

SECTION 02050 – DEMOLITION

PART 1 – GENERAL

1.01 GENERAL CONDITIONS

The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.

1.02 DESCRIPTION OF WORK

- A. Furnish all labor, materials and equipment necessary to accomplish all demolition and removal of existing structures as indicated on the plans, and as specified herein.
- B. Work shall include, but not be limited to the following:
 - 1. Demolish and remove existing chain link fence, posts, footings, and gates as shown on the Plans unless indicated to remain or relocated or as directed by the Construction Manager.
 - 2. Remove debris from within the existing concrete ditch to the extent indicated on the Plans. All debris removed from the existing concrete ditch shall remain on-site and placed atop the contaminated area within the existing fence line.
 - 3. If transite piping is encountered at the project site, the Contractor shall be responsible for removal and disposal in accordance with State and Federal regulations.
 - 4. Should the Contractor propose any demolition or removal of existing structures in addition to that shown in the Construction Drawings, he shall submit drawings for approval to the Construction Manager identifying said items ten (10) working days prior to the proposed commencement of such action, along with justifications for their demolition or removal. The Contractor shall submit for Construction Manager's review, erosion control measures employed during demolition and construction.
 - 5. The Contractor shall exercise extreme caution and comply with all OSHA and State of Hawaii Occupational Safety and Health Law (HIOSH) requirements when working in the vicinity of hazardous substances. All removed improvements shall be disposed off-site by the Contractor at his expense in compliance with all regulatory agency requirements.

1.03 RELATED SECTIONS

- A. SECTION 02120 – ENVIRONMENTAL PROCEDURES
- B. SECTION 02300 – GRADING

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 PREPARATION

A. Site Inspection:

Prior to any work in this Section, the Contractor shall inspect the entire site and verify with the Construction Manager all objects designated to be removed and to be preserved.

B. Scheduling:

1. Prior to starting work, the Contractor shall submit a plan and list of procedures for performing the demolition and removal work. The plan shall be approved by the Construction Manager.
2. Procedures shall include provisions for safe conduct of the work, removal, disposition of items to be salvaged, protection of property to remain, coordination with other work, timely disconnection of utilities, and a schedule of the sequence of operations.

C. Protect all existing items to remain. Any damage to existing facilities to remain shall be repaired to original or better condition and to the satisfaction of the Construction Manager by the Contractor at his expense.

D. Protect all existing items to be removed and/or salvaged. Coordinate removal, delivery times, and locations with the Construction Manager.

E. Remove debris from within the existing concrete ditch to the extent indicated on the Plans. All debris removed from the existing concrete ditch shall remain on-site and placed atop the contaminated area within the existing fence line and compacted in accordance with SECTION 02300 – GRADING.

F. Demolish existing items identified on plans completely. Demolition of chain link fences and gates shall include demolition and removal of concrete footings, posts, and other appurtenances in their entirety. Use such methods as required to complete the work within the limitations of governing regulations.

G. Use only suitable excavated material or imported borrow material approved by the Construction Manager for filling any areas exposed by demolition.

H. During demolition, keep work wetted down thoroughly to prevent dust and dirt from creating nuisance conditions. Clean adjacent structures and objects of all dust, dirt and debris resulting from demolition operations, as directed by the Construction Manager.

- I. Remove all debris resulting from demolition work (excluding debris removed from the concrete ditch) from the site as soon as possible. Debris shall be removed and transported in a manner that will prevent spillage on streets or adjacent areas.

END OF SECTION

SECTION 02100 – SITE PREPARATION

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.

1.02 DESCRIPTION OF WORK

Furnish all labor, materials and equipment necessary to clear and grub the entire construction area; to accumulate and dispose of all debris and waste materials; to lay out the entire work; all as shown on the Plans and as herein specified.

1.03 RELATED SECTIONS

- A. SECTION 02120 – ENVIRONMENTAL PROCEDURES
- B. SECTION 02230 – CLEARING AND GRUBBING
- C. SECTION 02300 – GRADING

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 GENERAL

- A. Conditions of Premises: The Contractor shall examine the site and become familiar with the existing conditions and the amount and kind of work to be performed.
- B. Permits: The Contractor shall obtain and pay for necessary permits prior to the commencement of work.
- C. Maintenance of Traffic: The Contractor shall conduct operations with minimum interference to adjacent roads.
- D. Public Safety: When necessary, the Contractor shall provide and erect barriers, etc., with special attention to protection of persons working in adjacent areas.
- E. Protection: Throughout the progress of the work, protection shall be provided for all property and equipment, and temporary barricades shall be provided as necessary. Work shall be done in accordance with the safety provisions of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, and the State of Hawaii's Occupational Safety and Health Standards, Rules and Regulations.
- F. Fires: No burning of fires of any kind will be allowed.

- G. Reference Points: Permanent and temporary bench marks, etc., shall be carefully maintained, but if disturbed or destroyed, shall be replaced as directed, at the Contractor's expense.
- H. Disposal: All materials resultant from operations under this Section shall become the property of the Contractor and shall be removed from the site at his expense. Loads of materials shall be trimmed to prevent droppings.

3.02 EXISTING UTILITIES AND STRUCTURES

The topographic survey did not identify any existing underground utility lines or structures within the project area. Should any underground utility line or structure such as cesspools, cisterns, tunnels, septic tanks, wells, pipelines, or other structures not shown on the drawings be encountered during construction, the Contractor shall immediately notify the Construction Manager of such discovery. The Construction Manager shall then investigate and issue instructions for the preservation or disposition of the unknown line or structure. Authorization for extra work shall be issued by the Construction Manager only as he deems necessary.

3.03 CLEAN UP OF PREMISES

Clean up and remove all debris accumulated from operations from time-to-time or as directed by the Construction Manager. Upon completion of the construction work and before final acceptance of the contract work, remove all surplus materials, equipment, etc., and leave entire job site to the satisfaction of the Construction Manager.

END OF SECTION

SECTION 02120 – ENVIRONMENTAL PROCEDURES

PART 1 – GENERAL

1.01 SITE SUMMARY

The East Kapolei Pesticide Mixing and Loading site was previously used for mixing, storing, and loading of pesticides for the commercial cultivation of sugarcane which ended approximately in 1994. Currently, the East Kapolei site is vacant and surrounding areas are leased for commercial cultivation of diversified fruit and vegetable crops.

Under Section 11-451-15(k) of the State Contingency Plan for remedial actions, an environmental investigation of the site was conducted and the presence of elevated arsenic, dioxins/furans, pentachlorophenol, and triazine pesticides were identified in the soils that may present an endangerment to human health and the environment. In addition, transite piping is likely to be present.

The proposed site grading and installation of engineering controls such as 60-mil geomembrane liner and low permeability soil layers will address the contaminated soils on the site. Contaminated soil will be effectively isolated from direct human contact and the geomembrane liner will prevent downward migration of storm water through the contaminated soils, eliminating the primary mechanism for contaminant leaching from the soil.

For the purpose of this project, the soils within the project site are classified as one of the following contamination levels:

- Level 1 contamination (slight): soils outside of the existing chain link fence area
- Level 2 contamination (moderate): soils along the perimeter within existing chain link fence area
- Level 3 contamination (high): soils near the middle of the existing chain link fence area

1.02 REFERENCES

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. Code of Federal Regulations (CFR):

29 CFR 126	Safety and Health Standards for Constructions
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.1000	Air Contaminants

29 CFR 1910.1020	Access to Employee Exposure and Medical Records
29 CFR 1910.1200	Hazard Communication
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards A
40 CFR 261	Identification and Listing of Hazardous Waste

B. State of Hawaii Administrative Rules:

HAR 11-54	Water Quality Standards
HAR 11-55	Water Pollution Control
HAR 11-58.1	Solid Waste Management
HAR 11-59	Ambient Air Quality Standards
HAR 11-60-1	Air Pollution Control
HAR 11-260	General Provisions
HAR 11-261	Identification and Listing of Hazardous Waste
HAR 11-273	Standards for Universal Waste Management
HAR 11-280	Public Information
HAR 11-451	State Contingency Plan

C. Hawaii Revised Statutes:

HRS 128D	Environmental Response Law
HRS 342B	Air Pollution Control
HRS 342D	Water Pollution
HRS 342H	Solid Waste Pollution
HRS 342J	Hazardous Waste

1.03 RELATED SECTIONS

- A. SECTION 01100 – SUMMARY OF WORK
- B. SECTION 01330 – SUBMITTAL PROCEDURES
- C. SECTION 01700 – EXECUTION

D. SECTION 02370 – EROSION AND SEDIMENTATION CONTROL

1.04 DEFINITIONS

Contractor: The individual and/or legal entity and its subcontractors and employees of the Contractor and subcontractor awarded the Contract.

1.05 DESCRIPTION OF WORK

- A. The work includes subgrade preparation, grading, and capping the contaminated soils with clean imported material and grassing. In areas with highest concentrations of contamination, a high-density polyethylene (HDPE) geomembrane liner and geotextile fabric will be installed to provide a primary barrier against storm water infiltration through the contaminated soil, therefore preventing migration of contaminants via soil leaching.
- B. Any construction activities that involve the disturbance of existing site soils and/or that may expose workers or the public to potentially contaminated soil shall fall within the Specifications provided herein.
- C. Suspected contaminants associated with long-term exposure hazards at the various sites within the project area include, but are not limited to, arsenic, dioxins/furans, pentachlorophenol, and triazine pesticides. In addition, transite piping is likely to be present.
- D. An existing concrete ditch is located adjacent to the contaminated site. Debris within the ditch shall be assumed to be contaminated and shall be handled in accordance with the Plans and these Specifications.

1.06 SUBMITTALS

The following submittals shall be provided to the Construction Manager a minimum of 10 working days prior to commencement of site work. The procedure for making submittals shall be as determined by the Construction Manager.

- E. Site Safety and Health Plan: Contractor shall submit a Site-specific Safety and Health Plan (SSHP) for review and approval prepared in accordance with 29 CFR 1910.120, covering protection of workers and the general public from potential hazards associated with the handling and/or disturbance of contaminated soil. Specific protection requirements shall be included in the SSHP and, at a minimum, as specified herein.
- F. Contaminated Soil Handling and Management Plan: Contractor shall submit a Contaminated Soil Handling and Management Plan for review and approval describing the tasks, sequence of operations, controls, and procedures. At a minimum, the Contaminated Soil Handling and Management Plan should address the following:
 - 1. Identification of activities that may disturb existing soils and generate potential exposure hazards to workers and/or the general public.

