded and/or refertilized by the Contractor at no extra cost to the Owner until all seeded areas meet these criteria.

END OF SECTION 02900

SECTION 02910

STRUCTURAL MEASURES FOR EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 Scope

A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, installation equipment, and incidentals required to provide erosion control during construction as specified herein and as shown on the Contract Drawings.

B. Job Conditions

1. The work shall include temporary erosion control (i.e., until vegetation has been established at the site) for those areas shown on the Contract Drawings and all areas disturbed by the Contractor. Work involves installation of silt fences, straw bales, stockpile erosion control and temporary stormwater drainage swales as shown on the Contract Drawings.

1.02 Related Work Specified Elsewhere

A. Lines and Grades: Section 01050

B. Quality Assurance/Quality Control: Section 01400

C. Dust Control and Work Area Maintenance: Section 02050

D. Clearing, Grubbing and Stripping Topsoil: Section 02020

E. Haul Road Construction: Section 02100

F. Embankment: Section 02200

G. Material Processing: Section 02205

H. Clay Liners: Section 02210

I. Dewatering: Section 02650

J. Stormwater Management: Section 02800

K. Vegetative Measures for Erosion and Sediment Control: Section 02900

L. Construction QA/QC Plan: Included with the Contract Documents

M. SWPPP for Stormwater Discharges Associated with Industrial Activities: Included with the Contract Documents

1.03 Reference Standards

A. All work for this section shall be performed in accordance with the "New York Standards and Specifications for Erosion and Sediment Control" dated November 2016 (i.e., Guidelines). The Guidelines are incorporated herein by reference.

1.04 Submittals

A. The Contractor is required to submit the following:

1. Manufacturer's certification test data and installation requirements for silt fence.

2. Manufacturer's certification test data and installation requirements for Geosynthetic Erosion Protection Mat.

PART 2 – MATERIALS

2.01 Silt Fence, Item 02911:

A. Silt fence fabric shall be woven geotextile having the following properties:

Property	**Typical Average Values**
Grab Strength (lbs)	100
Grab Elongation (%)	30 (max.)
Trapezoidal Tear Strength (lbs)	65
Mullen Burst Strength (psi)	210
Permittivity (sec^{-1})	0.1
AOS (U.S. Sieve No. Equivalent)	35
Ultraviolet Stability (%)	90

2.02 Straw Bales, Item 02912:

A. Straw bales may be used by the Contractor in place of silt fence at Contractor's request. Straw bales shall consist of undecayed firmly-packed straw or hay, nominal size of 14 inches to 18 inches by 36 inches as prepared by any standard hay bailing machine and firmly bound by at least 2 separate circuits of rope or band material which will withstand weathering for a minimum of 3 months.

2.03 Erosion Protection Stone, Item 02913:

A. The erosion protection stone shall consist of crushed stone or screened gravel meeting the material requirements in NYSDOT
B. Section 620 and sizes as shown on the Contract Drawings.

2.04 Geosynthetic Erosion Protection Mat, Item 02914:

A. Geosynthetic erosion protection blanket shall consist of a straw fiber matrix mechanically bound and covered on both sides by photodegradeable polypropylene netting such as North American Green S150 or covered on both sides by biodegradable jute netting such as North American Green S150BN. Equivalent products may be approved by the Project Engineer. Erosion matting shall be used as required and shall meet the Manufacturer's specifications and be approved by the Project Engineer prior to use.

PART 3 – EXECUTION

3.01 Installation

A. Silt fences shall be installed as shown on the Contract Drawings by securely fastening silt fence fabric to a woven wire fence fabric using wire ties. The silt fence fabric panels shall be installed loosely with adjacent panels overlapped a minimum of 12 inches.

B. Straw bales shall be installed as shown on the Contract Drawings in a row with ends tightly abutting. Each bale shall be embedded in the soil a minimum of 4 inches and placed so that the bale bindings are oriented horizontally.

C. Stockpile erosion control shall be installed as shown on the Contract Drawings with 10 feet benches where the vertical height of the stockpile exceeds 15 feet. Erosion protection stone shall be placed at low points in earth dike to serve as an outlet. Temporary seed and mulch shall be placed on stockpiles that will not be disturbed for more than 30 days

D. Temporary stormwater drainage swales shall be installed as shown on the Contract Drawings using erosion matting. Temporary stormwater drainage swales shall be sloped to direct runoff away from active landfill areas.

E. Erosion protection stone shall be placed in one lift to the lines and grades shown on the Contract Drawings. Stone shall be placed in the manner specified in NYSDOT Standard Specifications Section 620. The stone shall be place in a manner that avoids segregation. Smaller stone shall be chinked into voids to provide a relatively smooth stable surface.

F. Erosion protection stone shall be installed to form check dams in temporary and permanent drainage swales as shown on the Contract Drawings.

G. Erosion matting shall be installed in temporary and permanent drainage swales, and on disturbed slopes as shown on the Contract Drawings. Installation of mat shall be in accordance with the manufacturer's specifications.

H. Accumulated silt and debris shall be removed by the Contractor from behind the face of the silt fence when the silt deposits reach approximately one half the height of the fence or straw bale. Clogged or damaged fabric shall be immediately replaced at no additional cost to the Owner.

I. Installation of the erosion controls will be reviewed by the Project Engineer for compliance with the Specifications and Guidelines.

3.02 Provisions for Erosion Control during Construction

A. Contractor shall implement erosion control measures around all areas to be disturbed, to the satisfaction of the Project Engineer prior to disturbing ground. The Project Engineer will periodically inspect erosion control structures to confirm that Contractor is maintaining these features.

END OF SECTION 02910