2. Description of equipment and personnel that will be utilized for soil disturbance activities.
 3. Identification of controls to be implemented to prevent exposures to the general public, including a description of area air monitoring activities and the entity that will be responsible for conducting such activities.
 4. Identification of controls to be implemented to prevent contaminated soil from leaving the site through tracking off vehicle tires, storm water runoff, and/or other routes of migration.
 5. Identification of temporary stockpile locations and preventative measures to be used to minimize and/or eliminate the potential for cross-contamination (i.e., temporary stockpiles will not be placed on clean, imported fill material or paved surfaces that will remain).
 6. Description of procedures for equipment decontamination and frequency of decontamination.
 7. Description of procedures to be implemented in the event of a spill or release of hazardous materials or environmental contaminants caused by the Contractor during site operations.
- G. Training Certification: Submit certificates for review to Construction Manager, ensuring that employees have received appropriate training for work being performed.
- H. Training: Employees that encounter contaminated soil must have completed 40-hour Hazardous Waste Operations and Emergency Response Health and Safety Training (which satisfies OSHA 29 CFR 1910.120) and have current annual 8-hour refresher course certifications.
- I. Summary Report: Prepare summary report providing a detailed description of the work completed, progress photographs, air monitoring results, and documentation of any waste that was transported off the site for disposal no more than 10 working days after completion of contaminated soil handling activities.

1.07 NOTIFICATION

Contact the Construction Manager at least 3 working days prior to starting any onsite work.

PART 2 – EQUIPMENT

2.01 PERSONAL PROTECTIVE EQUIPMENT (PPE)

- A. Protective Clothing: The Contractor shall be responsible for furnishing personnel involved in handling of contaminated soil with protective covering. The level of protective clothing shall be specified in the SSHP.

- B. Respiratory Protection: The Contractor shall be responsible for furnishing personnel involved in handling of contaminated soil with appropriate respiratory protection in accordance with applicable OSHA standards. The types of respiratory protection shall be specified in the SSHP.

PART 3 – EXECUTION

3.01 PERMITS

The Contractor shall be responsible for obtaining applicable permits associated with soil handling activities that have not otherwise been obtained by DHHL.

3.02 PROTECTION OF WORKERS AND THE ENVIRONMENT

Protect workers and the environment from hazards in accordance with the SSHP, the construction best management practices (BMPs), and at a minimum, as specified herein:

- A. Training: Employees involved in handling of soil or any soil disturbance activities must have completed 40-hour Hazardous Waste Operations and Emergency Response Health and Safety Training (which satisfies OSHA 29 CFR 1910.120) and annual 8-hour refresher courses.
- B. Worker Safety: Workers shall wear and use PPE, as recommended by the SSHP. If PPE is not required, specify in the SSHP. Keep work footwear inside work area until completion of job. Have available one set of PPE required for use by Construction Manager for inspection of work. Do not carry out contaminated soil handling operations in confined spaces. Do not delay aid to a seriously injured worker for reasons of decontamination.
- C. Control Area: Establish a control area to prevent unauthorized entry of personnel. Demarcate work areas and provide 29 CFR 1910.145 signs at approaches and around perimeter. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering area. Allow only personnel briefed on the elements and trained as specified herein into the control area. Provide “No Smoking” signs as directed by the Construction Manager.
- D. Dust Control: Maintain strict dust control at all times to prevent dust particles from becoming airborne. Sprinkle or treat the soil at the site and other areas disturbed by operations with dust suppressants or water as necessary. A water truck should be on-site at all times to maintain dust control. Water used for dust control shall not be allowed to run-off onto public thoroughfares or into storm drainage systems.
- E. Vehicle Decontamination Measures: Establish and utilize vehicle decontamination measures described in the construction BMPs to prevent mud, dirt, rock, or sediment from being tracked beyond the Project site. Vehicle decontamination should also include any buckets, tracks, truck beds, tires, and other equipment that have come into contact with contaminated soils. Decontamination shall be performed prior to vehicles leaving the work area.

- F. Air Monitoring: At a minimum, air monitoring shall be conducted for at least three (3) full 8-hour shifts in each of the areas to establish a negative exposure assessment for worker's exposure to airborne contaminants during excavation or soil disturbance activities. The Contractor shall determine which contaminants are to be monitored to satisfy OSHA requirements and such information shall be included in the SSHP.

3.03 SOIL TESTING

Following excavation of the Level 1 (slightly-contaminated) soil, the Contractor shall notify the Construction Manager, who will arrange for additional testing of the soil for the presence of contaminants. The testing procedure may take up to two (2) months, during which the Contractor may not conduct any additional grading work.

3.04 SAFETY BARRIERS

Prior to beginning excavation work, the Contractor shall provide, erect, and maintain temporary safety barriers and security devices to reasonably prevent public entry into active work areas.

3.05 EXCAVATION/SOIL DISTURBANCE/SOIL HANDLING PROCEDURES

Notify the Construction Manager at least 3 working days prior to commencement of soil disturbance and handling activities. Use methods and equipment that result in minimal disturbance to remaining soil beyond the work limits and maintain strict dust control. The Contractor shall ensure that work at the site does not cause significant deterioration of existing air quality. Specifically, the Contractor shall ensure compliance with ambient air quality standards established in HAR 11-59 and shall comply with air pollution control requirements specified in HAR 11-60.1, at a minimum. The Contractor shall be responsible for conducting area air monitoring to detect potential air emissions from the property. If, at any time, area air monitoring indicates the presence of elevated contaminant concentrations at the property boundary, the Contractor will be required to take additional measures, at no additional cost to DHHL, to remedy the emissions to levels complying with all appropriate ambient air quality standards or to pre-established background levels identified by DHHL.

3.06 BACKFILLING EXCAVATIONS AND CAPPING SITE SOILS

Any excavations are to be backfilled with clean imported material as indicated on the Plans or in these Specifications. Contaminated site soils are to be kept on-site and shall not be transported off-site. All work must be performed in accordance with 29 CFR 1910.120. Further description of imported fill placement is provided in SECTION 02300 – GRADING.

3.07 INSPECTION

The soil remediation work may be inspected by the State Department of Health and/or the Environmental Protection Agency both during and after construction. The Contractor shall make arrangements directly with the appropriate agencies and/or DHHL to arrange for inspection of work and obtain the necessary approvals, prior to the completion date outlined in these specifications.

END OF SECTION

SECTION 02230 – CLEARING AND GRUBBING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.

1.02 DESCRIPTION OF WORK

Furnish all labor, materials and equipment necessary for removing and disposing of vegetative and unwanted material within the Project limits specified on the Plans. The Contractor shall clear the premises of all obstacles and obstructions, the removal of which will be necessary for the proper reception, construction, execution and completion of other work included in this Contract.

1.03 RELATED SECTIONS

- A. SECTION 01700 – EXECUTION
- B. SECTION 02120 – ENVIRONMENTAL PROCEDURES
- C. SECTION 02370 – EROSION AND SEDIMENTATION CONTROL

1.04 LIMITS

The limits of clearing and grubbing shall cover the entire site as needed to complete the Work as indicated on the Plans.

1.05 PRECAUTIONS

The Contractor shall protect from injury and damage all surrounding trees, plants, utilities, etc. Any damages to existing improvements shall be repaired or replaced by the Contractor at his expense to the satisfaction of the Construction Manager.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 VECTOR CONTROL

Prior to clear and grubbing, the contractor shall provide five (5) minimum days of a vector control program to abate, contain, eradicate, and suppress vector populations including mice and rats. The vector control program shall include the most humane methods possible including, but not limited to, baiting and trapping.

3.02 CLEARING

Unless indicated elsewhere in these Contract Documents, clear the natural ground of loose vegetative and unwanted material interfering with the proposed work. Vegetative material includes, but is not limited to, weeds, brush, roots, stumps, trees, logs, roots of downed trees, residue of agricultural crops, and grass. Unwanted material includes, but is not limited to, rubbish, lumber, utility poles, scrap metal, trash piles and other loose debris.

3.03 GRUBBING

- A. After clearing has been completed, the site shall be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557.
- B. Avoid overcompaction of the exposed subgrade above 95 percent compaction.
- C. Remove all large roots in excess of 2 inches in diameter, and backfill and compact the resulting depression.
- D. Completely remove stumps and roots and nonperishable solid objects. Backfill stump holes and other holes with structural material and compact according to SECTION 02300 – GRADING.

3.04 REMOVAL AND DISPOSAL OF MATERIAL

- A. All cleared or grubbed materials shall become the property of the Contractor and shall be hauled away from the site and disposed of by the Contractor at his expense to an authorized land disposal site.
- B. No burning to dispose of cleared or grubbed material will be permitted. No materials shall be dumped on private or public property without proper authorization.
- C. All soil originating from within the Project site shall be assumed to be contaminated and shall not be removed from the Project area.

END OF SECTION

SECTION 02300 – GRADING

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.
- B. All grading work shall be in accordance with (1) Chapter 14, Articles 13, 14, 15, and 16, as related to grading, soil erosion and sediment control, of the Revised Ordinances of Honolulu, 1990, as amended, (2) the Soils Report entitled, "Soils Investigation, Asphalt Pavement Cover, Former East Kapolei Pesticide Mixing and Loading Facility, Kapolei, Oahu, Hawaii," dated June 15, 2010, prepared by Hirata and Associates, Inc., and (3) "Gravel Cap Recommendations; Former East Kapolei Pesticide Mixing and Loading Facility Memorandums," dated November 1, 2010 and November 15, 2010, prepared by Hirata and Associates, Inc. including any amendments.
- C. All work shall be in accordance with SECTION 02120 – ENVIRONMENTAL PROCEDURES.
- D. The elevations provided on the drawings represent finish ground conditions. The Contractor shall adjust his work accordingly to account for the topsoil layer.
- E. Grading shall be carried to the lines and grades as shown on the Plans or as directed by the Construction Manager.
- F. All imported materials shall be entirely derived from clean, uncontaminated sources.

1.02 DESCRIPTION OF WORK

- A. Furnish all labor, materials and equipment necessary for earthwork as indicated on the Plans and specified herein.
- B. For the purpose of this project, the soils within the project site are classified as one of the following contamination levels:
 - 1. Level 1 contamination (slight): soils outside of the existing chain link fence area
 - 2. Level 2 contamination (moderate): soils along the perimeter within existing chain link fence area
 - 3. Level 3 contamination (high): soils near the middle of the existing chain link fence area

1.03 RELATED SECTIONS

- A. SECTION 02050 – DEMOLITION
- B. SECTION 02120 – ENVIRONMENTAL PROCEDURES

C. SECTION 02230 – CLEARING AND GRUBBING

D. SECTION 02370 – EROSION AND SEDIMENTATION CONTROL

E. SECTION 02630 – HIGH DENSITY POLYETHYLENE (HDPE) GEOSYNTHETIC LINER

F. SECTION 02631 – GEOTEXTILE

1.04 QUALITY ASSURANCE AND CODES

- A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory and paid for by the Contractor.
- B. Field Dry Density and Moisture Content Tests: Submit field test data sufficiently in advance of construction so as not to delay work. Furnish a drawing showing test locations, test numbers, and elevations. Submit test results within 3 days of test date. Field density tests shall be performed for subgrade of excavation for pavements, areas to receive fill, and backfill and fill lifts.
- C. Test for Moisture-Density Relations: Submit test results for each material at least 7 days prior to compacting of each material
- D. Testing and Reporting: The Contractor shall verify testing and reporting requirements with the Construction Manager and prior to the start of earthwork operations.

1.05 REFERENCE OF COMMERCIAL STANDARDS

ASTM D422	Standard Test Method for Particle-Size Analysis of Soils
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 kN-m/m ³))
ASTM D2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D5084	Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter

1.06 SUBMITTALS

- A. Test Reports: Submit test reports as directed by the Construction Manager. Contractor shall verify all requirements prior to the start of earthwork operations.
 - 1. Certification of Compaction: A Soils Engineer has been retained by the Construction Manager to test and certify all compaction work. Certifications and test results shall be submitted to the Construction Manager within three (3) days of the test.
 - 2. Field Dry Density and Moisture Content Tests: Submit field test data not listed above sufficiently in advance of construction so as not to delay work. Furnish a drawing showing test locations, test numbers, and elevations. Submit test results within 3 days of test date.
 - 3. Manufacturer's product literature: Submit manufacturer's product literature including description of material and physical properties and laboratory test data for general fill to the Project Engineer for approval at least 15 calendar days prior to construction.
- B. In addition, submit laboratory test results for materials from borrow site as follows:
 - 1. Gradation per ASTM D422.
 - 2. Proctor per ASTM D1557.
 - 3. Plasticity index per ASTM D4318.
 - 4. Hydraulic conductivity per ASTM D5084.

1.07 PROTECTION

- A. Sediment and Erosion Control: The Contractor shall incorporate the Erosion Control measures and procedures as specified in the Contract and in these Specifications.
- B. Existing Utilities and Work Areas: The Contractor shall be responsible for the protection of existing surface and subsurface utilities within and abutting the project site.

1.08 SPECIAL CONSIDERATIONS

Special considerations will be required in the construction of the project due to existing surface and subsurface soil conditions. These include the following:

- A. Erosion control measures shall be provided by the Contractor until the completion of construction. The Contractor shall be responsible for providing protection to graded areas against action of the elements.
- B. If the actual soil conditions encountered during construction are different from those assumed or considered in the Soils Report, the Contractor shall notify the Construction Manager immediately.

- C. The Contractor shall ensure that work at the site does not cause significant deterioration of existing air quality. Specifically, the Contractor shall ensure compliance with ambient air quality standards established in HAR 11-59 and shall comply with air pollution control requirements specified in HAR 11-60.1. The Contractor shall be responsible for conducting area air monitoring to detect potential air emissions from the property.

1.09 CONTRACTOR'S AND SOILS ENGINEER'S RESPONSIBILITIES

- A. A Soils Engineer has been retained by the Construction Manager to monitor and perform testing during the earthwork operations and prepare and sign the final Grading Report.
- B. All clearing, site preparation or earthwork performed on the project up to the approximate finish grade shall be conducted by the Contractor under the inspection of the Soils Engineer.
- C. The Soils Engineer shall perform laboratory testing of all imported soils to determine its acceptability for site backfill.
- D. It is the Contractor's responsibility to prepare the ground surface to receive the fills and to place, spread, mix, moisture condition, and compact the fill in accordance with the Specifications herein. The Contractor shall also remove all unsuitable and deleterious materials.
- E. It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment shall be shut down to allow completion of compaction. Sufficient watering apparatus will also be provided by the Contractor with due consideration for the fill material, rate of placement, and the time of year.
- F. The Contractor shall not implement blasting as a means for removal of material.
- G. The Soils Engineer shall promptly notify both the Contractor and the Construction Manager verbally of any failing compaction tests and the results of such tests to the extent the tests show a lack of compliance with Specifications. These items shall also be documented by the Soils Engineer.
- H. If field density test indicate inadequate compaction or moisture content, the Contractor shall moisture condition and recompact and retest until adequate compaction and adequate moisture content is achieved at no additional cost to DHHL.

PART 2 – PRODUCTS

- 2.01 Material imported from areas outside of the project site may be utilized as fill provided each material conforms to the Specifications herein. Roots, tree branches, and other deleterious materials missed during clearing operations shall be removed from the fill. The imported material shall also be tested prior to delivery to insure that it does not contain any environmental contamination unless otherwise directed by the Construction Manager.

- 2.02 General fill material shall be well-graded, non expansive granular material free of trash, debris, vegetation, corrosive, organic or decomposable material, or metals. The maximum size particle for fill and backfill material shall be 3 inches.
- 2.03 Imported granular fill shall be well-graded, non-expansive granular material. Specifications for the gravel material shall indicate a maximum particle size of 3 inches and state that between 8 and 20 percent of soil by weight shall pass the #200 sieve. In addition, the plasticity index (P.I.) of that portion of the soil passing the #40 sieve shall not be greater than 10. Imported granular fill shall have a CBR expansion value no greater than 1.0 percent and a minimum CBR value of 15 percent, when tested in accordance with ASTM D 1883.
- 2.04 Low permeability soil material shall meet the gradation criteria and characteristics specified below.

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing By Dry Weight</u>
3 inch	100%
¾ inch	85 – 100%
No. 10	70 – 100%
No. 200	>50%

Plastic Limit: ≥ 30

Plastic Index: ≥ 15

Hydraulic Conductivity: $< 1 \times 10^{-5}$ cm/sec

Maximum Lift Thickness – 8 inches loose; and

Minimum Compaction – 90 percent of maximum dry density at ± 2 percent of optimum

Moisture content as determined by modified Proctor testing (ASTM D1557).

- 2.05 DHHL has secured the use of material from a nearby borrow site (approximate location is shown on the Plans) and will allow the Contractor to use the material for this Project if it meets the criteria stated above.

The borrow material has been determined to be suitable for use as general fill for this Project. DHHL is currently testing the borrow material for conformance with the above sections for use as low permeability soil.

The material from the borrow site has already been tested and confirmed to be void of contaminants.

- 2.06 Construction barrier fence shall be constructed of HDPE and be the “Magna” product, manufactured by Conwed Plastics, LLC, or approved equal.
- 2.07 Metallic marking tape shall consist of a solid aluminum foil core. Tape shall be 6 inches wide with a minimum thickness of 5.0 mil manufactured by Presco, or approved equal. Marking tape shall be imprinted with the following warning message:

“CAUTION! STOP DIGGING!
ARSENIC AND DIOXIN CONTAMINATED SOIL BELOW
CONTACT HAWAII DEPARTMENT OF HEALTH”

PART 3 – EXECUTION

3.01 GENERAL

- A. The grading activity shall generally follow the procedure outlined below. If the Contractor wishes to deviate from the outlined procedure, he shall provide his proposed procedure to the Construction Manager for review and approval prior to beginning his work.
- B. The fill locations shall be staked in the field based on the construction drawings. The final site boundary at each location shall be determined in the field and approved by the Construction Manager.
- C. Grading stakes shall be placed in a 10-foot by 10-foot grid to assist in verifying the design depth and thickness achieved.
- D. The layers of fill placement shall maintain a minimum thickness as indicated on the project Plans and as specified herein.
- E. Placement of fill layers shall not exceed lifts greater than 8 inches.
- F. The on-site soils to be excavated are contaminated and the Contractor shall minimize airborne dust to the maximum extent practicable.

3.02 SITE PREPARATION

All areas within the limits of grading as indicated on the Plans, shall be cleared and grubbed in accordance with SECTION 02230 - CLEARING AND GRUBBING prior to excavating and filling.

3.03 EXCAVATION AND PLACEMENT OF LEVEL 1 (SLIGHTLY-CONTAMINATED) SOIL

- A. The areas outside of the existing chain link fence contain slightly-contaminated soil. Excavate these areas to the depths and elevations indicated on the Plans unless otherwise directed by the Construction Manager.
- B. The Level 1 (slightly-contaminated) soil shall be placed within the Level 2 (moderately-contaminated) and Level 3 (highly-contaminated) areas as indicated on the Plans. All contaminated soil shall remain within the Project site.
- C. In areas where fill is placed on existing ground that is steeper than 5 horizontal to 1 vertical, the existing ground surface shall be benched as the fill is brought up in lifts.
- D. Each layer of fill and backfill material shall be placed in horizontal lifts not exceeding 8 inches.
- E. Following excavation of the Level 1 (slightly-contaminated) soil, the Contractor shall notify the Construction Manager, who will arrange for additional testing of the soil for the presence of contaminants. The testing procedure may take up to two (2) months, during which the Contractor may not conduct any additional grading work. If the presence of

additional contamination is confirmed, the Contractor shall over-excavate to remove the contaminated soil as directed by the Construction Manager. The additional contaminated soil shall be placed within the Level 2 (moderately-contaminated) and Level 3 (highly-contaminated) areas as indicated on the Plans.

- F. After placement of Level 1 (slightly-contaminated) soil is completed, lay construction barrier fence atop the finished ground to act as a visual barrier. The barrier fence shall have a minimum overlap distance of 12 inches between rolls and have full coverage over the entire area to receive fill. Anchoring the edges of the construction barrier fence is not necessary.

3.04 TREATMENT OVER LEVEL 3 (HIGHLY-CONTAMINATED) SOIL

- A. For the Level 3 area that was determined as having the highest levels of contamination, a 24-inch thick layer of low permeability soil shall be placed atop the construction barrier fence.
- B. Place low permeability soil in lifts not to exceed 8 inches and compact to at least 90 percent of maximum dry density at ± 2 percent of optimum moisture content as determined by ASTM D1557.
- C. Place layers of geotextile fabric and high-density polyethylene geomembrane liner atop the low permeability soil in accordance with SECTION 02630 – HIGH-DENSITY POLYETHYLENE (HDPE) GEOSYNTHETIC LINER and SECTION 02631 – GEOTEXTILE and as indicated on the Plans.
- D. Perform appropriate quality assurance/quality control inspections and testing of the geomembrane liner in accordance with SECTION 02630 – HIGH-DENSITY POLYETHYLENE (HDPE) GEOSYNTHETIC LINER.

3.05 FINAL TREATMENT OF PROJECT AREA

- A. After placement of the geotextile fabric and high-density polyethylene geomembrane liner, the Contractor shall place a first layer of imported clean granular fill over the Level 2 (moderately-contaminated) area to a minimum depth of 24 inches as indicated on the Plans.
- B. Place metallic marking tape in a 10' x 10' grid pattern on top of the 24-inch thick layer of clean granular fill and geomembrane liner.
- C. Place a second layer of imported clean granular fill atop the metallic marking tape to a depth of 18 inches.
- D. Place a 6-inch thick layer of topsoil and grass in accordance with SECTION 02900 – LANDSCAPING.

3.06 RESTORATION OF LEVEL 1 (SLIGHTLY-CONTAMINATED) EXCAVATED AREAS

- A. For excavated areas, the exposed subgrade shall be scarified to a minimum depth of 6 inches, moisture conditioned to about 2 percent above optimum moisture content, and compacted to between 90 and 95 percent compaction as determined by ASTM D 1557.
- B. Place clean, imported granular fill material to within 6 inches of the finished ground elevation.
- C. Place a 6-inch thick layer of aggregate base course to match the existing roadway elevations indicated on the Plans.
- D. For other areas where indicated on the Plans, place a 6-inch thick layer of topsoil to match the existing ground elevations.

3.07 SLOPES

- A. Fill slopes and cut slopes into soil materials shall be as indicated on the Plans and shall not exceed 3 horizontal to 1 vertical.
- B. Fill slopes shall be constructed by either overfilling and cutting back to compacted soil or the slope shall be track-rolled at 5-foot vertical height intervals.
- C. All fill slopes shall be planted or protected from erosion.

3.08 COMPACTION

- A. Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density of the same soil established in accordance with ASTM D 1557 test procedures. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density.
- B. Each layer of fill and backfill shall be thoroughly compacted from edge to edge using conventional compaction equipment. Fill materials shall be compacted to between 90 and 95 percent compaction as determined by ASTM D 1557. Overcompaction of the exposed subgrade above 95 percent compaction should be avoided.
- C. The imported granular fill and overlying base course within the reconstructed roadways shall be compacted to a minimum 95 percent compaction as determined by ASTM D 1557.
- D. Compaction tests shall be conducted with nuclear gauge method (ASTM D2922) and sand cone method (ASTM D1556). At least two nuclear gauge tests and one sand cone test shall be performed at each lift at the Level 3 (highly-contaminated) area.

3.09 GRADING CONTROL

- A. Observation of the fill placement shall be provided by the Soils Engineer during the progress of grading.

- B. In general, density tests shall be made at intervals not less than 5,000 square feet per lift. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.
- C. Density tests shall also be made on the surface material to receive fill and cut areas as required by the Soils Engineer.
- D. Where failing density tests occur, the Contractor and DHHL's representative will be verbally notified of such conditions followed by written communication from the Soils Engineer.

3.10 FINISHING

The complete excavation and fill surface shall be true to grade and elevation and shall provide a firm base. Tolerances shall be 0.25 feet.

END OF SECTION

SECTION 02370 – EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.

1.02 DESCRIPTION OF WORK

Furnish all labor, materials and equipment necessary for the installation and maintenance of the construction sediment and erosion control measures.

1.03 GENERAL

- A. All erosion and sediment control measures are to be placed prior to any surface disturbance and shall comply with the State Department of Health regulations.
- B. The Contractor shall ensure that erosion and sediment control measures are implemented and maintained as necessary.
- C. Soil disturbing activities include but are not limited to: Demolition, clearing and grubbing, excavation, grading, and preparation for final seeding.

1.04 RELATED SECTIONS

- A. SECTION 02050 – DEMOLITION
- B. SECTION 02100 – SITE PREPARATION
- C. SECTION 02120 – ENVIRONMENTAL PROCEDURES
- D. SECTION 02230 – CLEARING AND GRUBBING
- E. SECTION 02300 – GRADING

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 CONSTRUCTION

- A. Prior to starting any construction, the Contractor shall install the erosion and sediment control devices as indicated on the Plans to prevent silt and debris from leaving the project site.

- B. During grading operations, maintain the grade to prevent damage to adjoining property from water and eroding soil.
- C. Install temporary berms, cut-off ditches and other provisions needed for construction methods and operations. Should there be a question if the temporary measures are insufficient to prevent erosion, the Construction Manager shall make the final determination.
- D. Finish the cut and fill slopes according to the Contract. Shape, install topsoil, and plant or finish the cut and fill slopes according to the Contract as the work progresses.
- E. Temporary seeding shall be placed on exposed surfaces that will not be brought to final grading or permanent cover treatment within 30 days of the exposure to reduce erosion and sedimentation by stabilizing exposed soils. Seeded areas shall be checked regularly for bare spots, washouts, and healthy growth to assure that a good stand of grass is being maintained. Reseed areas that fail to establish vegetation cover as soon as such areas are identified.

3.02 DUST CONTROL

- A. Prevent dust from becoming airborne at all times including non-working hours, weekends and holidays in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 60.1 - Air Pollution Control.
- B. The Contractor shall ensure that work at the site does not cause significant deterioration of existing air quality. The Contractor shall be responsible for conducting area air monitoring to detect potential air emissions in accordance with SECTION 02120 – ENVIRONMENTAL PROCEDURES.
- C. Contractor is responsible for all damage claims due to their negligence to control dust.

3.03 SILT FENCE

- A. Install silt fencing as indicated on the Plans.
- B. Utilize standard strength synthetic filter fabric for sediment barriers. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6 inch overlap, and securely sealed.

3.04 COMPOST FILTER SOCK

- A. Install compost filter sock in accordance with the Plans.
- B. The compost filter socks shall be placed at the locations indicated on the Plans during non-working hours and shall be moved out of the construction area while work is in progress.

3.05 MAINTENANCE

1. Erosion and sediment control devices shall be inspected immediately after each rainfall and at least daily during prolonged rainfall.
2. Silt fences shall be inspected for depth of sediment, tears, and to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground. Any deficiencies shall be repaired immediately.
3. Should the filter fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
4. Sediment deposits shall be removed after each storm event and/or when deposits reach approximately 1/3 the height of the barrier or when the sediments limit or prevent the flow of water through the fabric.
5. Any sediment deposits remaining in place after the sediment control devices is no longer required shall be graded to conform to the existing grade, prepared, and seeded.

3.06 CONFORMANCE

Failure to conform to the above requirements and regulations will be cause for temporary or permanent suspension of operations. If operations are suspended due to the Contractor's failure to conform, the Contractor shall maintain the project during the period of suspension at no cost to DHHL.

END OF SECTION

SECTION 02585 – TRAFFIC CONTROL

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

- A. The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.
- B. During any time the normal function of a roadway is suspended, temporary traffic control planning must provide for continuity of function: movement of traffic, land users, access to property, etc. Effective temporary traffic control must provide for the safety of workers, road users, and land users. It is essential that concern for traffic safety, worker safety and efficiency of traffic movement form an integral element of every temporary traffic control zone, from planning through completion of work activity.

1.02 DESCRIPTION OF WORK

Work under this Section shall consist of the planning for and the implementation of maintenance and protection of vehicular and/or user traffic during construction. Maintenance and protection of traffic includes furnishing, assembling, placing and relocating traffic control devices and removing all devices when they are no longer required.

1.03 REFERENCE STANDARDS

- A. Standard Specifications of the State Department of Transportation.
- B. Manual on Uniform Traffic Control Devices (MUTCD), Part VI Standards and Guides for Traffic Control for Streets and Highway Construction, Maintenance Utility and Incident Management Operation, latest edition.

1.04 SUBMITTALS

The Contractor shall prepare and submit a proposed traffic control plan to the Construction Manager for approval. The traffic control plan shall be thoroughly planned and scheduled, and any potentially unsafe condition shall be minimized such that motorists, users, and workers are protected at all times. The proposed traffic control plan shall be approved by the Construction Manager before the Contractor begins work.

PART 2 – PRODUCTS

2.01 MATERIAL

Contractor shall provide all materials necessary to perform the work including, but not limited to, construction signs, reflectorized drums, pre-cast concrete construction barrier, traffic cones, or any other devices required or specified by the Construction Manager.

PART 3 – EXECUTION

3.01 GENERAL

- A. Traffic control devices must be in good condition. Traffic control devices shall conform to the MUTCD.
- B. Prior to beginning construction, traffic control devices shall be in place. Traffic control devices shall be kept clean and maintained in good condition until no longer required for the project, at which time they shall be removed from the project area.
- C. Existing roadways shall be kept open to traffic unless otherwise approved or shown on the drawings.
- D. The Contractor shall perform daily inspections, including weekends and holidays, and take all corrective action to ensure compliance with the traffic control plan and other approved standards. The duties shall include, but shall not be limited to, the responsibility for ensuring the following:
 - 1. Setup and removal of all traffic control devices in accordance with the Contract Documents;
 - 2. Correction of deficiencies of traffic control devices within 2 hours of discovery or notification by the Construction Manager;
 - 3. Repositioning traffic control devices displaced by traffic or construction equipment;
 - 4. Repairing or replacing damaged traffic control devices;
 - 5. Replacing batteries, light bulbs, control panels, and other electrical components;
 - 6. Keeping all traffic control devices clean;
 - 7. Properly storing and packing equipment and vehicles so as not to create a traffic hazard;
 - 8. Properly storing traffic control devices when not in use; and,

END OF SECTION

SECTION 02630 – HIGH DENSITY POLYETHYLENE (HDPE) GEOSYNTHETIC LINER

PART 1 - GENERAL

- 1.01 **GENERAL CONDITIONS:** The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02. **WORK INCLUDED:** Furnish all labor, materials, services, equipment and related items necessary to install 60 mil smooth high density polyethylene (HDPE) geosynthetic liner in accordance with the specifications of this section, and dimensions, sections and details shown on the plans.
- 1.03 **RELATED SECTIONS**
- A. SECTION 02300 – GRADING
- B. SECTION 02631 – GEOTEXTILE
- 1.04 **REFERENCE OF COMMERCIAL STANDARDS**
- | | |
|------------|--|
| ASTM D792 | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement |
| ASTM D1004 | Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting |
| ASTM D1238 | Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastomer |
| ASTM D1505 | Standard Test Method for Density of Plastics by the Density-Gradient Technique |
| ASTM D1603 | Standard Test Method for Carbon Black in Olefin Plastics |
| ASTM D3895 | Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry |
| ASTM D4833 | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products |
| ASTM D5199 | Standard Test Method for Measuring the Nominal Thickness of Geotextiles and Geosynthetics |
| ASTM D5397 | Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test |
| ASTM D5596 | Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics |

ASTM D5885	Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
ASTM D5721	Standard Practice for Air-Oven Aging of Polyolefin Geomembranes
ASTM D6365	Standard Practice for the Non-destructive Testing of Geomembrane Seams using the Spark Test
ASTM D6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods
ASTM D6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

GRI Standard GM13 (Revision 9), Geosynthetics Research Institute June 1, 2009

GRI Standard GM19 (Revision 2), Geosynthetics Research Institute January 28, 2005

1.05 SUBMITTALS

A. Pre-installation - Submit prior to geomembrane deployment:

1. Origin (supplier's name and production plant) and identification (brand name and number) of resin used to manufacture geomembrane.
2. Copies of dated quality control certificates issued by resin supplier.
3. Results of tests conducted by geomembrane manufacturer to verify that resin used to manufacture geomembrane meets Specifications
4. Statement that amount of reclaimed polymer added to resin during manufacturing did not exceed 2% by weight.
5. List of materials which comprise geomembrane, expressed in following categories as percent by weight: polyethylene, carbon black, and other additives.
6. Manufacturer's specification for geomembrane which includes properties listed and measured using appropriate test methods.
7. Written certification that minimum values given in manufacturer's specification are guaranteed by geomembrane manufacturer.
8. Quality control certificates, signed by geomembrane manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.

9. Field panel layout and identification code including dimensions and details.
10. Resumes of geomembrane installation supervisor and master seamer including dates and duration of employment.
11. List of personnel performing seaming operations including experience information.
12. Certificate that extrudate to be used in comprised of same resin as geomembrane to be used.
13. List of seaming equipment.

B. Installation - Submit as installation proceeds:

1. Quality control documentation recorded during installation.
2. Warranty: A written warranty shall be obtained from the manufacturer (for material) and the installation contractor (for workmanship). These documents shall warrant both the quality of the material for a minimum of 20 years and workmanship for a minimum of 2 years.

C. Qualifications:

1. Manufacturer: Manufacturer shall have minimum 5 yrs continuous experience in manufacture of HDPE geomembrane experience totaling at least 2,000,000 sq ft of manufactured HDPE geomembrane for minimum of 10 completed facilities.
2. Installer:
 - a. The installation contractor shall be the manufacturer or a manufacturer approved Contractor trained and licensed to install the manufacturer's geomembrane. Installation shall be performed under the constant direction of the field installation supervisor supplied from the installation contractor who shall remain on site and be in charge throughout the liner installation for liner activities by the installer. This installation supervisor shall have installed or supervised the installation and seaming of a minimum of 2,000,000 square ft of HDPE geomembrane.
 - b. Actual seaming shall be performed under the direction of a master seamer who has seamed a minimum of 900,000 square ft. The master seamer, who may also be the installation supervisor, shall be present whenever seaming is performed and during seam and liner repair operations.

D. Quality Control (QC) Programs:

1. Quality Control is defined as actions taken by a manufacturer or Contractor to ensure conformance of the contract documents.

2. Provide manufacturer's certifications, reports, and test results in accordance with Section 1.05.A.
3. Perform quality control tests as specified in Section 2.01.A.4.
4. Provide installer contractor's quality control plan, including descriptions, personnel, equipment, field test forms, and a layout plan that provides identification for installed geomembrane panels and repairs spots in accordance with Section 1.05.A.
5. All costs for Quality Control shall be borne by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Geomembrane Material:

1. The 60 mil thick smooth geomembrane shall have the following properties:

PROPERTY	METHOD	VALUE*
Thickness	ASTM D5199 min. average reading	60 mil
Density	ASTM D1505 g/cc	0.940
Melt Index (resin)	ASTM D1238	1 g per 10 minutes, max. (Condition 190/2.16)
Tensile Properties: (each direction)	ASTM D6993 Yield stress, lb/in Break stress, lb/in Yield elongation, % Break elongation, %	126 228 12 700
Tear Resistance	ASTM D1004, lb	42
Puncture Resistance	ASTM D4833, lb	108
Carbon Black Content	ASTM D1603, %	2 – 3%
Carbon Black Dispersion	ASTM D5596	Cat 1-2
Environmental Stress Crack Resistance	ASTM D5397 (Appendix)	300 hrs min.
Oxidative Induction Time (OIT) Standard OIT or High Pressure OIT	ASTM D3895 ASTM D5885	100 min. 400 min.
Seam Properties Shear strength, lb/in Peel strength, lb/in**	ASTM D6392 (1 in wide @ 2 in/min)	120 78/FTB
UV Resistance High Pressure OIT (% retained after 1,600 hrs)	ASTM D5885	50%

* All values, unless specified otherwise are minimum average roll values as reported by the

specified test methods.

** Film tear bond (FTB): A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area.

2. Geomembrane shall be manufactured from new polyethylene resin. Use of geomembrane recycled during manufacturing process shall be permitted with written approval from Owner and if recycled geomembrane does not exceed 2% by weight. Geomembrane manufactured from non-complying resin shall be rejected.
3. Geomembrane Characteristics:
 - a. Contain maximum of 1% by weight of additives, fillers, or extenders (not including carbon black).
 - b. Contain between 2% and 3% by weight of carbon black for ultraviolet light resistance.
 - c. No pinholes, bubbles, or other surface features that compromise geomembrane integrity. Free of blisters, non-dispersed raw materials, or other signs of contamination by foreign matter.
4. Geomembrane Manufacture Quality Control: Test inspections shall be performed by geomembrane manufacturer as follows:
 - a. Test geomembranes to demonstrate that resin meets the requirements of this section.
 - b. Continuously monitor geomembrane during manufacturing process for inclusions, bubbles, or other defects. Geomembranes which exhibit defects shall not be acceptable for installation.
 - c. Monitor thickness continuously during manufacturing process.
 - d. Tests shall be conducted for following properties in accordance with test methods specified: density, carbon black content, carbon black dispersion, thickness, tensile properties, tear strength, and puncture resistance.
 - e. Perform these tests on geomembrane, minimum of once every 40,000 ft². Samples not complying with Specifications shall result in rejection of rolls. At geomembrane manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify non-complying rolls and to qualify individual rolls.
 - f. Perform environmental stress crack resistance test on geomembrane at minimum of once every resin lot.
 - g. Geomembrane manufacturer shall certify these tests have been performed for each resin used to manufacture rolls for this project in

accordance with test methods specified: oxidative induction time, oven aging at 85°C, and UV resistance.

B. Seaming and Testing Equipment:

1. Welding:

- a. Maintain onsite minimum of one spare operable seaming apparatus.
- b. Seaming equipment shall not damage geomembrane.
- c. Use of extrusion welding apparatus equipped with gauges giving temperature of extrudate at nozzle of apparatus, or utilize hand-held gauges to measure extrudate temperatures.
- d. Use fusion-welding apparatus which are self-propelled devices equipped with gauge indicating temperature of heating element and method of monitoring relative pressure applied to geomembrane.
- e. Place electric generator on smooth base such that no damage occurs to geomembrane.

2. Vacuum Testing Equipment:

- a. Vacuum box assembly consisting of rigid housing, transparent viewing window, soft neoprene gasket attached to bottom of housing, porthole or valve assembly, and vacuum gauge.
- b. Pump assembly equipped with pressure controller and pipe connections.
- c. Pressure/vacuum rubber hose with fittings and connections.
- d. Soapy solution to wet test area.
- e. Means of applying soapy solution.

3. Air Pressure Testing Equipment:

- a. Manual or motor-driven air pump equipped with pressure gauge, capable of generating, sustaining, and measuring pressure between 24 and 35 psi, and mounted on cushion to protect geomembrane.
- b. Rubber hose with fitting and connections.
- c. Sharp hollow needle or other approved pressure feed device.
- d. Air pressure monitoring device.

4. Tensiometer Testing Equipment:

- a. Tensiometer shall be capable of maintaining constant jaw separation rate of two inches per min and shall be calibrated, with certificate of calibration less than one year old kept with tensiometer.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING:

A. Packaging and Shipping:

1. Manufacturer shall identify each roll delivered to site with following: manufacturer's name, product identification, thickness, roll number, roll dimensions.
2. Protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.
3. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
4. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from site and replaced with new rolls.
5. Rolls or portions of rolls without identification labeling will be rejected and shall be removed from site.

B. Storage and Protection:

1. Contractor will provide on-site storage area for geomembrane rolls from time of delivery until deployment.
2. Preserve integrity and readability of geomembrane roll labels.
3. Rolls which do not have proper identification at delivery will not be accepted.

3.02 CONFORMANCE TEST:

The Owner's Representative, at the presence of the Contractor, will cut samples from the geomembrane roll stored at the project site and ship to Geosynthetic Quality Assurance Laboratory for conformance tests to verify HDPE geomembrane material properties as specified in Section 2.01.A.1. No geomembrane installation shall commence until satisfactory conformance test results are obtained.

3.03 CONSTRUCTION:

- A. Geomembrane Placement: Place geomembrane on top of installed geotextile as shown on the plans. Thoroughly inspect geotextile installed area for continuous coverage and overlaps prior to placement.
- B. The Contractor shall be responsible for the following:
 - 1. No equipment or tools shall damage the geomembrane by handling, trafficking, or other means.
 - 2. No personnel working on the geomembrane shall wear damaging shoes or engage in other activities that could damage the geomembrane.
 - 3. The method used to unroll the panels shall not cause scratches or crimps in the geomembrane and shall not damage the underlying geotextile.
 - 4. The method used to place the panels shall minimize wrinkles. Locations of any wrinkles shall be identified on the Contractor's drawings. All defects shall be marked and documented for repairs by the Contractor. Defects may also be marked for repairs by the Owner's Representative.
 - 5. Defects are defined as any abnormalities that affect the physical properties of the geomembrane material.
 - 6. Adequate loading (e.g. sandbags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind (in case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels).
 - 7. Direct contact with the geomembrane shall be minimized, i.e. the geomembrane in traffic areas shall be protected by geotextiles, extra geomembrane or other suitable materials.
- C. Geomembrane Installation:
 - 1. Panel Nomenclature:
 - a. Field panel is defined as roll or portion of roll cut and seamed in field excluding patches and cap strips.
 - b. Identify each field panel with identification code (number or letter-number) consistent with Contractor's layout plan. This identification code shall be provided by the Contractor quality control plan.
 - c. Writing on liner with colored markers shall be white for the Contractor and yellow for the Owner's Representative, respectively.

2. Protection:

- a. Do not use equipment which damages geomembrane.
- b. Ensure that the prepared subgrade surface and the geotextile underlying geomembrane have not deteriorated since previous acceptance, and remains acceptable immediately prior to geomembrane deployment.
- c. Keep the geotextile immediately underlying geomembrane clean and free of debris.
- d. Do not permit personnel to smoke or wear shoes that can damage geomembrane while working on geomembrane. Personnel shall not bring glass bottles on geomembrane.
- e. Unroll panels in manner which does not cause excessive scratches or crimps in geomembrane and does not damage the underlying geotextile or supporting subgrade.
- f. Place panels in manner which minimizes wrinkles (especially differential wrinkles between adjacent panels).
- g. Prevent wind uplift by providing adequate temporary loading and/or anchoring (e.g. sandbags, tires) that shall not damage geomembrane. In case of high winds, continuous loading is recommended along panel edges.
- h. Protect geomembrane in areas where excessive traffic is expected with geotextiles, extra geomembrane, or other suitable materials.

3. Field Panel Deployment:

- a. Install field panels at locations indicated on the Contractor's layout plan.
- b. Replace damaged (torn, twisted, or crimped) field panels, or portions thereof, at no cost to the Owner. Repair other damage as directed by the Owner's Representative.
- c. Remove damaged panels or portions of damaged panels which have been rejected from work area.
- d. Do not proceed with deployment at ambient temperature below 32°F or above 104°F.
- e. Do not deploy during precipitation, in presence of excessive moisture (fog, dew), in area of ponded water or in presence of excessive winds.
- f. Do not undertake deployment if weather conditions will preclude material seaming on same day as deployment.

- g. Do not deploy geomembrane field panels in one day more than what can be seamed during that day.

4. Seam Layout:

- a. When possible, orient seams parallel to line of maximum slope, i.e., oriented along, not across, slope.
- b. When possible, no horizontal seam shall be less than 5 ft from toe of slope.
- c. In general, maximize lengths of field panels and minimize number of field seams.
- d. Align geomembrane panels to have nominal overlap of 3 in. for extrusion welding and 4 to 6 in. for fusion welding. Final overlap shall be sufficient to allow peel tests to be performed on seam.

5. Temporary bonding:

- a. Hot air device (Leister) may be used to temporarily bond geomembrane panel to be extrusion welded.
- b. Do not damage geomembrane when temporarily bonding adjacent panels. Apply minimal amount of heat to lightly tack geomembrane panels together. Control temperature of hot air at nozzle of any temporary welding apparatus to prevent damage to geomembrane.
- c. Do not use solvent or adhesive.

6. Seaming Methods:

- a. Approved processes for field seaming are extrusion fillet welding and fusion welding. Proposed alternate processes shall be documented and submitted to Owner for approval. Alternate procedures shall be used only after being approved in writing by Owner.
- b. Seams shall meet the requirements of ASTM D6392.
- c. Use double-fusion welding as primary method of seaming adjacent field panels. For cross seam tees, associated with fusion welding, extrusion weld to minimum distance of 4 inches on each side of tee. Place welder on protective pad to prevent geomembrane damage between seaming. When subgrade conditions dictate, use moveable protective layer (e.g. extra piece of geomembrane) directly below each overlap of geomembrane that is to be seamed to prevent build-up of moisture between sheets and prevent debris from collection around pressure rollers.

- d. Use extrusion fillet welding as secondary method for seaming between adjacent panels and as primary method of welding for detail and repair work. Purge heat-degraded extrudate from barrel of extruder prior to beginning seam and whenever extruder has been inactive. Place smooth insulating plate or fabric beneath hot welding apparatus after usage. Use clean and dry welding rods or extrudate pellets. Complete grinding process without damaging geomembrane within one hour of seaming operation. Minimize exposed grinding marks adjacent to extrusion weld. Do not allow exposed grinding marks to extend more than 0.25 in. outside finished seam area. Grind perpendicular to seam.

7. Seaming Procedures:

- a. Conduct seaming at ambient temperature between 32°F and 104°F, and at dry conditions, i.e., no precipitation or other excessive moisture (such as fog or dew). Do not conduct seaming during excessive winds.
- b. Do not field seam without master seamer being present.
- c. If required, provide firm substrate by using extra piece of geomembrane, or similar hard surface directly under seam overlap to achieve proper support for seaming apparatus.
- d. Align seams with fewest possible numbers of wrinkles. Extend seams to outside edge of panels placed in anchor trench. Prior to seaming, ensure that seam area is clean and free of moisture, dust, dirt, debris, or foreign material.
- e. Wrinkles at seam overlaps shall be cut along ridge of wrinkle in order to achieve flat overlap. Cut wrinkles shall be seamed and any portion where overlap is inadequate shall be patched with an oval or round patch of same geomembrane extending minimum of 6 in. beyond cut in each direction.
- f. Deploy and seam geomembrane to minimize bridging due to temperature changes that could result in failure of liner.
- g. No seaming of geomembrane is permitted unless demonstrated to the Owner that geomembrane seam quality will not be compromised.
- h. Trial seaming shall be conducted under same ambient temperature conditions as actual seams. New trial seams shall be conducted if ambient temperature rises by more than 5°F from initial trial seam test conditions. Such new trial seams shall be conducted upon completion of seams in progress during temperature rise.
- i. At the option of the Owner, additional destructive seam tests may be required for any suspect areas.

8. Repair Procedures:

- a. Repair portions of geomembrane exhibiting flaw, or failing destructive or non-destructive test.
- b. Final decision as to repair procedure shall be as directed by the Owner's Representative.
- c. Acceptable repair procedures include the following:

Patching: Piece of same geomembrane material extrusion welding into place. Use to repair large holes, tears, non-dispersed raw materials, and contamination by foreign matter.

Spot welding or seaming: Bead of molten extrudate placed on flaw. Use to repair, pinholes, or other minor, localized flaws.

Capping: Strip of same geomembrane material extrusion welded into place over inadequate seam. Use to repair large lengths of failed seams.

Extrusion welding flap: Bead of molten extrudate placed on exposed flap of fusion weld. Use to repair areas of inadequate fusion seams, which have exposed edge. Repairs of this type shall be approved by the Owner and shall not exceed 20 ft in length.

Removal and replacement: Remove bad seam and replace with strip of same geomembrane material welded into place. Use to repair large lengths of failed seams not exceeding 20 ft in length.

- d. For each repair method:

Ensure surfaces are clean, dry, and prepared in accordance with specified seaming process. Ensure seaming equipment used in repairing procedures meet requirements of this section. Extend patches or caps at least 6 in. beyond edge of defect. Round corners of patches with radius of approximately 3 in.

- e. Do not place overlying layers over locations which have been repaired until acceptable non-destructive and destructive (laboratory) test results are obtained.

D. Field Quality Control:

1. Visual Inspection:

- a. Contractor shall examine seam and non-seam areas of geomembrane for identification of defects, holes, blisters, non-dispersed raw materials, and any sign of contamination by foreign matter.
- b. Contractor shall clean and wash out geomembrane surface if it is

determined that amount of dust or mud inhibits examination.

- c. Do not seam any geomembrane panels that have not been examined by Contractor personnel and Owner's Representative.
- d. Non-destructive seam test areas and the entire installed area with geomembrane panels should be checked by the Contractor.

2. Trial Seams:

- a. Perform trial seams on fragment pieces of geomembrane liner to verify that conditions are adequate for production seaming.
- b. Perform trial seams at beginning of each seaming period, and at least once every 4 hrs, for each production seaming apparatus used that day. Each seamer shall make at least one trial seam each day.
- c. Perform trial seams under same conditions as actual seams.
- d. Perform trials seams only under observation of the Owner's Representative.
- e. Seam overlap shall be as indicated for finished seam.
- f. Each trial seam sample shall be at least 5 ft long by 1 ft wide (after seaming) with seam centered lengthwise.
- g. Cut three 1 in.-wide specimens from sample. These specimen locations shall be selected randomly along trial seam sample by the Owner's Representative. Test specimens in peel using field tensiometer. Samples shall not fail in sheet or exceed specified peel criteria specified in Section 2.02.A.1.
- h. If specimen fails, entire trial seam operation shall be repeated. If additional fails, do not use the seaming apparatus and seamer until deficiencies are corrected and two consecutive successful trial welds are achieved.
- i. Cut remainder of successful trial seam into three pieces; one to the Contractor, one to be retained in Owner's archives, one to be retained by the Owner's Representative for possible laboratory destructive seam testing.

3. Non-destructive Seam Testing:

- a. The purpose of non-destructive tests is to check continuity of seams. It will not provide quantitative information on seam strength.

The Contractor shall perform non-destructive tests on field seams over their full length using vacuum test for extrusion seams, air pressure for

double-fusion seams or other Owner approved method.

Perform non-destructive testing for acceptance at the presence of the Owner's Representative.

- b. Vacuum Testing for extrusion seams: Energize vacuum pump and reduce tank pressure to approximately 12 in. by 48 in. with soapy solution. Place box over wetted area. Close bleed valve and open vacuum valve. Ensure that leak-tight seal is created.

For minimum of 10 seconds, apply vacuum and examine geomembrane through viewing window for presence of soap bubbles. If no bubbles appear within 10 seconds, close vacuum valve and open bleed valve, move box over to next adjoining area within minimum 3 in. overlap and repeat process. Mark and repair areas where soap bubbles appear and then repeat vacuum test.

- c. Air Pressure Testing for double-fusion seam: Seal both ends of seam to be tested. Insert needle or other approved pressure feed device into air channel created by fusion weld. Insert protective cushion between air pump and geomembrane.

Pressurize air channel to pressure of 30 psi. Close valve and allow pressure to stabilize for 2 minutes. Observe air pressure for 5 minutes after initial 2-minute stabilization period ends. If pressure loss exceeds 3 psi or pressure does not stabilize, locate and repair faulty areas, and then repeat air pressure test.

Cut opposite end of tested seam area once testing is completed to verify continuity of air channel. If air does not escape, locate blockage and retest un-pressurized area. Repair cut end of air channel. Remove needle or other approved pressure feed device and repair hole in geomembrane.

4. Destructive Seam Testing:

- a. The purpose of destructive seam testing is to evaluate seam strength. Perform destructive seam test as seaming progresses. Failed destructive seam sample shall result if grips of testing machine cannot be closed on sample test flap due to excessive temporary welding.
- b. Location and frequency: Test at minimum frequency of one test location per 250 linear feet of seam length performed by each welding machine.

Test locations shall be determined during seaming, at the discretion of the Owner's Representative. Contractor will not be informed in advance of locations where seam samples will be taken.

The Owner reserves the right to increase frequency of testing in accordance with performance results of samples previously tested.

c. Sampling Procedures:

Cut samples at locations chosen by the Owner's Representative who will number each sample and record sample number and location in panel layout drawing. Repair holes in geomembrane resulting from destructive seam sampling immediately in accordance with repair procedures described in this Specification.

Continuity of repair and seams shall be in accordance with vacuum testing requirements.

d. Sample Dimensions:

Field Testing: Cut 1 in. wide samples, 8 in. long with seam centered parallel to width. Distance between these 2 samples shall be 42 inches. Test both samples on field tensiometer in peel. If both samples pass field test, take sample for laboratory testing.

Laboratory Testing: Take laboratory test sample from between samples taken for field testing. Cut sample for laboratory testing 12 in. wide by 42 in. long with seam centered lengthwise. Cut this sample into three parts. The Owner's Representative shall distribute parts as follows:

- One part to Contractor for optional laboratory testing, 12 in. by 12 in.
- One part to Geosynthetic Quality Assurance Laboratory for testing, 12 in. by 18 in.
- One part to Owner for archive storage, 12 in. by 12 in.

Destructive Test Failure Procedures: When sample fails destructive testing, whether testing is conducted by field tensiometer or Geosynthetic Quality Assurance Laboratory, Contractor has the following options:

- Repair seam between any two passing destructive test locations.
- Trace welding path to intermediate point 10 ft minimum from point of failed test in each direction and take a 1 inch wide sample for an additional field test at each location. If these additional samples pass test, then take full laboratory samples. If these laboratory samples pass tests, repair seam between these locations. If either sample fails, repeat process to establish zone in which seam should be repaired.
- Acceptable repaired seams shall be bound by two locations from which samples passing laboratory destructive tests have

been taken. In cases exceeding 50 ft of repaired seam, the Owner's Representative may have the Contractor perform a destructive test on the repaired seam.

- When sample fails, the Owner may require additional testing of seams that were welded by same welder and/or welding apparatus during same time shift.
- e. Repair Verification: The Owner's Representative will observe and log each repair including observation of non-destructive test for each repair. Non-destructive test results that pass shall indicate adequate repair. Repairs more than 50 ft long may require destructive test sampling. Failed destructive or non-destructive tests indicate that repair shall be redone and retested until passing test results.
- f. Large Wrinkles: Wrinkle is considered to be large when geomembrane can be folded over onto itself.

When seaming of geomembrane is completed, and prior to placing overlying materials, the Owner's Representative will identify large geomembrane wrinkles which should be cut and resealed. Cut and reseat those wrinkles identified; and seam produced while repairing wrinkles shall be non-destructively tested. Repair during coldest part of installation period.

PART 4 - MEASUREMENT AND PAYMENT

- A. Geomembrane shall be measured by surface area installed. Only the area approved for geomembrane will be measured. The geomembrane surface area in the anchor trench shall be included in the overall geomembrane surface area. Overlap will not be measured for payment. The excavation and backfilling of the anchor trench shall be considered incidental to the quantity of liner specified and shall not be measured separately for payment.

All trial seam welding as well as non-destructive and destructive testing of field seams carried out by the installation contractor is part of his quality control requirements and shall be considered incidental.

- B. Payment for the in-place geomembrane liner shall be by the square foot as measured and based on the actual installed surface area of the geomembrane.

Payment for the in-place geomembrane liner shall be full compensation for supply and installation of geomembrane, including excavation and backfilling of anchor trenches, all labor, materials, transportation, equipment and associated activities for proper installation of the geomembrane liner as described herein.

END OF SECTION

SECTION 02631 – GEOTEXTILE

PART 1 - GENERAL

- 1.01 **GENERAL CONDITIONS:** The General Conditions and Special Provisions preceding these specifications shall govern this section of the work.
- 1.02. **WORK INCLUDED:** Furnish all labor, materials, services, equipment and related items necessary to install geotextile below and above the 60 mil smooth high density polyethylene (HDPE) geosynthetic liner in accordance with the specifications of this section, and dimensions, sections and details shown on the plans.
- 1.03 **RELATED SECTIONS**
- SECTION 02300 - GRADING
- 1.04 **REFERENCE OF COMMERCIAL STANDARDS**
- | | |
|------------|---|
| ASTM D123 | Standard Terminology Relating to Textiles |
| ASTM D3786 | Standard Test Method for Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method |
| ASTM D4354 | Standard Practice for Sampling of Geosynthetics for Testing |
| ASTM D4355 | Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus |
| ASTM D4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles |
| ASTM D4632 | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles |
| ASTM D4751 | Standard Test Method for Determining Apparent Opening Size of a Geotextile |
| ASTM D4833 | Standard Test method for Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products |
| ASTM D4873 | Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples |
| ASTM D4884 | Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Geotextiles |
- 1.05 **SUBMITTALS**
- A. **Pre-installation - Submit prior to geotextile deployment:**

1. Mill certificates or affidavits signed by a legally authorized official from the geotextile manufacturer. These shall include the mill certificates or affidavits attesting that the geotextile meets the chemical, physical, and manufacturing requirements stated in this specification, and that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. Acceptance of the geotextile will be based on the mill certificates or affidavits.
2. Quality control certificates, signed by the geotextile manufacturer. Each quality control certificate shall include applicable roll identification numbers, testing procedures, and results of quality control tests.
3. Resumes of personnel who will perform geotextile installation including dates and duration of employment.
4. Field seam samples produced from the geotextile and threads on the project site and with the sewing equipment used for producing the samples.

B. Installation - Submit as installation proceeds:

1. Quality control documentation recorded during installation.
2. Warranty: A written warranty shall be obtained from the manufacturer (for material) and the installation contractor (for workmanship). These documents shall warrant both the quality of the material for a minimum of 20 years and workmanship for a minimum of 2 years.

C. Qualifications:

1. Manufacturer shall have minimum 5 yrs continuous experience in manufacturing geotextile totaling at least 2,000,000 sq ft for minimum of 10 completed facilities.
2. Installation contractor shall have minimum 3 yrs continuous experience in installing geotextile totaling at least 500,000 sq ft for minimum of 5 completed facilities.

D. Quality Control (QC) Programs:

1. Quality Control is defined as actions taken by a manufacturer or Contractor to ensure conformance of the contract documents.
2. Provide manufacturer's certifications, reports, and test results in accordance with Section 1.05.A.
3. Provide installation contractor's quality control plan, including description of personnel, equipment, methods to ensure continuous geotextile coverage below and above HDPE geomembrane panels, and protection of geotextiles during installation.

4. All costs for Quality Control shall be borne by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS:

- A. Geotextile: Geotextile shall be a 16-oz, polypropylene, staple fiber, nonwoven, needled-punched geotextile. Stabilizers and/or inhibitors shall be added to the base polymer if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments retain dimensional stability relative to each other, including the edges. The edges of the geotextile shall be finished to prevent the outer fiber from pulling away from the geotextile. The geotextile material properties shall meet or exceed the minimum average roll values listed below:

MATERIAL PROPERTIES	TEST METHOD	TEST METHOD
<u>Physical</u> Weight (typical)	ASTM D4632	16 oz./s.y.
<u>Mechanical</u> Grab Tensile Grab Elongation Puncture Strength Trapezoidal Tear Mullen Burst	ASTM D4632 ASTM D4632 ASTM D4833 ASTM D4533 ASTM D3786	380 lbs 50% 240 lbs 145 lbs 800 psi
<u>Endurance</u> UV Resistance (500 hours)	ASTM D5261	70% retained

- B. Seams: The seams of the geotextile shall be sewn with thread of a material meeting the chemical requirements of the geotextile.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING:

A. Packaging and Shipping:

1. Manufacturer shall identify each roll delivered to site with the following: manufacturer's name, type of geotextile, lot number, roll number, and roll dimensions.
2. Protect geotextile from excessive heat, cold, moisture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading.

3. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
4. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from the site and replaced with new rolls.
5. Rolls or portions of rolls without identification labeling will be rejected and shall be removed from the site.

B. Storage and Protection:

1. Contractor will provide onsite storage area for geotextile rolls from time of delivery until deployment.
2. Preserve integrity and readability of geotextile roll labels.

3.02 CONFORMANCE TEST:

- A. The Owner's Representative, in the presence of the Contractor, will cut samples from the geotextile roll stored at the project site and ship to Geosynthetic Quality Assurance Laboratory for conformance tests to verify geotextile material properties as specified in Section 2.01. No geotextile installation shall commence until satisfactory conformance test results are obtained.

3.03 CONSTRUCTION:

- A. Subgrade Preparation for Geotextile: Prepared subgrade should be a smooth and firm surface as construction in accordance with SECTION 02300 - GRADING of these Special Provisions. The subgrade surface shall be free from obstruction, debris, depressions, erosion features, or vegetation. Any irregularities shall be removed so as to ensure continuous, intimate contact of the geotextile with the entire surface. Any loose material, soft or low density pockets of material, shall be removed; erosion features such as rills, gullies, etc. shall be graded out of the surface before geotextile placement.
- B. Anchor Trench: Anchor trench shall be excavated and backfilled in accordance with details shown on the Plans and with SECTION 02300 - GRADING of these Special Provisions. Care shall be taken backfilling the trenches to prevent any damage to the geotextile. If damage occurs, it shall be repaired by the installation contractor prior to the completion of backfilling.
- C. Geotextile Installation:
1. General: The geotextile shall be placed in the manner and at the locations as shown on the plans. At the time of installation, the geotextile shall be rejected if it has defects, rips, holes, flaws, deteriorations or damage incurred during manufacture, transportation or storage.
 2. Placement: The geotextile shall be laid smooth and free of tension, stress,

folds, wrinkles, or creases. The strips shall be placed to provide a minimum width of 12 inches of overlap for each joint. The Contractor may adjust the actual length of the geotextile used based on initial installation experience. Sand bags may be placed on geotextile to prevent uplift by wind.

3. Protection: The geotextile shall be protected at all times during construction from damages. Any damage to the geotextile during its installation or during placement of overlaying material shall be replaced by the Contractor at no cost to the Owner. The work shall be scheduled so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Before placement of soil cover materials, the Contractor shall demonstrate that the placement technique will not cause damage to the geotextile. In no case shall any type of equipment (except extrusion welding machines) be allowed on the unprotected geotextile.
4. Overlapping and Seaming: The overlap of geotextile rolls shall be minimum 12 inches after seaming.

PART 4 - MEASUREMENT AND PAYMENT

- A. Geotextile shall be measured by surface area installed. Only the area approved for geotextile will be measured. The geotextile surface area in the anchor trench shall be included in the overall geotextile surface area. Overlap will not be measured for payment. The excavation and backfilling of the anchor trench shall be considered incident to the quantity of liner specified and shall not be measured separately for payment.
- B. Payment for the in-place geotextile shall be by the square foot as measured and based on the actual installed surface area of the geotextile.

Payment for the in-place geotextile liner shall be full compensation for supply and installation of geotextile, including excavation and backfilling of anchor trenches, all labor, materials, transportation, equipment and associated activities for proper installation of the geotextile as described herein.

END OF SECTION

SECTION 02900 – LANDSCAPING

PART 1 - GENERAL

1.01 GENERAL REQUIRMENTS

The General Conditions and Special Provisions preceding these Specifications shall govern this section of the Work.

1.02 DESCRIPTION OF WORK

The work of this Section includes but is not limited to the following:

1. Clearing and grubbing.
2. Pre-planting weed control.
3. Imported screened soil.
4. Soil preparation.
5. Fine grading.
6. Planting operations.
7. Maintenance.
8. Warranty.

1.03 CODES AND STANDARDS

Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State, and local authorities in furnishing, transporting, and installing materials.

1.04 SUBMITTALS

- A. General: Submit under provisions of SECTION 01330 – SUBMITTAL PROCEDURES.
- B. Imported Screened Soil: After Contract is awarded, furnish source of imported screened soil to the Construction Manager.

1.05 PROJECT CONDITIONS

Use minimum amounts of fertilizers, herbicides and pesticides suitable to achieve the intended results.

1.06 WARRANTY

- A. Period: Warrant grassing for three (3) months following commencement date of maintenance period.
- B. Replacement: Immediately replace any grassing that declines or dies during the warranty period. Furnish, plant, and maintain as specified for original planting. The Contractor is not responsible for replacement of grassing after the maintenance period, which declines or dies as a result of poor maintenance by DHHL, vandalism, negligence by others, or acts of God.

PART 2 - PRODUCTS

2.01 GRASS

- A. Grass shall be "Manienie" or as directed by the Construction Manager. At the option of the Contractor, grass planting may be by seeds (plain seeding or by hydro-mulching) or by sprigs.
- B. Grass seeds shall be fresh, hulled, and meet the following requirements:

Pure Seed	95.0% minimum
Crop Seed	1.0% maximum
Weed	0.5% maximum
Inert Material	5.0% maximum
Germination	85.0% minimum
- C. Grass seeds shall be delivered to the site in unopened, sealed containers, labeled with the brand name and per cent purity. Labeling shall indicate that the seeds passed a certified germination test no more than 12 months prior to use.
- D. Grass sprigs shall be healthy living runners and stolons, a minimum of 6 inches long with at least 3 nodes. After they are dug, they shall be covered and kept moist until planted.

2.02 MULCH

- A. Mulch shall be specially-processed fiber containing no growth or germination-inhibiting factors. It shall be such that any addition and agitation in the hydraulic equipment with seed, fertilizer, water and other additives not detrimental to plant growth, the fibers will form a homogeneous slurry. When hydraulically sprayed on the soil, the fibers shall form a blotter-like ground cover which readily absorbs water and allows infiltration to the underlying soil.
- B. Stabilizing and water retaining agent for hydro-mulching option only shall be "Verdyol Super", "Ecology Control M-Binder" or approved equal. Rate of application of "Verdyol Super" shall be 50 lbs./acre and that for "Ecology Control M-Binder shall be 60 lbs./acre.

2.03 IMPORTED SCREENED SOIL

Fertile, friable soil of loamy character, free of clay, refuse, branches, weeds, noxious seeds, nematodes or other deleterious matter. Stones and earth lumps shall not exceed 1-1/2 inches in largest dimension. The acceptable pH range is 6.0 to 7.0. Soil is subject to approval by the Construction Manager.

2.04 FERTILIZERS

- A. Fertilizer: Sulfur-coated, pelletized, uniform in composition, dry and free-flowing. Deliver to the site in the original, unopened containers, each bearing the manufacturers guaranteed analysis. Any fertilizer, which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.
- B. Requirements: Commercial fertilizer shall be of the following percentages by weight of active ingredients:
 - 1. 10-30-10
 - 2. 15-15-15
 - 3. Ammonium sulfate (21-0-0)
 - 4. 16-16-16
 - 5. 18-18-5

2.05 SOIL AMENDMENTS

- A. Organic non-nutrient soil conditioners shall be Kellogg's Nitrohumus Soil Conditioner" or approved equal.
- B. Organic nutrient-soil amendment (humus) shall be Gro-Power Plus (5-3-1), Ferto (6-4-2) or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION OF PLANTING AREAS

- A. Provide an even 6-inch layer of topsoil over top layer of clean, imported granular fill at areas indicated on the Plans unless otherwise directed by the Construction Manager. Spread fertilizer along with amendments over rough grade in planting areas and then scarify soil to a depth of 6-inches by tilling until the soil is loose and fine textured. Refer to grading plans for finish grades.
- B. Remove stones exceeding 1-1/2 inches in largest dimension, sticks, rubbish, and other extraneous matter that is exposed by tilling. Remove this debris from the site.
- C. Grades shall be smooth and on a uniform plane with no abrupt changes or pockets.

Insure surface drainage of all planting areas, and notify Construction Manager of any discrepancies, obstructions, or other conditions considered detrimental to proper execution of the work.

3.02 INSTALLATION OF GRASSING

- A. Immediately prior to planting operations, all planting areas shall be cleared of weeds, debris, rocks over 1" in diameter and clumps of earth that will not break up.
- B. Option by Grass Seeding: If grass seeds are used, the following procedure shall be used (NOTE: Contractor should exercise caution in seeding slopes where seeds may be washed away):
 - 1. The grass seeds shall be broadcast uniformly by hand or by sowing equipment at the rate of 100 lbs./acre. Half the seeds shall be sown with the sower moving in one direction and the remainder shall be sown at right angles to the first direction.
 - 2. The surface shall then be raked to a smooth even plane while the seeds are simultaneously worked into the soil to a depth of about 1/2".
 - 3. The surface shall then be smoothed and compacted by means of a culti-packer, roller or other similar equipment weighing 60 to 90 pounds per lineal foot of roller.
 - 4. The planted area shall then be watered sufficiently to provide water penetration to a depth of at least 2" and shall then be kept moist until roots are established.
- C. Option by Hydro-Mulching of Grass Seed: This work shall consist of furnishing and applying hulled seed, fertilizer, mulch and stabilizing and water retaining agent by hydro-mulching.
 - 1. The seeds shall be applied at the rate of 100 lbs./acre minimum. Mulch shall be applied at a rate of 500 lbs./acre minimum (31 lbs. per 900 sq. ft.). In every application, complete and uniform coverage of the soil shall be attained.
 - 2. First application of fertilizer shall be included with mulch and seed.
 - 3. The hydro-mulch equipment shall be capable of mixing all the necessary ingredients to a uniform mixture and to apply the slurry to provide uniform coverage. Seed, fertilizer, mulch mix and stabilizing water retaining agent shall be applied in one operation by hydraulic equipment made specifically for this use. The equipment shall have a built-in agitation system with an operating capacity sufficient to keep the mix in uniform distribution until pumped from the tank. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with hydraulic discharge spray nozzles which provide a uniform distribution of the slurry.
 - 4. Areas inaccessible to hydro-mulching application shall be seeded or hand sprigged and fertilized by approved hand methods.
 - 5. Water shall be applied immediately following mulching and the planted area shall then be kept moist until roots are established.

- D. Water lawn areas immediately following completion of grass planting operations.
- E. Maintain finish grade established prior to planting. Restore finish grade in any area disturbed by erosion or planting operations.

3.02 CLEAN UP

Remove from the premises, as work progresses, all rubbish and debris resulting from this work. Upon completion, leave entire area in a neat and orderly condition. Promptly remove any soil falling upon pavement as a result of these operations.

3.03 INSPECTIONS

- A. When all planting and clean-up have been completed, request that an inspection be held so that the maintenance period may be started. Correct all deficiencies noted at the inspection to the satisfaction of the Construction Manager before starting formal maintenance period.
- B. 5 to 10 days before end of maintenance period, request an inspection from the Construction Manager to resolve and correct any deficiencies. Make all corrections immediately.
- C. Hold another inspection on the last day of maintenance period or as soon thereafter as possible.
- D. Contractor and Construction Manager or their representatives, shall be present at each inspection.
- E. Request inspections at least one week in advance so that a mutually agreeable time may be arranged.

3.04 MAINTENANCE

- A. Begin maintenance period immediately after completion and approval of planting operations and continue for three (3) months after start of maintenance period. Care of plants prior to start of formal maintenance period is only incidental.
- B. Maintain all grass and planted areas in optimum condition and appearance. Maintenance shall include watering, weeding, fertilizing, replacing, maintaining of grades and elevations in all grassed areas, and other operations necessary to maintain work. Remove from the site all leaves, papers, trash, and debris, which accumulate in planting areas.
 - 1. Irrigate as necessary to secure maximum growth of plants. Carefully regulate irrigation to avoid overwatering, runoff and soil erosion.
 - 2. Keep planting areas free of weeds and undesirable grasses, including nutgrass. Remove entire root system of all weeds.

3. Topdress and roll lawn areas as necessary to obtain smooth and level lawn surface.
4. Immediately re-grass all bare spots within lawn areas.
5. Spread fertilizer over all ground cover areas at rate of 10 lbs. per 1000 sq. ft.; once, 2 weeks after start of maintenance period and again, every 30 days thereafter until completion of maintenance period.
6. Promptly wash off any fertilizer, which adheres to foliage. Irrigate planting areas following fertilizer application.
7. Contractor is not responsible for replacement of plants, which have been killed or otherwise damaged as a result of vandalism after start of maintenance period.
8. Acceptance of lawn areas at conclusion of maintenance period shall be conditioned upon 98% coverage of the overall area. Individual bare spots shall not exceed one square foot in area. Maintenance period for all planting shall be extended at no additional cost if grass planting does not meet this requirement.

END OF SECTION